UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
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Endangered Species Act (ESA) Section 7(a)(2) Biological and Conferencing Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

Renewal of ESA Section 10(a)(1)(A) Scientific Research and Enhancement Permit 20571-2R for the Reintroduction of Central Valley spring-run Chinook salmon to the San Joaquin River from the Merced River confluence to Friant Dam

NMFS Consultation ECO Number: WCR2023-01738

Action Agency: NMFS

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?
Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha)*	Threatened	Yes	No	No	NA
California Central Valley steelhead (*O. mykiss)*	Threatened	Yes	No	No	NA
Southern Distinct Population Segment North American green sturgeon (*Acipenser medirostris*)	Threatened	Yes	No	NA	NA
Southern Resident Killer Whales (*Orcinus orca*)	Endangered	No	No	NA	NA

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

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

Issued By:

Cathy Marcinkevage
Assistant Regional Administrator for California Central Valley Office

Date: **March 6, 2024**

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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 National Marine Fisheries Service (NMFS) prepared the biological 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 U.S.C. 1531 et seq.), as amended, and implementing regulations at 50 CFR part 402.

Section 10(a)(1)(A) of the ESA provides NMFS with authority to grant scientific research and enhancement exemptions to the ESA's section 9 "taking" prohibitions (see regulations at 50 CFR 222.301 through 222.308, and 50 CFR 224.101 through 224.102). Section 10(a)(1)(A) scientific research and enhancement permits may be issued to Federal or non-Federal entities conducting research or enhancement activities that involve intentional take of ESA-listed species. Any permitted research or enhancement activities must: (1) be applied for in good faith; (2) if granted and exercised, not operate to the disadvantage of the threatened or endangered species; and (3) be consistent with the purposes and policy set forth in section 2 of the ESA [50 CFR 222.303(f)]. When granting such permits, NMFS must consult internally under section 7 of the ESA to ensure that issuance of the permits do not appreciably reduce the likelihood of survival and recovery of ESA-listed species. In compliance with section 7(a)(2) of the ESA, in this biological opinion, NMFS analyzed the effects of issuing of Permit 20571-2R authorizing take of ESA-listed Central Valley (CV) spring-run Chinook salmon evolutionarily significant unit (ESU), California Central Valley (CCV) steelhead distinct population segment (DPS), and Southern DPS of North American (sDPS) green sturgeon, henceforth referred to as ESA-listed salmonids and sDPS green sturgeon.

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 part 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within 2 weeks at the NOAA Library Institutional Repository (https://repository.library.noaa.gov/welcome). A complete record of this consultation is on file at the Sacramento NMFS Office.

1.1.1. San Joaquin River Restoration Program and Settlement Act

In 1988, a coalition of environmental and fishing groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit known as NRDC, *et al.*, v. Kirk Rodgers, *et al.*, to challenge the renewal of long-term water service contracts between the United States and Central Valley Project Friant Division contractors. On September 13, 2006, the Settling Parties, including

NRDC, agreed on the terms and conditions of a settlement to the lawsuit (Settlement). Implementation of the Settlement is accomplished through the San Joaquin River Restoration Program (SJRRP).

One of the two primary goals of the Settlement, the Restoration Goal, is to restore and maintain fish populations in "good condition" in the mainstem San Joaquin River downstream of Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.

The Federal Implementing Agencies are authorized to carry out the Settlement by the San Joaquin River Restoration Settlement Act (Settlement Act) (Pub. L. 111-11, 123 Stat. 1349 (2009)). This legislation also mandates that CV spring-run Chinook are reintroduced into the San Joaquin River, California under the SJRRP. NMFS designated the reintroduced population as a nonessential experimental population (NEP) pursuant to section 10(j) of the ESA of 1973 (16 U.S.C. 1539(j)). The collection of CV spring-run Chinook for use in establishing the experimental population, release of those individuals for the purpose of establishing self-sustaining population, and monitoring of the population, requires action pursuant to section 10(a)(1)(A) of the ESA.

This document constitutes an ESA biological opinion for CCV steelhead, CV spring-run Chinook salmon, the threatened sDPS of North American green sturgeon, and also a conferencing opinion for the NEP of CV spring-run Chinook salmon in the San Joaquin River. Conferencing opinions, as opposed to biological opinions, are required when species encountered are treated as species proposed for listing. Pursuant to ESA section 10(j), for the purpose of this conferencing opinion, the CV spring-run Chinook salmon encountered in the SJRRP Restoration Area (Restoration Area) constitute an NEP, and shall be treated as a species that is proposed for listing (78 FR 79622; December 31, 2013). A conferencing opinion is only required if the analysis of the proposed action results in a jeopardy determination and we concluded the proposed action will not jeopardize the continued existence of the species. The analysis for CV spring-run Chinook salmon in the Restoration Area is included in this biological opinion because of the value of monitoring the capture of CV spring-run Chinook salmon within the Restoration Area. The final rule was published to designate a NEP population of CV spring-run Chinook salmon to allow reintroduction of the species between Friant Dam and the confluence with the Merced River on the SJR as part of the SJRRP (78 FR 79622; December 31, 2013). The final rule includes proposed protective regulations under ESA section 4(d) that provides specific exceptions to prohibitions under ESA Section 9 for taking CV spring-run Chinook salmon within the experimental population area, and in specific instances elsewhere.

The take exemption issued for CV spring-run Chinook salmon as part of this biological opinion will be for CV spring-run Chinook salmon encountered outside of the Restoration Area. The NEP of CV spring-run Chinook salmon will not be addressed in the ITS (see section 2.9 for more information). The analysis of NEP CV spring-run Chinook salmon is for informational purposes only. CCV steelhead and the sDPS of North American green sturgeon are not the target species but some may be captured incidentally during monitoring and research activities on the San Joaquin River. CCV steelhead and sDPS of green sturgeon will be handled according to the methods outlined in the San Joaquin River Restoration Program Steelhead Monitoring

10(a)(1)(A) permit (16608-3R, issued December 14, 2022) or a subsequent renewal of that permit. CCV steelhead captured during CV spring-run Chinook salmon trap-and-haul would receive identical treatment to those captured during steelhead monitoring surveys.

1.2. Consultation History

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR Part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

This permit, if issued, is a renewal of 10(a)(1)(A) Permit 20571, which supplanted two inactive section 10(a)(1)(A) permits issued to the U.S. Fish and Wildlife Service (USFWS), as part of the SJRRP, by NMFS: Permit 14868 and Permit 17781. Permit 14868 was issued to the USFWS on October 11, 2012, and authorized the collection of broodstock from Feather River Fish Hatchery (FRFH) for the SJRRP Conservation Hatchery Program. Permit 17781 was issued to USFWS by NMFS on March 21, 2014, and authorized additional collections from FRFH, as well as the release of FRFH transfers and fish being produced by the SJRRP Conservation Facilities into the San Joaquin River. Permit 20571 was issued to the USFWS on September 12, 2018, and authorized the collection of broodstock for the SJRRP, the operations of the SJRRP Conservation Facilities, and certain monitoring activities associated with the SJRRP.

In the application for Permit 20571-2R, USFWS is proposing to continue previously authorized work under Permit 20571, in addition to some new activities and incidental take exemptions for the sDPS of North American green sturgeon, described in detail below. Additional details of activities covered under Permit 20571, and additional activities requested in application 20571-2R are included in the Section 1.3 (Proposed Action) below.

The NMFS West Coast Region received a permit renewal application request (Permit 20571-2R) from USFWS to conduct research and enhancement activities for listed salmonid species in California's Central Valley on March 7, 2023.

A Notice of Receipt for the application of Permit 20571-2R (88 FR 14147) was published on March 7, 2023, in the Federal Register asking for public comments on the application. This took place after a period of pre-consultation between NMFS and USFWS.

The public was then given 30 days to comment on the application. The public comment period ended on April 6, 2023. No comments were received.

NMFS then initiated internal section 7 consultation on August 29, 2023. The species affected by the potential issuance of Permit 20571-2R to USFWS included threatened CCV steelhead, the sDPS of North American green sturgeon, and CV spring-run Chinook salmon, which are listed as threatened outside of the ESA 10(j) Restoration Area, and re-considered proposed for listing within the NEP area. The action area, as described in Section 2.3 below, included activities both within and outside the Restoration Area.

As part of the application for Permit 20571-2R, USFWS attached the associated Hatchery and Genetics Management Plan (HGMP) (CDFW 2023) for the Salmon Conservation and Research Facility (SCARF). The HGMP was submitted by the California Department of Fish and Wildlife (CDFW) to NMFS on March 7, 2023. NMFS reviewed the draft HGMP, and on June 26, 2023, NMFS notified USFWS and CDFW that the HGMP was considered sufficient[1] for consideration under section 10(a)(1)(A) of the ESA, and that the HGMP would become part of the package for consideration of issuance of Permit 20571-2R.

The USFWS requested that the consultation be effective for up to five years so that research, monitoring, and evaluation (RM&E) included in the HGMP can provide meaningful results and inform future management decisions. The temporal scope of NMFS's effects analysis must be long enough to make a meaningful determination of effects, and thus the analysis in this biological opinion is not limited to a five-year period. However, given the USFWS request, in addition to the standard regulatory reinitiation triggers, reinitiation will be required if implementation of the proposed action continues after December 31, 2028.

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 (see 50 CFR 402.02). We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not. Under the MSA, "Federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal agency (see 50 CFR 600.910).

NMFS describes a hatchery program as a group of fish that have a separate purpose and that may have independent spawning, rearing, marking and release strategies (NMFS 2008a). The operation and management of every hatchery program is unique in time, and specific to an identifiable stock and its native habitat (Pollard and Flagg 2004). In this specific case, the proposed action is described in the January 4, 2023, HGMP (CDFW 2023) which was determined sufficient for formal ESA section 7 consultation.

[1] "Sufficient" means that an HGMP meets the criteria listed at 50 CFR 223.203(b)(5)(i), which include (1) the purpose of the hatchery program is described in meaningful and measurable terms, (2) available scientific and commercial information and data are included, (3) the proposed action, including any research, monitoring, and evaluation, is clearly described both spatially and temporally, (4) application materials provide an analysis of effects on ESA-listed species, and (5) preliminary review suggests that the program has addressed criteria for issuance of ESA authorization such that public review of the application materials would be meaningful.

The proposed action is the operation of a hatchery program that produces CV spring-run Chinook salmon as part of an ESA 10(j) NEP for the SJRRP. Duration of the proposed action is five years. The purpose or reason for the hatchery program is to produce CV spring-run Chinook salmon for reintroduction in order to restore a self-sustaining population in the Restoration Area of the San Joaquin River. The applicant anticipates limited collections from extant CV spring-run Chinook salmon populations (e.g., Feather River, Butte Creek) and will use artificial propagation (with captive broodstock) to attain sufficient fish numbers for reintroduction.

Production for commercial or recreational fisheries are not part of this proposed action. No commercial or recreational fishery is dependent on the proposed program. The sole purpose of the program is to facilitate the reintroduction of CV spring-run Chinook salmon to the Restoration Area to help fulfil the goals of the SJRRP Settlement Act (Pub. L. 111-11, 123 Stat. 1349 (2009)). To the extent that there are existing fisheries that may catch SJRRP CV spring-run Chinook salmon, they are mixed fisheries and would exist with or without the SJRRP (and have previously been evaluated in a separate biological opinion (NMFS 2008b)).

NMFS is thus proposing to renew Permit 20571-2R, along with the new actions and take proposed, pursuant to section 10(a)(1)(A) of the ESA. The permit would authorize USFWS and CDFW to take threatened CV spring-run Chinook salmon and CCV steelhead. "Take" is defined in section 3 of the ESA; it means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect a listed species or to attempt to engage in any such conduct. The following analysis therefore examines the take that may affect the ESUs and DPSs that are the subject of this biological opinion.[2]

The research and enhancement activities proposed under Permit 20571-2R include broodstock collection, broodstock rearing and spawning, broodstock offspring and ancillary broodstock releases, release of translocated hatchery origin juveniles, trap and haul of juveniles and returning adults, and population monitoring.

1.3.1. Reintroduction Program and Assessment

Broodstock collections, as with all hatchery activities, would occur pursuant to the associated HGMP (CDFW 2023), and include potential collections from Butte Creek (juvenile life stage), FRFH (juvenile and/or egg life stage), the San Joaquin River (adult, juvenile, and/or egg life stage) and/or other opportunistic locations such as the fish trap on Keswick Dam and Big Chico Creek (adults) in northern California.

The hatchery program consists of the SCARF which is currently under construction and planned to be completed by late-2023, an interim SCARF (Interim Facility), and a small, Satellite Incubation and Rearing Facility (SIRF; collectively called the Conservation Facilities). The Conservation Facilities were/are being constructed by CDFW under the SJRRP for the purpose of propagating CV spring-run Chinook salmon for reintroduction into the San Joaquin River as

[2] An ESU of Pacific salmon (Waples 1991) and a DPS of steelhead (71 FR 834) are considered to be "species" as the word is defined in section 3 of the ESA. In addition, we use the terms "artificially propagated" and "hatchery" interchangeably in the biological opinion (and the terms "naturally propagated" and "natural").

part of completion of the SJRRP. These facilities are located near the town of Friant, near Friant Dam on the San Joaquin River, Fresno County, California.

The Interim Facility is currently in operation. The SCARF is adjacent to the Interim Facility. The Interim Facility is located adjacent to the CDFW's San Joaquin State Fish Hatchery (SJH). The SIRF is located 0.75 miles upstream of the SCARF on U.S. Bureau of Reclamation's Friant Dam Property. The Interim Facility is expected to meet SJRRP production goals during construction of the SCARF and will be repurposed after the SCARF is fully operational.

Juveniles and eggs collected from donor stocks will be transported to an approved quarantine facility and after clearing standard fish health assessment protocols set by CDFW, will be transferred to the Conservation Facilities. Fish will be reared under controlled hatchery conditions until maturity when they will be spawned or released into the San Joaquin River as ancillary broodstock. The progeny of the spawned broodstock will be reared at the facility from the egg stage to be released to the San Joaquin River at the juvenile stage. Some eggs or juveniles may be transferred to the SIRF for rearing and or research. These activities are described in further detail below.

1.3.1.1 Broodstock origin

The total number of broodstock collected from each source population over the course of the reintroduction will depend on the viability of those stocks and the effects of removal on the associated risk factors. While source population viability may limit the number of fish collected, collection goals are based on the number of fish necessary to capture the genetic diversity of the source stocks. Because each potential source population is distinct, they are considered independently when setting collection goals, but there is a maximum total number of juveniles that can be collected which is based on the capacity of the Conservation Facilities.

To increase broodstock effective population size, hatchery staff will attempt to double the number of males used in spawning events (CDFW 2023). Therefore, the SJRRP proposes to collect no more than 5,400 total individual juveniles for annual broodstock production, from all potential sources, although 2,700 is the minimum needed to meet production targets. The sex ratio of juveniles in a population is expected to be 50:50 male to female, and because the sex cannot be immediately determined, doubling the number of males in a broodstock population calls for a doubling of the total number of collected individuals.

Additionally, 60 juveniles from each collection event[3] will be sacrificed for pathology screening at the time of collection and another 10 from each collection event will be sacrificed for pathology screening near the end of the quarantine period.

[3] A collection event is any contiguous effort of collecting broodstock (i.e., eggs or fish) that may consist of one or more collecting actions over a specific period. The resulting broodstock collected will be considered a single lot and the individuals of which will be freely integrated together in transport, quarantine facilities, and fish hatchery. It will be from this lot that required pathology sacrifices will be taken for fish health screening (see Section 7 of the Hatchery and Genetic Management Plan; CDFW 2023).

The total number of eggs or juveniles collected annually and the collection source will be constrained by the Conservation Facilities capacity and donor stream conditions. If conditions are suitable, the SJRRP would prefer to collect equally across donor sources, with collection ratios dependent on acceptable removal from each donor source.

Feather River Fish Hatchery:
If the only source of donor stock available is the FRFH, the SJRRP will collect a maximum of 5,540 eggs or juveniles (Table 1). Actual collection numbers will depend on availability of fish from FRFH and other sources, as well as the space available at the Conservation Facilities. The SJRRP staff will assist with the spawning activities at FRFH to track each cross[4] made, ensuring that egg collections for the SJRRP are from pairs exhibiting the CV spring-run Chinook salmon phenotype. Eggs will only be collected that are more than what FRFH needs to meet its production targets, so that SJRRP collections will not impact FRFH production obligations.

Spawning and egg selection at FRFH, along with egg collection, will occur September through October during the FRFH CV spring-run Chinook Salmon spawning season. Eggs will be transferred to a quarantine facility, incubated, hatched, and reared to a suitable size and transferred to the Conservation Facilities. Prior to that the eggs and fry will have gone through quarantine and a fish health assessment approved by the CDFW Fish Health Lab.

Once juveniles arrive at the Conservation Facilities and are large enough to be coded-wire tagged, up to 25 individuals per day may be sacrificed (not to exceed 1,000 total) to check and calibrate tag depth[5] .

Butte Creek:
The SJRRP proposes to collect up to 2,910 juveniles in any given year from Butte Creek (2,700 for broodstock, and up to three collection events with 70 individuals per collection event retained for pathology) (Table 1). The actual number collected will depend on the number of adult returns to Butte Creek the previous spring (based on the ratio of escapement to viable population size (modified from Lindley, et al., 2007)) and the number of individuals collected from other sources as detailed above.

No CV spring-run Chinook salmon juveniles will be collected from Butte Creek if the number of female spawners is less than 250 for the year. The maximum number of juveniles that may be collected each year will scale up from 250 on a two to one (male to female) basis with the number of female spawners (up to 1,455). For example, 500 female spawners would allow 1,000 juveniles to be collected. When the number of female spawners equals or exceeds 1,455 the maximum of 2,910 juveniles may be collected.

[4] A "cross" is a mated pair. At the Feather River Fish Hatchery one female is crossed with one male. During the spawning process SJRRP staff keeps track of each mated pair or cross and can match it to the specific egg tray. This ensures that when the SJRRP collects eggs they can find specific crosses for the SCARF program.

[5] When inserting Coded Wire Tags it is necessary to calibrate the machinery. Tags are inserted by air pressure into the head of the fish and some tags may be inserted too deep, which will kill the fish. This process is necessary to find the correct adjustments before the majority of the juveniles are tagged.

Escapement on Butte Creek will be monitored and determined by either direct adult counts at a counting weir or by snorkel survey estimates during the holding period. Escapement estimates by annual carcass surveys will be used for validation and to account for pre-spawn mortality. CDFW Region 2 staff will be consulted in September or October each year to discuss annual escapement and proposed juvenile collection numbers the following winter and spring. Validation of escapement and confirmation of collection numbers will occur after carcass surveys are complete. Environmental conditions affecting the Butte Creek population (*e.g.*, drought, flood) will also be considered in determining annual collection numbers.

The SJRRP may collect CV spring-run Chinook salmon juveniles from existing sampling on Butte Creek to minimize handling and incidental mortality, control costs, and simplify logistics. Collections on Butte Creek will use the seasonal rotary screw trap (RST) and side diversion trap located at the Parrot-Phelan Diversion Dam near Chico, that are used for annual monitoring of CV spring-run Chinook salmon juvenile out-migrants. Collections on Butte Creek may occur throughout the outmigration period to capture the range of genetic diversity of the source population. Collections may extend through March, which is expected to encompass at least 95 percent of the juvenile outmigration period.

During fish processing activities at the RSTs, a subsample of randomly selected juveniles in different size groups will be selected for broodstock collection. Lifestages collected (e.g., fry, parr, smolt), fork length ranges for each size group, and numbers collected of each per collection event will vary throughout the collection period to represent the diversity seen within the sample catches. Collected juveniles will be transported to the holding site where they will be temporarily held in tanks or cages. Thereafter, the juveniles will be transferred to the quarantine facility for a minimum 30-day holding and fish health assessment. They will subsequently be transferred to the Conservation Facilities. Annual collections from Butte Creek will be segregated into two to three groups for quarantine and fish health assessment to reduce the potential for disease transfer between early and late collections.

<u>San Joaquin River:</u>
The SJRRP may collect individuals at three different lifestages: eggs, juveniles, or adults. The SJRRP may collect up to 2,980 CV spring-run Chinook salmon individuals from the San Joaquin River; however, the number collected in any given year will be determined by the number of adult spring-run Chinook Salmon returning to the Restoration Area and the number of individuals collected from other source stocks (Table 1).

Eggs:
The SJRRP will pursue two basic methods to collect eggs through redd extractions: either redd pumping or redd excavation. These methods are described in more detail in Section 7.2.1 of the HGMP (CDFW 2023). Approximately 20 eggs per redd may be collected. A maximum of 1,000 may be collected annually to be incorporated into broodstock, this is intended to limit the number of siblings in the broodstock. Broodstock collected as eggs will be transferred or held for quarantine and fish health assessment prior to being transported to the Conservation Facilities.

Juveniles:

The SJRRP may collect CV spring-run Chinook salmon juveniles on the San Joaquin River via emergence traps, RSTs, fykes, weirs, or seines. Emergence traps, or another NMFS-approved early lifestage monitoring gear type, may be used for collecting emerging fry. Up to 400 juveniles may be collected using an early lifestage monitoring method for incorporation into broodstock. Additionally, up to 600 juveniles may be sacrificed for genetic analysis. The rationale for sacrificing 600 juveniles for genetic analysis related to collections from emergence traps was developed in coordination with Carlos Garza (NOAA Fisheries, Southwest Fisheries Science Center), who recommended that a standard of ten samples per redd are needed to determine the number of maternal individuals that contributed eggs to the redd, if the redd is unknowingly superimposed and equal success is assumed (Garza 2022). If more than one male contributed to fertilization of the eggs, or differential success of a previously unknown superimposed redd is likely, a greater number of genetic samples would be required per redd. NMFS determined that 600 samples would be an appropriate compromise in the number of samples collected while providing a reasonable attempt to determine the number of maternal contributors and the number of fertilizers, along with providing enough sample duplication if contamination occurs, and keeping “intentional take” numbers at a restrained total.

RSTs, weir-style traps, fykes, or seines may be used for both monitoring and collection of juveniles from the Restoration Area. Juvenile collections within the Restoration Area may occur throughout the outmigration period in order to capture the genetic diversity of the source population in the broodstock. Collections may begin as early as November of each year and could extend through May, which is expected to encompass at least 95 percent of the juvenile outmigration period. See HGMP Sections 7.2.2 and 7.2.4 (CDFW 2023) for additional information.

During the collection period, CV spring-run Chinook salmon broodstock collected as juveniles will be transferred or held for quarantine and fish health assessment prior to being transported to the Conservation Facilities. Genetic testing will be used to confirm CV spring-run Chinook Salmon origin and manage the genetic diversity in the broodstock and spawning. Each fish will be individually tagged with Passive Integrated Transponders (PIT tags) for sorting after genetic testing and for identification for incorporation as broodstock. A PIT tag is an electronic device that relays passive signals to a radio receiver and allows individuals carrying the tags to be identified whenever they pass a location containing such a receiver without researchers having to recapture and handle the fish again to record its presence in the area. They are also used to identify and track metrics for individuals in the hatchery broodstock. All fish incorporated into broodstock are PIT tagged.

Adults:
Adults may be trapped utilizing a fyke net/trap, weir, seine, trammel or dip net (CDFW 2023). All adults will be identifiably tagged and fin-clipped for genetic analysis to confirm CV spring-run Chinook salmon origin. All individuals will then be transported to the upper reaches of the Restoration Area where there is suitable water temperature and spawning habitat. The adults may be held in either in-river net pens or transferred to a

holding facility. Adults collected in the spring and held in a holding facility will be checked for spawning “readiness” (ripeness) during the fall. Adults released into the San Joaquin River will over summer in holding pools until spawning is estimated to have begun, then will be re-captured and checked for ripeness. If a male and female are found to be ripe and have been determined to be a good match genetically, they will be artificially spawned. Eggs will be incubated and a few from each family will be selected for subsequent broodstock use. Remaining eggs will be incubated to the juvenile stage, implanted with a coded-wire tag (CWT), and released to the San Joaquin River to out-migrate.

An annual Donor Stock Collection Plan (DSCP) reviewed and approved by the NMFS and CDFW will outline how many individuals will be collected each year from each donor source, the manner in which collections will occur, and at which life stage collections will take place. The DSCP will be provided to NMFS at least 60 days prior to any collections. The donor stock collection window is quite long because egg collections at FRFH can take place as early as September, but juvenile collections would take place throughout the spring. The final determination on collecting wild donor stock will be informed by spawner surveys. Since these data will not be available prior to planning egg collections, if the SJRRP modifies actions described in the DSCP, an addendum to the DSCP will be provided to NMFS.

Table 1. Collection Methods and Maximum Annual Collection Levels by Source Populations (CDFW 2023).

Population	Targeted Life Stage	Max Annual Collection[1]	Collection Methods
Feather River Fish Hatchery	Eggs or Juveniles	5,470	Hatchery Operations
San Joaquin River	Eggs, Juveniles, or Adults	2,980	Redd Extraction, Emergence Trap, Rotary Screw Trap, Fykes or Weirs, Dip Nets
Butte Creek	Juveniles	2,910	Rotary Screw Trap
Various Other Sources (i.e., Big Chico Creek, Keswick Dam)	Eggs, Juveniles, or Adults	Unknown[2]	Opportunistic and based on the current monitoring occurring at the location

[1] Maximum numbers included in section 10(a)(1)(A) permit application. Maximum collections form all source populations combined would be 5,400 eggs or juveniles per year, plus those required for pathology clearance (i.e., 70 per collection), based on Conservation Facilities capacity and Conservation Program needs.

[2] Collections will not exceed the maximum annual collection but will depend on location, conditions, and other annual collections.

Proportion of natural-origin fish in the broodstock (pNOB): The Conservation Program will prioritize the collection of natural-origin (non-hatchery) fish, but FRFH fish may be utilized if non-hatchery fish are not available or collections are not permitted from wild populations. The Conservation Program will strive to include fish from at least two potential broodstock source populations. While the SCARF is under construction, the Conservation Program will seek to annually collect enough juvenile fish and eggs to obtain a total 50-100 relatively unrelated females and 100-200 relatively unrelated males to breeding age.

Broodstock selection: To allow the hatchery to identify close relatives and minimize mean kinship, all potential spawners will be genetically analyzed, generally prior to age-one. Thereafter, a relatedness estimate (*e.g*., Queller and Goodnight 1989; Blouin *et al.* 1996) will be developed for all pairs of broodstock fish (Kozfkay *et al.* 2008; Sturm *et al.* 2009) including potential breeding pairs to evaluate potential mates and same-sex pairings to detect full-siblings. Based on the molecular relatedness estimate, a spawning matrix will be constructed following Sturm *et al.* (2009). The spawning matrix will be organized by female, with all potential male mates listed below her in order of preference, based on their coefficient of relatedness (most desirable male is the least genetically-related).

All fish will be spawned when ripe. Actual pairings will attempt to involve the males highest on the list when the female is ripe, but no matings will involve fish related at the level of halfsibling or higher. Eggs from each female will be divided into four groups of roughly equal size and each will be fertilized by a different male. If fecundity is particularly low (*i.e*., less than 1,000 eggs per female), eggs may be divided into fewer groups. A target ratio of 2 males for every female will increase genetic diversity across all broodstock mated. No male will be used with more than three females, assuming egg lots are split four ways, and no male will be used to fertilize more than the equivalent of 3/4 of a total egg lot. Eggs and fry from each cross will be kept separately until shortly after emergence, when the major period of in-hatchery mortality is passed, to allow for evaluation of the success of the cross.

If undertaken, matings between two different source populations will likely follow a different protocol because inbreeding is not a concern for these crosses. Fish will be selected for outcrossing based on their mean pairwise relatedness estimate compared to all other fish in their source population. The fish that are most highly related to the other fish in their populations are at the highest risk for causing inbreeding depression and are the least likely to have alleles otherwise not present within their populations. In the outcrossed fish protocol, females will be paired with four outgroup males randomly selected from the males chosen for outcrossing, and fertilization and rearing will proceed as described above for within population crosses.

Any returning adults in the San Joaquin River that are included in the broodstock would be evaluated using the same relatedness estimate approach identified above. Returning adults can be identified based on genetics or coded wire tags. Fish identified as strays (not produced from SJRRP broodstock) may or may not be used as broodstock, depending on their origin. The natal origin for these fish can be determined based on genetic analysis. Eggs and/or juveniles resulting from these fish will be held separately until origin is determined.

> Males: Some hatcheries faced with low male fertility use an approach where eggs are fertilized with a second male's milt (referred to as backup males) to ensure fertilization. Initially, backup males will not be used at the Conservation Facilities to avoid overrepresentation of some males due to advantages in sperm competition (Miller and Kapuscinski 2003, Campton 2004). Backup males may be required if infertility levels significantly reduce production below expected levels.

Initially, in the early years of operation, the Conservation Program experienced high levels of precocious male maturation in both yearlings (age-1) and jacks (age-2). In 2012, 84 percent of the experimental Central Valley fall-run male Chinook salmon (*Oncorhynchus tshawytscha)* matured as jacks; and in 2013, 33 percent of the CV spring-run Chinook salmon males matured as yearlings. Since then, through research conducted at the facility (McGrath- Castro et al. 2019; Winsor et al. 2021) the SJRRP has reduced yearling maturation rates to generally < 2 percent and jacking rates to about 12 percent annually through managing growth rates during sensitive maturation decision periods. Based on research conducted on site (McGrath-Castro et al. 2019; Winsor et al. 2021), there appears to be both a genetic component and a hatchery induced component of early male maturation. Therefore, in the early stages of restoration, the Conservation Program will allow contribution from age-2 males only when necessary to meet production goals. In general, jacks will be used in a maximum of 20 percent of crosses to ensure representation of alternative life history strategies. Over time, hatchery staff will work to reduce jack usage to 10 percent or less, with the goal to represent contributions of jacks to a rate similar to those of the source populations. Ultimately, jack usage levels will be governed by the recommendations of the SJRRP technical staff through the Genetics Subgroup and in coordination with the Fisheries Management Workgroup

Method and location for collecting broodstock: The location and life-history stage of broodstock collected will vary based on several factors, including the population status of each source population, potential impacts to the source population, the accessibility of each life-stage, disease status, stipulations of collection permits, and guidance from SJRRP technical staff like the Fisheries Management Workgroup.

Feather River Fish Hatchery: CV spring-run Chinook salmon broodstock collection protocols will be conducted according to methods described in the FRFH HGMP (currently under review by NMFS). Only fish entering the FRFH between April 1 and June 30, that reenter the hatchery in September, as identified by the presence of Hallprint® tags, will be used for broodstock for the Conservation Facility. These may be crossed according to FRFH protocols. Ovarian fluid samples from adults will be collected for analysis to determine presence of viruses and bacteria. After Fish Health Lab clearance, the preferred crosses can be segregated for the SJRRP. Selected broodstock eggs or juveniles will be transferred from FRFH to the quarantine facility. Up to 70 individuals will be sacrificed for pathology and then pending clearance, the remainder will be transferred to the Conservation Facilities. Individuals will only be collected that are in excess of what FRFH needs to meet its production targets, so that SJRRP collections will not impact FRFH production obligations.

Butte Creek: Collections on Butte Creek may occur throughout the outmigration period to capture the range of genetic diversity of the source population. Collections may extend through March, which is expected to encompass at least 95 percent of the juvenile outmigration period. During fish processing activities at the RSTs, a subsample of randomly selected juveniles in different size groups will be selected for broodstock collection. Lifestages collected (e.g., fry, parr, smolt), fork length ranges for each size group, and numbers collected of each per collection event will vary throughout the collection period to represent the diversity seen within the sample catches. Collected juveniles will be transported to the holding site where they will be temporarily held in tanks or cages. Thereafter, the juveniles will be transferred to the quarantine facility for a minimum 30-day holding and fish health assessment. They will subsequently be transferred to the Conservation Facilities. Annual collections from Butte Creek will be segregated into two to three groups for quarantine and fish health assessment to reduce the potential for disease transfer between early and late collections.

Collected juveniles will be held in self-contained rearing units or cages near (i.e., within one-hour drive) the collection site during the collection period and prior to transfer for quarantine and pathology testing. The site will be equipped with electrical power, water, and will be secured to prevent unauthorized entry or vandalism. Staff will be present daily for fish husbandry, system maintenance, and water quality monitoring (e.g., temperature and dissolved oxygen).

Self-contained rearing units will include a five-horsepower chiller, mechanical and biological filters, a UV sterilizer, an aeration system, pumps to recirculate treated water, and a circular tank(s) (minimum 500-gallon capacity) capable of rearing up to 7,500 juvenile CV spring-run Chinook salmon at 200 fish/pound (fish/lb). The SJRRP possess several such units and will test them prior to deploying them for interim holding CV spring-run Chinook salmon collections on Butte Creek. In the event of incoming water loss, the system will be able to run for up to one week with no adverse effects to the fish. The system will also be equipped with either a back-up generator or solenoid actuated, diffused oxygen in case of power failure. If necessary due to equipment failure or unforeseen events, fish may be transferred to holding tanks at Silverado Fisheries Base, FRFH Annex, SIRF, or Interim Facility once SCARF construction is completed and if approved by the Fish Health Lab (the specifics of these facilities are discussed in Section 1.3.1.3).

Juveniles will then be transferred to a quarantine facility for a minimum 30-day holding and fish health assessment before ultimately being transferred to the Conservation Facilities. Annual collections from Butte Creek will be segregated into two to three groups for quarantine and fish health assessment in order to reduce the potential for disease transfer between early and late collections of fish.

<u>San Joaquin River</u>: The SJRRP may collect individuals at three different lifestages: eggs, juveniles, or adults. The SJRRP may collect up to 2,980 CV spring-run Chinook salmon individuals from the San Joaquin River; however, the number collected in any given year will be determined by the number of adult CV spring-run Chinook salmon returning to the Restoration Area and the number of individuals collected from other source stocks.

> Eggs: The SJRRP will pursue two basic methods for redd extractions: either redd pumping or redd excavation. These methods are described in more detail in Section 7.2.1 of the HGMP (CDFW 2023). Approximately 20 eggs per redd may be collected. A maximum of 1,000 may be collected annually to be incorporated into broodstock, this is intended to limit the number of siblings in the broodstock. Broodstock collected as eggs will be transferred or held for quarantine and fish health assessment prior to being transported to the Conservation Facilities.

If redd pumping is conducted, eggs will be collected from redds using a small portable backpack mounted water pump as described by Murdoch and Hopely (2005). An aluminum probe is inserted into the redd. The probe is designed with an air intake, which creates a Venturi effect that combines water and air. The mixture of air and water is used to float eggs to the surface. A collection basket covered with wire mesh and a cloth net bag on the downstream side will be used to collect eggs. The basket will be placed over the portion of redd to be sampled. To minimize stress to the redd, hydraulic sampling will begin at the farthest most downstream point of the tail spill and progressed systematically upstream as necessary. This method ensures that disturbance to the redd is confined to the furthest downstream portion of the redd, decreasing the probability of impacts from personnel (*i.e.*, stepping on egg pockets) or the sampling process (*e.g.*, changing the hydraulics of the redd). Each redd will be sampled carefully until the first egg is collected and the developmental stage verified (*i.e.*, eyed-egg stage). Eyed-eggs will be removed from the collection net by hand or with a small dip net and placed in small buckets. Buckets will then be placed in coolers on ice for transport to quarantine. Excess eggs will be re-injected into the redd using the hydraulic egg planter or carefully returned to the red by hand.

Redd excavation consists of carefully hand-digging into the tail spill of identified CV spring-run Chinook salmon redds to obtain live fertilized eggs. The specific redds from which eggs are to be obtained, will be selected from areas of shallower water and gentle velocities to facilitate obtaining eggs without loss. Gravel will be carefully removed from the tail spill of the red, by hand until eggs are reached. The digging process will proceed slowly so that a clear view of the excavated area can be maintained throughout the process. Snorkel gear will be used to get a clear underwater view of the excavated area. A fine mesh dip net will be used to retrieve the eggs. Eggs will be placed into a bucket of river water, maintained at or below the temperature of the river, as they are removed from the gravel. They will be counted as they are placed into the bucket until the desired number of eggs is reached (greater than 20 eggs). Once the eggs are obtained from the redd, gravel will be carefully replaced into the area from which it was removed until the pre-disturbance substrate contour is recreated.

Juveniles: The SJRRP may collect CV spring-run Chinook salmon juveniles on the San Joaquin River via emergence traps, RSTs, fykes, weirs, or seines. Emergence traps, or another NMFS-approved early lifestage monitoring gear type, may be used for collecting emerging fry. Up to 400 juveniles may be collected using an early lifestage monitoring method for incorporation into broodstock. Additionally, up to 600 juveniles may be sacrificed for genetic analysis[6]. Juvenile collections within the Restoration Area will

[6]The rationale for sacrificing 600 juveniles for genetic analysis related to collections from emergence traps was developed in coordination with Dr. Carlos Garza (NOAA Fisheries, Southwest Fisheries Science Center). Dr. Garza stated that a standard of ten samples per redd are needed to determine the number of maternal individuals that contributed eggs to the redd, if the redd is unknowingly superimposed and equal success is assumed. If more than one male contributed to fertilization of the eggs, or differential success of a previously unknown superimposed redd is likely, a greater number of genetic samples would be required per redd. NMFS determined that 600 samples would be an appropriate compromise in the number of samples collected while providing a reasonable attempt to determine the number of maternal contributors and the number of fertilizers, along with providing enough sample duplication if contamination occurs, and keeping intentional take numbers at a restrained total.

occur throughout the outmigration period in order to capture the maximum genetic diversity for broodstock. Collections may begin as early as November of each year and extend through May, which is expected to encompass at least 95 percent of the juvenile outmigration period.

During the collection period, broodstock collected as juveniles will be transferred or held for quarantine and fish health assessment prior to being transported to the Conservation Facilities. Genetic testing will be used to confirm CV spring-run Chinook salmon origin and manage the genetic diversity in the broodstock. After genetic testing, each fish will be individually PIT tagged for sorting and incorporation as broodstock.

Adults: The SJRRP may choose to collect adults from the Restoration Area or provide passage assistance to the spawning grounds when returning adults are not able to migrate on their own. Depending on river conditions and facility needs, CV spring-run Chinook salmon adults may be collected at two different time periods either prior to over summering in the system, or in the late summer to early fall just prior to spawning.

Adults will be trapped utilizing a fyke net/trap, weir, seine, trammel or dip net (CDFW 2023). All adults will be identifiably tagged and fin-clipped for genetic analysis to confirm CV spring-run Chinook salmon origin. All individuals will then be transported to the upper reaches of the Restoration Area where there is suitable water temperature and spawning habitat. The adults may be held in either in-river net pens or transferred to a holding facility. Adults collected in the spring and held in a holding facility will be checked for ripeness during the fall. Adults released into the San Joaquin River will over summer in holding pools until spawning is estimated to have begun, then will be re-captured and checked for ripeness. If a male and female are found to be ripe and have been determined to be a good match genetically, they will be artificially spawned. Eggs will be incubated and a few from each family will be selected for subsequent broodstock use. Remaining eggs will be incubated to the juvenile stage, implanted with a CWT, and released to the San Joaquin River to out-migrate.

<u>Various Other Sources</u>: If volitional passage on the San Joaquin River is not possible due to passage barriers or lack of connected flow resulting in no returning adult CV spring-run Chinook salmon present in the Restoration Area, and fish in-river are documented as adult CV spring-run Chinook salmon (i.e., verified by run timing, genetics, CWT analysis, or other tagging or monitoring data) in any of the San Joaquin River tributaries (i.e., Stanislaus, Tuolumne, and/or Merced Rivers), the SJRRP may opportunistically collect CV spring-run Chinook salmon juveniles or eggs for broodstock from these tributaries.

Any efforts to collect CV spring-run Chinook salmon will be made in cooperation with NMFS and CDFW Regional staff that work with Chinook salmon in the watershed(s) where the collections are proposed to occur. The number of fish collected by the SJRRP will be determined at the time of collection but will be limited by the capacity of the Conservation Facilities and the availability of a quarantine facility. CV Spring-run Chinook salmon may also be collected from San Joaquin River tributaries if collections from the Restoration Area are insufficient to meet the annual production goal. As such, a maximum of 2,910 juveniles or eggs, including collections for pathology (i.e., 2,700 for broodstock and 210 for pathology, up to 3 collection events of 70 each event) may be collected from the tributaries of the San Joaquin River. The collection and transportation of fish or eggs by the SJRRP will follow the methods described below. All individuals collected as potential broodstock will be analyzed to determine if they are genetically CV spring-run Chinook salmon, and if they will contribute to the genetic diversity of the SJRRP's broodstock.

If a situation arises outside of the San Joaquin River Basin where a localized population of adult CV spring-run Chinook salmon are unlikely to successfully reproduce or their resulting progeny are not expected to survive (e.g., due to poor environmental conditions or inaccessibility to suitable spawning habitat), the SJRRP may opportunistically collect those fish or their resulting progeny or eggs for use as potential broodstock. Any effort by the SJRRP to collect CV spring-run Chinook salmon will be made in cooperation with local NMFS and CDFW Regional staff, and any other entities that work with CV spring-run Chinook salmon in the watershed(s) where the collections may occur. The number of fish collected by the SJRRP will be determined at the time of the event. However, the number collected will be limited by the capacity of available holding and quarantine facilities like CDFW's Silverado facility in Napa.

The opportunistic collection and transportation of fish or eggs by the SJRRP will follow the methods described below. Therefore, a maximum of 5,400 CV spring-run Chinook salmon eggs or juveniles may be collected for broodstock across all donor sources. For pathology studies an additional 70 individuals will be collected for each collection event, up to a maximum of nine events (i.e., 2 FRFH, 3 Butte Creek, 4 San Joaquin River and the tributaries in combination). A subset of the collection will be intentional (directed) mortality taken for fish health analysis (pathology). The total number of eggs or juveniles collected annually, and the collection source will be constrained by the Conservation Facilities capacity, donor stream conditions, and available funding. If conditions are suitable, the SJRRP will collect equally from all donor sources, with collection ratios dependent on acceptable level of effects of the removal from each donor source.

Duration of collection: Activities may vary depending upon conditions, location of collections, life stages to be collected and SJRRP needs, but are anticipated to occur annually as follows:

- Eggs and juveniles will be collected from source stocks September through May.
- Emergence trapping would occur September through March.
- Returning adults (for broodstock or transport) would be collected January through October.

Feather River Fish Hatchery: Spawning, egg selection, and egg collection will occur in September and/or October during the FRFH spawning season. Individuals will only be collected that are in excess of what FRFH needs to meet its production targets, so that SJRRP collections will not impact FRFH production obligations.

Butte Creek: Collections on Butte Creek would occur throughout the outmigration period in order to capture the maximum genetic diversity for the source population in the broodstock. Collections may extend through March, which is expected to encompass at least 95 percent of the juvenile outmigration period.

San Joaquin River: The duration of collection is based on the life stage targeted for collection. Depending on river conditions and facility needs, adults may be collected at two different time periods, either prior to over-summering in the system, or in the late summer/early fall just prior to spawning. Juvenile collections within the Restoration Area will occur throughout the outmigration period in order to capture the genetic diversity for the source population in the broodstock. Collections may begin as early as November of each year and could extend through May, which is expected to encompass at least 95 percent of the juvenile outmigration period.

Various Other Sources: The duration of collection is based on the life stage targeted for collection. Depending on location conditions, adults may be collected at two different time periods, either prior to over-summering in the system, or in the late summer/early fall just prior to spawning. Juvenile collections could occur throughout the outmigration period in order to capture the genetic diversity for the source population in the broodstock. Collections may begin as early as November of each year and could extend through May, which is expected to encompass at least 95 percent of the juvenile outmigration period.

1.3.1.2 Proposed mating protocols (hatcheries only)

Feather River Fish Hatchery: Corresponding individual fish data will be collected from the parents of each cross, including: adipose fin status, CWT number, gender, weight, fork length, ovarian fluid sample number, tissue sample number, and corresponding genetic analysis data. These data will be used to select preferred crosses. Ovarian fluid samples will be collected from adult females to determine the presence of pathogens. In accordance with their protocols, the FRFH will segregate eggs from individual crosses into vertical incubator trays.

Once disease status and run timing are known, and once eggs have eyed, the SJRRP will randomly select eyed-eggs from segregated lots up to the maximum allowed. If the FRFH is unable to segregate enough eggs from preferred crosses, then the SJRRP may also select eyed-eggs, up to the maximum allowed, from the FRFH CV spring-run Chinook salmon egg trays. However, since the FRFH does not have the space to segregate all crosses it is likely that two to three different crosses may be in one tray.

After Fish Health Laboratory clearance, selected broodstock eggs will be transferred from FRFH to the quarantine facility. Up to 70 individuals will be sacrificed for pathology and then pending clearance, the remainder will be transferred to the Conservation Facilities.

Eggs are preferred for collection because of the ability to target genetically diverse individuals and collect temporal diversity, while maintaining low risk to the donor population. Furthermore, collection at this life stage provides greater survival to adulthood, thereby reducing population level impacts. Eggs also provide the least amount of risk associated with disease transfer due to their ability to withstand disinfection and many pathogens are not vertically transmitted from parent to ova.

San Joaquin River (Conservation Facilities): Consistent with the standards and guidelines outlined in the 2023 HGMP, all broodstock at the Interim Facility, SIRF and SCARF, and will be examined weekly during the spawning season to determine ripeness, and all ripe fish will be spawned, or released in the river. To allow the hatchery to identify close relatives and minimize mean kinship, all potential spawners will be genetically analyzed and a relatedness estimate (*e.g.*, Queller and Goodnight 1989) will be developed for all pairings of broodstock fish (Kozfkay *et al.* 2008, Sturm *et al.* 2009), both potential breeding pairs (to evaluate potential mates) and same sex pairings (to detect full-siblings). Based on the molecular relatedness estimate, a spawning matrix will be constructed following Sturm *et al.* (2009). The matrix will be organized by females, with all potential male mates listed below her in order of preference, based on their coefficient of relatedness (most desirable male is the least genetically-related).

Actual pairings will involve the four males with a low relatedness value when the female is ripe, and no pairings will involve fish related at the level of half-sibling or greater. Females to be spawned will be euthanized by a sharp blow to the base of the skull using a blunt object. The ventral wall of the abdominal cavity will be slit open and eggs allowed to freely flow into a metal spawning pan. Eggs from each female will be divided into four groups of roughly equal size and each will be fertilized by a different male. Milt from males will then be expressed into the pan. Each male will be used with no more than four different females.

The eggs will be put into incubation trays. Eggs and fry from each cross will be kept separately until the swim-up stage to allow for evaluation of the success of the cross. As available, and as governed by the recommendations of the hatchery and river monitoring technical teams, precocious males and jacks will be used to ensure representation of alternative life history strategies.

1.3.1.3 Proposed protocols for each annual broodstock release

Hatchery produced fish and ancillary broodstock may be released to the river at various life stages based on production targets, hatchery capacity, river conditions, research, and program needs. The vast majority of releases from the rearing facilities will be the progeny of SJRRP broodstock, but broodstock will also be released to the river for a variety of reasons.

<u>Ancillary Broodstock Releases</u>: The SJRRP determines each year how many fish will be collected for broodstock based on donor population conditions and the Conservation Facilities capacity. This donor stock collection recommendation is based on experience in previous years with broodstock survival from one life stage to the next, number of age three and four year-old spawners, fecundity, etc. However, these numbers can't always be accurately predicted and the SJRRP, in order to maintain adequate holding capacity for representatives across all brood years, may need to release salmon at various life stages.

Broodstock that is considered "ancillary" are those individuals that are in excess to the numbers of fish needed for production spawning. These ancillary fish may be released into the Restoration Area. If these ancillary fish are not released to the Restoration Area they will be culled. However, SJRRP biologists deemed releases of ancillary broodstock to the river to spawn and potentially contribute to the population a more beneficial use than losing the fish to culling. All ancillary CV spring-run Chinook salmon released by the SJRRP will be adipose fin clipped and tagged (CWTs) and will be in addition to the scheduled annual production releases intended for the reintroduction.

The Conservation Facilities provide opportunities to study the yearling and adult life stages as part of planned fish releases. Annual releases of yearlings will increase as the Conservation Facilities reaches full capacity. Criteria for releasing yearling and older broodstock will be based on:

- Facility Carrying Capacity – To account for early rearing stage mortality, each year, more broodstock will be collected for the Conservation Facilities than may be held when they reach maturity. In addition, to increase the effective population size of the hatchery population, a ratio of 2:1 (male to female) are used during mating, thus resulting in ancillary females. The carrying capacity of the Conservation Facilities allows the spawning of approximately 450 adult females with 900 males annually. Each year up to 5,400 individual juveniles may be collected across all stocks for broodstock development. Estimated rearing mortality accounts for losses of approximately 65 percent. In the spring of their second year, the fish inventory will be evaluated and fish releases will be made based on the anticipated loss in the coming years and the carrying capacity of the facility.

- Genetic Relatedness Data – The genotype of the excess fish above will be examined, and fish will be selected for release to maximize the effective population size through reducing family size variance in the hatchery broodstock population.

- Sex Ratio Data – Chinook salmon are a semelparous species. Early maturing first and second year males typically die, particularly in a captive rearing program. This disproportionate loss of males results in a skewed sex ratio. An uneven sex ratio can reduce the effective population size. Therefore, in a typical year more females will be selected for ancillary release than males due to the anticipated higher precocity rate and loss of first and second year males, and the desire to increase the effective population size by using a 2:1 (male to female) spawning ratio.

- Incorporating Captive Reared Adults into Spawning Population – To minimize hatchery induced selection, adults from the broodstock population will be released directly into the San Joaquin River in Reach 1 to allow natural spawning. Transfer from transport tank to the river will be achieved when possible by using methods such as water-to-water transfer or released directly from the tank using a pipe or shoot. Direct netting of fish would be minimized to the extent possible to reduce injury and fish stress. Yearling releases would be performed similarly to other juvenile releases and would be conducted with those releases as feasible.

<u>Juvenile Releases for Reintroduction</u>: The fish will be released directly from the hatchery when there is adequate flow in the river side-channel, and connectivity with the lower San Joaquin River outside the Restoration Area. Additional release locations may be necessary based on the condition of the river. Additional potential release sites are presented in Table 10.2 of the HGMP (CDFW 2023). To minimize straying, juveniles would be released as far upstream as feasible based on river connectivity and expected survival out of the Restoration Area.

Juveniles will generally be released to the Restoration Area between February and April. Selection of sites will be made based on environmental conditions given the water year type. Shaded sites or sites with suitable water temperatures (<18º C), depths (>1.5 m), and water velocities (~.2 m3/sec) will be selected. Temperature, depth, dissolved oxygen, and water velocity will be measured throughout the extent of the holding and release activities. When fish cannot be released adjacent to the hatchery due to barriers to outmigration, fish will be released below the last barrier.

Transportation procedures for the purpose of fish releases will vary depending on life stage to be released. Eggs will be place in a specialized Styrofoam shipping container and will be cooled and kept moist using non-chlorinated ice and transported in a dark environment. Upon arrival at the release site, eggs will be rehydrated and tempered to the receiving water by increasing the egg temperature 1º C per hour until matching the receiving water temperature.

Juvenile and adult fish will be transported to the release site using the following general guidelines (Carmichael *et al.* 2001):

1. Reduce the number of stressors
2. Reduce the severity of stressors
3. Minimize the duration of stressors
4. Minimize plasma ion disturbances
5. Minimize increases in metabolic rate

Fish will be released from the Conservation Facilities either directly to the San Joaquin River using a volitional release channel or transported to a release site using a standard fish transport tank. The transport tank will be filled with raw hatchery water supply immediately prior to transport. The transport water will be oxygenated using compressed oxygen cylinders with oxygen stones and impellor driven aerators. Dissolved oxygen levels will be monitored and maintained near saturation during transport. Transport water may be supplemented with sodium chloride to provide a physiologically isotonic concentration to minimize ionic disturbances. When possible, fish will be moved in and out of the transport tank without netting using a shoot attached to the transport tank to minimize stress and loss of slime. When possible, the release site will be near the Conservation Facilities and predicted spawning ground. However, releases may occur much farther downstream within the Restoration Area to avoid migratory barriers and transport time may be as long as two hours if necessary. Water will be tempered to two degrees Celsius of the river location receiving the fish before transferring fish. When possible, releases will occur at night to minimize predation.

<u>Direct Translocation</u>: *Eggs*: Eggs would be obtained from the FRFH. FRFH protocols would be followed for the collection, fertilization and incubation of eggs at the FRFH. Procedures will also include pathology testing of ovarian fluid and potentially kidney/spleen tissues. Health inspection data for infectious hematopoietic necrosis virus (IHNV) and bacterial kidney disease (BKD) are collected from ovarian fluid of returning adult females annually during spawning.

A number of eggs from a minimum of 50 crosses will be segregated for use by SJRRP. Due to space availability, the FRFH may be unable to segregate all crosses into individual egg trays.

Therefore, the maximum number of crosses segregated may change each year. A minimum of 50 crosses will be selected by FRFH personnel for segregation throughout the spawning season to maximize genetic diversity.

Once transfer of eggs has been approved by the CDFW Fish Health Lab based on the disease status, and the CV spring-run timing has been verified, a near equal number of eyed eggs from each cross will be enumerated by counting, weighing, or by estimating volumetrically up to the maximum allowed. This is the preferred method, since the SJRRP will have the opportunity to select from individual preferred crosses. Eggs from IHNV and BKD negative females will be properly disinfected at FRFH (or at the receiving location) and transported for translocation to the SIRF or additional streamside incubators.

As they develop into juveniles they will be reared in 3 to 6-ft diameter circular tanks or may be transferred to in-river holding pens. All juveniles will be tagged (CWT) and clipped (adipose fin) when they reach the appropriate size. Eggs for direct translocation may be moved directly to the Interim Facility without being quarantined when broodstock operations shift to the SCARF.

If the FRFH is unable to segregate enough eggs for direct translocation from preferred crosses, then the SJRRP may also select eyed-eggs, up to the maximum allowed, from the FRFH CV spring-run egg trays. However, since the FRFH does not have the space to segregate all crosses it is likely that two to three different crosses may be in one tray. The SJRRP acknowledges that selecting eyed-eggs using this method may reduce the number of available preferred crosses since a non-preferred cross (*i.e.*, BKD or IHNV positive female parent) may be mixed with a preferred cross, thus requiring rejection of the entire tray.

All eggs destined for translocation to the San Joaquin River will be transported when they are the most shock resistant. Trout and salmon eggs become progressively more fragile during a period extending roughly from 48 hours after water-hardening until they are eyed. The eggs must not be moved until this critical period has passed. During the eyed stage, eggs would be addled, cleaned measured, counted, and transported (Piper *et al.* 1986). Transport will occur between the eyed stage and several days prior to hatching.

Eggs will be placed in a specialized shipping container (*e.g.*, Styrofoam cooler) to reduce excessive movement and limit damage to the egg membrane. Eggs will be segregated in wet cheesecloth, then placed in the shipping container, kept cool and moist using wet ice, and transported in a dark environment. Ice will be in a separate compartment of the shipping container, so as not to be in direct contact with the eggs. The ideal temperature for transport is between 5–10° C. A standard vehicle will be used to transport eggs. To ensure all CV spring-run Chinook salmon released are tagged, eggs will not be directly translocated into the San Joaquin River. Eggs will be transported for incubation and rearing to a size suitable for tagging.

<u>Juveniles</u>: An alternative method would be to take juveniles directly from raceways at the FRFH after eggs have hatched. If the SJRRP is unable to accept translocation fish until after egg trays hatch and juveniles are rearing in swim up troughs or raceways, then the SJRRP would select translocation juveniles from the CV spring-run raceways prior to any marking or tagging that would designate them as Feather River CV spring-run releases. Any juveniles released into the

San Joaquin River will be adipose clipped and coded wire tagged. Tagging of direct translocation fish would occur where adequate holding and tagging facilities would be located. Prior to collections, the SJRRP will coordinate with FRFH staff and work closely with them during collections. The SJRRP will follow FRFH standard procedures and practices. Prior to transfer, fish will require a pre-transfer fish health inspection from the CDFW Fish Health Lab which will include the sacrifice of twenty fish per release group for analysis.

Any juveniles requiring transport directly to the San Joaquin River or another facility would be moved by transport tank. Transport will usually occur between January and April. The tank would be filled with water from the source stream or facility just prior to transport. Transport times would depend on the location, but may be as long as six hours. Before transferring fish, the water would be tempered to within 2° C of the water temperature at the receiving facility.

Once the juvenile CV spring-run Chinook salmon reach an appropriate size, they will be marked (adipose fin clipped), tagged (CWT), and released directly to the river. Pre-health assessment requirements, as defined by CDFW pathologists, will be followed for juveniles. Up to 20 fish per rearing system, but not more than a total of 80 fish, will be euthanized for fish health inspection. Additionally, up to 10 percent of juveniles may be held back and later released as yearlings.

Acclimation (Y/N) and duration of acclimation: Whether transferred directly from the FRFH, or reared from eggs, juveniles released into the San Joaquin River would either be held in net pens or in transport tanks for acclimation and imprinting before being released to the river. Fish that are raised primarily on San Joaquin River water will not require imprinting time. The required acclimation period will be determined as necessary by temperature differential (i.e., a holding time necessary to temper at rate not greater than 1° C per hour and not more than 5° C/day) according to established research (DeTolla *et al.* 1995 and Eldridge *et al.* 2015). Holding times for acclimation may be reduced at the discretion of NMFS to increase predicted survival depending on river conditions (*e.g*., if fish in holding tanks are exhibiting signs of confinement stress). After the acclimation period, these fish will be released to predetermined locations along the San Joaquin River.

Volitional release (Y/N): Large-scale releases will occur either as direct volitional release from the Conservation Facilities (once the larger hatchery facility is complete) or transported to offsite locations if migratory conditions in the Restoration Area do not support outmigration through the entire Restoration Area. Fish will be transported using a transport tank. The tank will be filled with raw San Joaquin River water immediately prior to transport. Release sites will be within the Restoration Area, downstream of migratory barriers, and transport time will vary according to release site. Water will be tempered to near the temperature of the receiving water and will not exceed two degrees Celsius of the river location receiving the fish before releasing fish. When possible, releases will occur at night to minimize predation.

External mark(s): Conservation Facilities production/releases are 100 percent marked (adipose fin clipped), allowing for accurate evaluation of program contribution to natural production and effects of the program on the natural populations in the San Joaquin basin.

Internal marks/tags: All fish released will be tagged using CWTs. The tags (visually indicated by the removed adipose fin) will allow fish to be identified as belonging to a particular Conservation Facilities cohort. All captive broodstock will be tagged using 12 mm PIT tags after reaching a minimum length of 65 mm. Additional tagging methods may also be used including disc tags, genetic sampling for parental based tagging, or other agency approved marking methods.

Maximum number released: The proposed fish release levels will be based on: (1) the success of the Conservation Program, (2) quantities of fish from the source populations and (3) the success of the captive rearing program. The projected releases in Table 2 reflect the anticipated production level of the Interim Facility and up to the maximum production capabilities for which the SCARF was designed. The actual carrying capacity of the river system is currently under investigation and will be based on available rearing, holding, and spawning habitat. However, channel improvement and habitat enhancement projects for the SJRRP are planned to continue, and these projects will increase carrying capacity as the reintroduced population grows. Release numbers over time will be tailored to accommodate identified carrying capacity.

Broodstock Releases: To appropriately manage the broodstock population and in response to river conditions, releases may include up to 2,500 ancillary broodstock annually, primarily as yearlings (age 1+) or at age 2+ or older, as necessary for broodstock population management. Initially, up to ten percent of the broodstock offspring may be held back and released as yearlings to simulate proportions in natural populations. The actual percentage of yearling releases may change over time based on information gained on the relative survival of release groups, facility operation needs, or new information regarding the proportion of yearling migrants in wild populations.

Adults may be released to the river as part of restoration and ongoing holding and spawning habitat assessments studying fish behavior as well as habitat availability and suitability of river conditions. The number of yearlings and adults released annually from hatchery production will be based on the recommendations of the Fisheries Management Workgroup in consultation with the Conservation and Genetics subgroups of the SJRRP.

Juvenile Releases: The number of juveniles produced and released from the Conservation Facilities will increase over time as the facilities reaches maximum production. However, actual production will vary year to year based on broodstock survival, fecundity and other factors. In some years, there may be a need to release juveniles to the river based on these unpredictable factors.

Table 2. Projected juvenile and associated broodstock source populations(s).

Release Year	Broodyear of Collected Donor Stock	Broodstock Collections (eggs or juveniles)	Target Number of Juveniles Released	Broodstock Source Population
2023	2019	5,265	200,000	FRFH
2024	2020	5,464	450,000	FRFH
2025	2021	2,196	750,000	FRFH
2026	2022	2,394	1,000,000	FRFH
2027	2023	5,540*	1,000,000	FRFH
2028	2024	5,540*	1,250,000	FRFH, Butte Creek, San Joaquin River, other opportunistic sources
2029+	2025+	5,540	1,250,000	FRFH, Butte Creek, San Joaquin River, other opportunistic sources

*Salmon Conservation and Research Facility is expected to open in winter of 2023/24 but will be operating with a limited budged until additional funding source is secured. Therefore, broodstock collections will remain limited until a long-term funding source is secure.

Release location(s): After the acclimation period, fish will be released to predetermined locations along the San Joaquin River within the Restoration Area. Fish for the reintroduction will be released as high in the system as possible, given water quality and passage conditions lower down in the system, or other logistical considerations.

Time of release: Juveniles will be released into the San Joaquin River intermittently from October through April, however most releases will typically take place between January and April depending on river conditions and fish size. Adult releases into the San Joaquin River will take place intermittently from February through October.

Fish health certification: Diagnostic procedures for pathogen detection will follow American Fisheries Society professional standards as described in the American Fisheries Society Bluebook (AFS-FHS 2007) and the CDFW Fish Health Policy for Anadromous Fish Hatcheries (February 19, 2014). The goal or the CDFW's fish health strategy is as follows:

1. Strive to produce healthy fish for release or transfer.
2. Ensure all production fish are raised under a specific fish health management program.
3. Monitor and evaluate the health of wild and cultured fish populations.

4. Foster open and frequent communication among managers to jointly resolve fish health related issues.

If disease is identified, appropriate treatments will be prescribed by a CDFW Fish Pathologist as appropriate, and follow-up examinations will be performed as necessary. Fish health assessments will be conducted CDFW Fish Health Lab staff at critical points during fish husbandry to prevent disease outbreaks. These include:

1. Analysis of ovarian fluid from female spawners.
2. Analysis during quarantine and at least 30 days prior to transfer to the Conservation Facilities.
3. Analysis immediately prior to transfer to the Conservation Facilities.
4. Analysis prior to release to the wild.
5. Analysis for diagnostic purposes during disease outbreaks.

Pre-release health assessments include smolt index, fat index, plasma protein, blood hematocrit, *etc*., and are based on the work of Adams *et al.* (1993). Treatment methods prescribed by fish pathologists for disease outbreaks and treatment protocols will be carried out by hatchery staff. Depending on the cause of any outbreak, treatment methods may vary.

The transfer of out-of-basin fish to the Conservation Facilities requires preventative measures to avoid introduction of infectious disease. Some fish pathogens found in California are capable of severely impacting wild fish populations and disease issues can, and have, threatened captive rearing or broodstock programs.

Fish in hatcheries are particularly susceptible to disease due to high fish densities and the added stressors of the hatchery environment. The Conservation Facilities lie in close proximity to the San Joaquin Fish Hatchery, a major producer of rainbow trout for regional recreational fishing. A Bio-security Protocol is strictly adhered to in order to prevent disease transfer between the facilities (see Section 7 of the HGMP). The three pathogens of highest concern IHNV, BKD, and Whirling Disease (*Myxobolus cerebralis*). Transfer of a virulent pathogen to the trout hatchery or Conservation Facilities, could result in the need to destroy the entire fish inventory for facility disinfection.

Therefore, careful fish health inspections are necessary prior to all fish transfers into a State hatchery facility. For broodstock collections, 60 individuals are sampled for a fish health assessment at the time of collection. After the quarantine period, another 10 are sampled for a pre-transfer health assessment prior to transferring to the rearing facility. These inspections include quarantining fish to investigate all instances of sick, moribund, and dead animals in an attempt to immediately identify the cause of the problem. In addition, a total of 60 fish from multiple brood years may also be euthanized for an annual facility fish health certification. To prevent introduction of pathogens to the Conservation Facilities, all eggs or fish collections from a given lot may be destroyed if these pathogens are identified during health assessments. After completion of the full-scale SCARF, and pending approval from CDFW Hatchery Coordinator and Fish Health Lab, the Interim Facility may be used for temporary holding, research, and quarantine prior to pathology clearance and transfer to the SCARF.

Fish will be euthanized during disease outbreaks to aid in the identification of pathogens and allow administering proper treatment. Six fish will be euthanized for each occurring epizootic event. In addition, to prevent potential disease outbreaks, diseased and or moribund fish will be removed from the healthy population and, if necessary, euthanized.

USFWS will work with CDFW Pathology to determine which quarantine facilities are appropriate for use. If sufficient quarantine cannot be provided by any of the backup facilities or another appropriate site, then proposed fish collections will cease. Quarantine facilities may also be used for short term holding and potentially longer-term holding, if the need arises. Under such circumstances, culture tanks will be made available at the facilities for that specific purpose.

Silverado Fisheries Base: Located in Yountville, California, Silverado would be the standard quarantine facility for all fish transfers. CDFW operates Silverado for the purpose of juvenile fish and egg quarantine. Previously, all eggs and juveniles going to the Conservation Facilities have been sent to Silverado for quarantine and pathology and the SJRRP anticipates using Silverado for future quarantine. Typically, salmon can be housed at the facility between mid-November and mid-May of each year; however, CDFW has extended this holding period in the past by installing appropriate water refrigeration systems.

Interim Facility and SIRF: After completion of the full-scale SCARF, the current Interim Facility may be used as a quarantine facility pending approval by CDFW Fish Health Lab and/or for research. The Interim Facility will have the capacity to incubate eggs, rear juveniles, and hold adults prior to transfer to the SCARF. Additionally, the SIRF may be used for quarantine purposes. The SIRF uses its own water supply line and allows for isolated incubation and the holding and/or quarantine of fish to all but eliminate the risk of disease transfer to broodstock.

Alternative Quarantine: If other quarantine facilities are not available, then collections will be transferred to Center for Aquatic Biology and Aquaculture (CABA), located in Davis, California, as a backup. CABA's fish culture tanks utilize a secure source of well water which is generally considered free of fish pathogens. CABA has a capacity for hatching a minimum of 40,000 Chinook salmon eggs at one time and is capable of rearing them to approximately five grams. The FRFH Annex has also been suggested as a potential quarantine facility, although the option has not been explored. If the annex were to be used the logistics would be worked out ahead of time.

1.3.1.4 Proposed hatchery adult management

Anticipated number or range in hatchery fish returns originating from this program: Though survival rates vary between hatchery programs, the Conservation Facilities will seek to achieve 85 percent survival from egg to hatching to match that experienced at FRFH in recent years (Cavallo *et al.* 2009) and 75 percent or better survival from egg to smolt stages over the duration of the program. Finally, the Conservation Facilities will aim to achieve greater than 49 percent survival from smolt to adult (Pollard and Flagg 2004).

CV spring-run Chinook salmon spawning started in the fall of 2015, at the Interim Facility and has continued annually since.

Table 3. Adaption of table 1.4 from the 2023 HGMP (CDFW 2023).

Spawn Data Category	Spawn Year 2017	Spawn Year 2018	Spawn Year 2019	Spawn Year 2020
Total Eggs Spawned	375,043	306,764	318,201	289,714
Total Eggs to eyed stage	276,110	246,237	262,645	229,861
Total Emerged	263,179	223,349	248,380	216,085
Total smolts released to San Joaquin River	206,379	207,337	233,654	199,429
Total yearlings released to San Joaquin River	1,450	5,232	9,600	5,094
Number of juveniles retained for yearlings	5,928	9,580	5,481	3,706
Number of juveniles retained for broodstock	2,212	500	0	0
Total smolt production	214,519	217,417	248,735	203,135
Percent Survival to eyed stage	73.6%	80.3%	82.5%	79.345
Percent survival from eyed to emergence (ponding)	95%	91%	94.6%	94.01%
Percent Survival Spawn to Emergence (ponding)	70%	73%	89.0%	74.6%
Percent Survival from eyed stage to Release	75%	84%	78.1%	74.7%
Percent Survival from eggs spawned to Release	57%	71%	78.2%	69.7%

With a target release of 1,000,000 juvenile CV spring-run Chinook salmon once the SCARF is operational, up to 367,500 adults could return to the San Joaquin River Basin given the survival targets described above. However, actual escapement will likely be much less due environmental factors such as flows, temperature, predation, etc.

Removal of hatchery-origin fish and the anticipated number of natural-origin fish encountered: When determining the number of broodstock to collect, the Program considers the viability and extinction risk of the source populations, as well as how collections would affect those factors. The number of eggs or juveniles to collect annually is determined by permitting restrictions and the rearing capacity of facilities at the time of the collection. The target number for collection is described in the Program's annual DSCP. As broodstock and production capacity increase, collections will be expanded beyond the current Feather River population, to additional source populations including, but not limited to, Butte Creek and the San Joaquin River.

Once the experimental population is established, efforts will be made to minimize the influence of hatchery-origin fish on wild fish in the experimental population, which includes progeny of repatriated, recolonizing, or returning CV spring-run Chinook salmon spawners. This will be achieved by maintaining a four-year mean Proportionate Natural Influence (PNI) above 0.67, consistent with Hatchery Scientific Review Group (HSRG) recommendations (HSRG 2004). PNI is the proportion natural-origin spawners in the broodstock (pNOB) divided by the sum of the proportion of effective hatchery-origin spawners on spawning grounds (pHOS) and pNOB (HSRG 2004).

The HSRG developed guidelines for "Integrated" hatcheries, with the goal of ensuring that natural selection outweighs domestication selection while a population is augmented by hatchery production. The HSRG did not explicitly consider the unique problems presented in a reintroduction effort and does not have explicit goals for such programs. While the HSRG recommendations would apply to a reintroduction after a wild population has been established, the recommendations are not appropriate for the early years of a reintroduction and are not the goals for the initial stages of such efforts.

The Conservation Program's goals, during the Reintroduction Period and Interim Period, are different for two primary reasons. First, the HSRG work is predicated on the existence of natural population, and there is no natural population in the Restoration Area. A natural population must be established by the hatchery before the HSRG recommendations can be used to evaluate hatchery practices. Second, in a reintroduction, it is desirable that the genetics of the broodstock dominate for the first two generations to avoid founder effects and to ensure that as much diversity as possible is captured from the source populations (Fraser *et al.* 2008), before natural selection becomes the primary selective force.

This contrasts with a typical hatchery situation, where the HSRG recommendations seek to minimize the hatchery influence on the natural population. After a natural origin population is established and begins adapting to the new river system, the HSRG recommendations will become applicable to the Program. The timing of the applicability of the HSRG recommendations will depend on the success of the reintroduction effort, but will almost certainly be applicable after the Interim Period and may begin to be applicable at the middle or end of the Reintroduction Period.

Appropriate uses for hatchery fish that are removed: To produce adequate numbers of adult broodstock, a sufficient number of CV spring-run Chinook salmon may be collected, which may result in surplus broodstock. Over the lifespan of the program, surplus fish will periodically be removed from the broodstock facility and preferably released to the San Joaquin River. Broodstock releases would depend on river conditions and suitability for CV spring-run Chinook salmon. Surplus fish may be released for reintroduction, research purposes, or held in the Conservation Facility for other research purposes. Instream research goals will depend on the life stage at the time of release. Research fish will be monitored for false migration pathways, predation, spawning behavior, and other life history traits. In some instances, surplus fish may be euthanized, within the bounds of the permit.

The Conservation Program will dispose of salmon carcasses in two ways. First, some carcasses arising from hatchery mortalities will be frozen and generally disposed of through the hatchery solid waste disposal system, which involves ultimate disposal at the municipal disposal facilities.

Second, carcasses derived from mortalities that have undergone adequate depuration following chemical treatment may be used to provide nutrient loading in streams.

Performance standard for pHOS (proportion of naturally spawning fish that are of hatchery-origin): Hatchery produced adults in natural production areas do not exceed appropriate proportion of the total natural spawning population. The appropriate portion will vary based on the phase of reintroduction and the performance of the Conservation Program, with interim targets established by the Fisheries Management Workgroup and Donor Stock Collection Group (DSCG), but the four-year average pHOS are expected to trend down during the local adaptation phase of the reintroduction. Per Fisheries Framework[7] guidance, the four-year mean pHOS is expected to be less than 15% by the end of the reintroduction period, which according to Fisheries Framework is defined as when the 5-year running average adult natural origin returners (NOR) spawning escapement is equal to or exceeds 500 fish. Origin of adults will be based on using a combination of physical marks, genetic analysis, otolith analysis, and/or identifying tags of a representative sample of the population.

Performance standard for stray rates into natural spawning areas: Returning SJRRP adults will likely stray into San Joaquin River tributaries, where they may interbreed with other Chinook salmon. The extant number of CV spring-run Chinook salmon in the San Joaquin River tributaries is unknown. To minimize straying, juveniles produced for the SJRRP, would be released as far upstream as feasible based on river connectivity and expected survival out of the Restoration Area. It is also important to note, straying of returning adults may increase the genetic diversity of recipient populations resulting in potential benefits for San Joaquin Basin tributaries.

1.3.1.5 Proposed research, monitoring, and evaluation

Adult sampling, purpose, methodology, location, and the number of ESA-listed fish handled: Population monitoring and evaluation may include monitoring by video, acoustic tracking, visual surveys, and redd and spawning surveys. Adult abundance will be used as a measure for evaluating SJRRP success. Calculations from literature based on smolt to adult survival and ocean survival for CV fall-run Chinook salmon from the Stanislaus River were used to develop take numbers for broodstock collection and as benchmarks to assess reintroduction success. Adults are expected to return 2–4 years following juvenile releases.

<u>Visual Underwater Surveys and Acoustic Tracking Surveys</u>: Adults in the holding and spawning reaches will be monitored for survival and habitat utilization, when there is both funding and in situ conditions appropriate for monitoring. Visual underwater surveys will be conducted weekly to count and monitor over summering adult CV spring–run Chinook salmon in available holding pool habitat of the Restoration Area. Surveys could be conducted from February (or when adults first enter holding sub-reaches) through November. Fish will not be handled or captured during holding area observations, and mobile acoustic receivers may be used to track and monitoring fish tagged with acoustic transmitters. This monitoring will include physical habitat monitoring.

[7] This Fisheries Framework establishes a schedule for implementation of the fisheries management actions in the San Joaquin River Restoration Program based upon the best available science and information. https://www.restoresjr.net/?wpfb_dl=1055

Additionally, mortalities related to over summer holding will be monitored. As adult holding densities increase over time, density dependent factors affecting survival will be assessed (e.g., disease, stress, illegal harvest). This information will be included in annual reporting for this permit.

Spawning Surveys: Redd surveys and escapement surveys will be used to assess reproductive success of adult migrants. Genetic information may be collected from carcasses through the collection of tissues from fresh carcasses. Evaluation of adipose fin presence will be used to determine origin (*i.e*., hatchery versus natural origin, *etc*.). The head of any fish missing an adipose fin will be collected for CWT extraction and analysis.

Escapement is defined as the number of individuals that escaped the recreational and commercial fisheries (*i.e*., survived) and were capable of producing offspring (Ross 1997). Escapement may be quantified by marking fresh carcasses using two external tags (*e.g*., individually numbered aluminum tags attached by hog ring to their maxilla). Although there is no commercial or recreational fishing for salmon permitted in the Restoration Area, evidence of poaching has been observed (*e.g*., picture on social media, hooks on carcasses; Castle et al. 2016a).

Unique tag codes may be used for each individual to determine which week an individual was originally detected. Once marked, fresh carcasses will be released in flowing water to ensure "mixture" of the marked population. Recapture of marked carcasses in subsequent weeks will be identified as a recapture and their tag codes recorded. After processing marked and unmarked carcasses designated as decayed or skeletons, their tail will be cut off (between adipose and caudal fin) to prevent the unmarked carcasses from being double counted or marked carcasses removed from the mark-recapture study.

The SJRRP does not currently have any plans to actively bring CV fall-run Chinook salmon into the spawning reaches of the Restoration Area. If CV fall-run Chinook salmon are brought back into the Restoration Area SJRRP staff will refer to the Draft Segregation Protocol[8].

Emergence traps could be used to assess egg survival in a subsample of redds as it relates to habitat conditions over time. If egg survival is lower than established habitat targets (*i.e*., lower than 50 percent), it could limit the SJRRP's success in reintroducing the population. This information will be used to recommend habitat restoration projects that may be needed to improve the spawning habitat conditions to support optimal egg survival.

Juvenile sampling, purpose, methodology, location, and the number of ESA-listed fish handled: Juvenile monitoring may consist of various outmigrant traps, and fry emergence monitoring. To evaluate survival and abundance, RSTs will be used throughout the Restoration Area. Juvenile Chinook salmon may be sampled in the upper Reaches of the Restoration Area, with RSTs placed in various locations during near-term monitoring, as well as at downstream locations to evaluate survival through the Restoration Area. Once established, RST site locations will remain fixed seasonally unless changes in river conditions warrant the need to move them or if new RST sites are considered necessary for long-term monitoring.

[8] Draft Segregation Protocol Appendix E of the Fisheries Framework

CWT monitoring outside the Restoration Area (Mossdale Trawls, etc.) will be used to assess migration timing to the Delta. Additionally, acoustic and PIT tagging studies can use CV spring-run juveniles collected under this permit to begin to evaluate reach specific survival and movement patterns following the same protocols used currently for CV fall-run Chinook salmon juvenile outmigration assessment.

Study plans for ongoing or future studies are available in the Annual Technical Report for the SJRRP and this permit. Use of broodstock collected under this permit for additional studies will be evaluated annually by the Donor Stock Collection Work Group (DSCWG).

Rotary Screw Trap: The RST consists of a funnel-shaped cone that is screened and suspended in the water column between floating pontoons. The cone rotates as water flows past the trap, guiding the fish moving downstream into a livebox attached to the rear of the trap cone. RSTs are usually installed at a fixed location and can continuously sample for extended periods. Fish are confined to the live trap, which will be checked at least once daily to process fish and remove debris. Under high debris loads, the trap will be checked and cleaned more frequently. If conditions in the livebox indicate in-trap predation is a concern, fish refuge devices will be installed within the livebox to dissipate water velocities and reduce predation. If fish refuge devices appear to cause mortality or injury to listed fish these features would be modified or removed. When monitored at the appropriate time interval relative to the number of fish being collected, RSTs result in low mortality rates.

Fyke Net or weir-style trap: Fish weirs are porous barriers built across streams to capture migrating fish in flowing waters and generally have higher capture efficiency than RSTs. There are many different types of juvenile collection weirs and they can be constructed from a range of materials based on site conditions, but generally they function very similarly. Fyke traps or v-shaped weirs direct downstream migrating fish into a collection box. Similar to RSTs, these traps have low mortality rates when checked and cleared of debris at least once daily. All juvenile traps (RST, fyke, and weir) will be emptied at least once daily, and more frequently when fish or debris loads require. Daily trap checks will include visual inspection, and traps will be cleaned and maintained as necessary.

Beach Seines: A seine consisting of a length of fine mesh netting with a weighted lead line bottom and floating buoy top line will be set from shore. The seine will be pulled through the water to encircle fish, closed off against the adjacent shore, trapping the fish. Juvenile Chinook salmon trapped in the seine purse will be subsequently processed and removed for transport. Seines of various lengths and mesh sizes may be used depending on location and conditions, and the number of personnel required to use the seine in manner that is safe for personnel and fish will vary accordingly. Personnel who are conducting the seining will be careful to minimize capture of debris in a manner that could injure listed fish. Personnel will inspect the seine in the water to be sure that all seined fish are accounted for and processed appropriately.

Emergence traps: Once redds are detected, their coordinates will be marked and the date of detection will be recorded. If possible, acoustic telemetry will be used to determine the female(s) associated with the redd. Emergence traps will be placed on each selected redds shortly before emergence is expected to begin based on the Accumulated Thermal Units (ATUs) experienced by each redd. Previous work has shown that emergence typically begins around 650 ATUs, so emergence traps are placed at approximately 600 ATUs, or about five days prior to the beginning of fry emergence (Castle et al. 2016a, 2016b). Emergence traps will be monitored frequently beginning prior to emergence through the end of emergence to minimize harm and mortality of fry in the sampling containers. For each emergence trapped redd, the ATUs will be calculated by adding average daily water temperatures over the incubation and emergence period (i.e., from date of redd discovery to trap removal) from the closest California Data Exchange Center (CDEC) station gage(s).

The emergence trap will consist of nylon mesh covering a steel frame and a canvas skirt that will be buried into the gravel to minimize lateral escapement of fish. Each emergence trap will be approximately 2.4 m by 1.8 m with a collection jar at the narrower downstream end.

During installation, each emergence trap will be carried over to the selected redd and placed on top of the egg pocket(s). Subsequently, rebar will be installed around the frame and cinched down to secure the trap to the riverbed. Caps will be installed on exposed rebar to minimize public safety hazards. Thereafter, the canvas skirt will be buried and the collection jar will be attached to the narrow caudal end of the trap. Emergence traps will be checked and cleaned regularly (e.g., approximately 2-4 times per week; daily during peak emergence) and emerged alevin or fry captured within the live-well of the trap will be counted, measured to the nearest millimeter fork length, identified by life-stage or level of development, assessed for physical abnormalities, and weighed. A subsample of the captured fish may be retained, transferred to a quarantine facility, and eventually incorporated into broodstock. For those individuals observed that show external signs of fish health concerns, the individuals may be rapidly fixed in Davidson's fixative and sent off for histological examination.

Marking, Tagging, and Other Procedures Conducted during RM&E Activities:
Handling and Anesthesia: All measuring and tagging activities will require netting, removal, and handling of fish. To minimize the likelihood of detrimental stress effects, tricaine methane sulfonate (MS-222), Aqui-S, or carbon dioxide (e.g., Alka-Seltzer or compressed gas) anesthesia will be administered to juveniles during measuring and weighing activities and PIT tag implantation. Dosage and administration will follow protocols outlined in the draft FRFH HGMP (DWR 2009). Dosage for MS-222 will range from 25 to 100 parts per million (PPM), based on weight of the fish, ensuring the minimum amount of substance necessary to immobilize each for handling and sampling procedures. All processed fish will be allowed to recover in holding vessels before being returned to the rearing tanks. Although physical damage from tagging is possible, the effects of acute stress associated with injury is likely to subside after 12 hours (Gadomski et al. 1994).

Fin Clip and Genetic Sampling: The entire population of captive reared broodstock will be genotyped for parental based tagging. A small fin clip will be collected from spawned fish and either dried on blotter paper or stored in ethanol. The tissue samples will be sent to the CDFW Tissue Archive in Sacramento, California, where half of the tissue will be archived and half will be sent to a contracting lab for genetic analysis. In the lab, the genetic sample from each fish will be genotyped and identified for sex. The results will be stored in a parent database. Naturally spawned offspring will also be genotyped. Their parents will be located in the database and the stock and cohort of origin recorded.

Code Wire Tagging: CWTs are small (less than 1 mm) lengths of wire implanted into the snout of each juvenile fish using specialized automated equipment. Before CV spring-run juveniles are released to the river, each individual is tagged. Tagging occurs when the fish are at a minimum of 30 mm in length. Tagging facilities will consist of one or more mobile manual-tagging trailer(s), or an individual tagging station will be used. Inside the tagging trailer, fish are size graded and distributed to tagging stations with corresponding appropriately sized head molds for CWT insertion.

Tagging stations consist of a CWT machine, and a quality-control device that ensures the tag is inserted. Calibrating CWT machines for appropriate tag length and insertion depth requires lethal take. The number of fish required for lethal take associated with CWT insertion calibration depends on many factors such as: size distribution of fish, the number of fish tagged, the number of days that fish are tagged, and the type of equipment used for tagging. The maximum take for the CWT insertion calibration process is listed in the take tables below (25 per calibration event, and 1,000 annually).

Passive Integrated Transponder Tag: Broodstock reared at the Conservation Facilities also will be tagged using 12 mm PIT tags after fish reach a length of 65 mm. Sterilized PIT tags will be implanted into the peritoneum. PIT tags will be used for monitoring individual fish throughout captivity. Reared juveniles would be measured and weighed, implanted with a PIT tag, and tissue would be collected for genetic analysis (as mentioned in Section 1.3.7.3.2 above). To minimize the potential for detrimental effects, MS-222 anesthesia would be administered to juveniles during measuring and weighing activities and PIT tag implantation.

External Tags: Captured fish may be tagged externally, below the dorsal fin, with a uniquely numbered disc or anchor tag (*e.g.*, T-bar, dart, disc), to identify fish after release. Different color tags may be used to distinguish between gender, and release date. Adult fish will be anesthetized during all tagging activities using MS-222 or carbon dioxide.

Acoustic Tags: Juvenile CV spring-run Chinook salmon may be tagged with Juvenile Salmon Acoustic Telemetry System (JSATS) or other appropriate acoustic technology (e.g. tag transmitters appropriately sized for the individual fish). Tagging will be conducted in the Interim Facility, SCARF, SIRF or the mobile processing trailer. JSATS tag placement will involve surgical techniques requiring an approximate ½ inch incision closed by suturing with standard absorbable suture material by staff experienced in the procedure. Fish will be recovered for 24 hours to minimize latent mortality from surgical implanting of tags, unless environmental conditions or the discretion of biologists warrants less recovery time.

Acoustic and archival tagging of adults will occur through either surgical implants through a one-inch abdominal incision and sutured closed or gastrically inserted using a balling gun. Acoustic tags may be coupled with archival temperature tags by affixing each other with glue or by heat shrink tubing to improve recovery of archival tags. Fish being tagged, may be anesthetized to surgically implant the tags.

Conditions Common to All Section 10(a)(1)(A) Permits that Involve RM&E Activities: Upon issuance, research and enhancement permits include the following conditions that are applicable before, during, and after the research activities. These conditions are intended to (a) manage the interaction between scientists and ESA-listed salmonids by requiring that research activities be coordinated among permit holders, and between permit holders and NMFS; (b) minimize impacts on ESA-listed species; and (c) ensure that NMFS receives correct information about the effects the permitted activities have on the species concerned.

All research permits issued by NMFS include the following conditions:

1. The permit holder must ensure that listed species are taken only at the levels, by the means, in the areas and for the purposes stated in the permit application, and according to the conditions in this permit.
2. The permit holder must not intentionally kill or cause to be killed any listed species unless the permit specifically allows intentional lethal take.
3. The permit holder must handle listed fish with care and keep them in cold water to the maximum extent possible during sampling and processing procedures. When fish are transferred or held, a healthy environment must be provided; e.g., the holding units must contain adequate amounts of well-circulated water. When using gear that captures a mix of species, the permit holder must process listed fish first to minimize handling stress.
4. In most research conditions, researchers must stop capturing and handling listed fish if the water temperature exceeds 22° C at the capture site. Under these conditions, listed fish may only be identified and counted.
5. The permit holder must use a sterilized needle or scalpel for each individual injection when PIT-tags are inserted into listed fish.
6. The permit holder must obtain approval from NMFS before changing sampling locations or research protocols.
7. The permit holder must notify NMFS as soon as possible but no later than two days after any authorized level of take is exceeded or if such an event is likely. The permit holder must submit a written report detailing why the authorized take level was exceeded or is likely to be exceeded.
8. The permit holder is responsible for any biological samples collected from listed anadromous species as long as they are used for research purposes. The permit holder may not transfer biological samples to anyone not listed in the application without prior written approval from NMFS.
9. The person(s) actually doing the research must carry a copy of the permit while conducting the authorized activities.
10. The permit holder must allow any NMFS employee or representative to accompany field personnel while they conduct the research activities.
11. The permit holder must allow any NMFS employee or representative to inspect any records or facilities related to the permit activities.
12. The permit holder may not transfer or assign this permit to any other person as defined in Section 3(12) of the ESA. This permit ceases to be in effect if transferred or assigned to any other person without NMFS's authorization.

13. NMFS may amend the provisions of this permit after giving the permit holder reasonable notice of the amendment.
14. The permit holder must obtain all other Federal, state, and local permits/authorizations needed for the research activities.
15. On or before January 31st of every year, the permit holder must submit to NMFS a post-season report in the prescribed form describing the research activities, the number of listed fish taken and the location, the type of take, the number of fish intentionally killed and unintentionally killed, the take dates, and a brief summary of the research results.
16. If the permit holder violates any permit condition they will be subject to any and all penalties provided by the ESA. NMFS may revoke this permit if the authorized activities are not conducted in compliance with the permit and the requirements of the ESA or if NMFS determines that its ESA section 10(d) findings are no longer valid.

"Permit holder" means USFWS or any employee, contractor, or agent of the SJRRP that is acting under the authority of Permit 20571-2R.

1.3.1.6 Proposed operation and maintenance of hatchery facilities

Salmon rearing and management activities will occur at the Conservation Facilities. Each of these facilities has separate water supply lines, so they can be operated independently without risk of disease transfer through the water supply. The Interim Facility is located on the grounds of CDFW's SJH, and has been operational since 2010. The full-scale SCARF will be located next to the Interim Facility along the San Joaquin River adjacent to the SJH in Friant, California, about 20 miles northeast of Fresno (Fresno County) and one mile downstream of Friant Dam. The full-scale SCARF is anticipated to be operational in late 2023 or early 2024, at which time both facilities will be operational together. If the SCARF is not fully operational in 2023, the small-scale Interim Facility will continue to be used for the captive broodstock program.

Interim Facility: The Interim Facility has been in operation since 2010 and now includes 3-foot and 6-foot diameter circular tanks, three 16-foot diameter circular tanks, and two 20-foot diameter circular tanks. Each tank is covered to prevent escape and predation. It is designed to rear and spawn about 50-100 pairs of adult salmon pairs annually and up to 200,000 juvenile salmon. For spawning and incubation, the Interim Facility includes 12-tray vertical flow incubators (Marisource®, Fife, Washington); deep matrix incubators; and a moist air incubator (ARED, Inc., Wrangell, Alaska). In addition, the Interim Facility includes water recirculation and chilling equipment that allows temperature control during incubation and rearing. The systems are capable of operating on flow-through to 95 percent recirculation and include chillers and water filters including solids filters, biological filters, UV sterilizer, aeration and real-time monitoring of water temperature and dissolved oxygen, with an alarm system to notify staff if parameters are out of range. Once the full-scale SCARF is operational, the Interim Facility may be used for quarantine and or for conducting fish research. The Interim Facility may also be used for the holding and spawning of returning adult CV spring-run Chinook salmon, and the incubation and rearing of their offspring.

SCARF: The SCARF will consist of a hatchery building; a smolt production, captive rearing, and holding facility consisting of different sized containers or vessels, piping, and concrete channels for drains and volitional fish releases. The smolt production area would be an open-air area consisting of twelve 20-foot diameter and four 30-foot diameter circular culture tanks used for smolt production. Ventria (operable openings) on the side of the tanks would allow fish to voluntarily enter the release channel system during periods of fish outmigration. Additionally, six 8-foot, six 20-foot, and three 30-foot diameter circular culture tanks will be used for rearing and holding broodstock. The permanent SCARF will be designed to accommodate the maximum broodstock size of approximately 1,350 adult broodstock that are spawned at the hatchery per broodyear with a ratio of two males per one female. This maximum number of spawners takes into account additional fish from expected losses of initial broodstock collections due to survivability from one life stage to the next, ancillary releases of broodstock juveniles (0-1), yearlings (1+) and adults used for habitat studies on the river, etc.

SIRF: The SIRF includes four self-contained rearing units, each with five 6-ft diameter 500-gallon circular tanks. The systems are capable of operating on flow-through to 95 percent recirculation and include chillers and water filters. These systems could be used to incubate eggs or rear juveniles prior to release to the San Joaquin River. The SIRF could also be used as quarantine for collected broodstock or to temporarily hold adult CV spring-run Chinook salmon returning to the San Joaquin River until they are ready to be spawned.

Water source(s) and quantity for hatchery facilities: Water for the Conservation Facilities will be supplied from Millerton reservoir behind Friant Dam, which has a total capacity of 520,500 acre-feet (642,027,300 cubic meters). The watershed upstream of Friant Dam drains 1,638 square miles (4,242 square km) on the western slope of the Sierra Nevada Mountain Range in Fresno and Madera Counties and is bounded by the watersheds of the Merced and Fresno Rivers on the north and the Kings River on the south. The geology of the watershed is primarily granitic. It extends east to the crest of the Sierra Nevada with a general ridge elevation of about 10,000 feet above mean sea level (3,048 meters), and occasional peak elevations greater than 13,000 feet (3,962 meters), and westward to Friant Dam about 25 miles (40 km) north from Fresno at an elevation of about 350 feet (107 meters) (SJRRP 2009).

The SCARF is adjacent to the existing CDFW SJH in Friant, California. Water flow at the SJH has been reliable in its 65 years of operation, with only one disruption due to an underground pipe break. Water flow at the SCARF is anticipated to be equally reliable. The SJH has successfully hatched and raised trout at the site since 1955 and has benefited from the favorable water temperature and water quality conditions. The source water for the SJH is a continuous 35 cubic feet per second (cfs) supply of water gravity fed from Friant Dam. The water is delivered first to a Fish Release Hydropower Plant via two different pipelines: a 24-inch diameter pipeline from two Friant Dam penstocks, and a 30-inch diameter pipeline that takes water from the Friant Kern Canal near the left dam abutment. The temperature of the water in each pipeline varies throughout the year, and valves are used to control the flows to maintain favorable temperature conditions for the SJH.

The SJH supply water and the adjacent river water are of the same origin and are fairly similar in temperature. During the late summer/fall period when water temperatures are a concern, the entire supply may come from the base of Friant Dam because water from the Friant-Kern Canal is too warm to use. Water supply is typically maintained between 45-55° F (7.2-12.8°

C) throughout the year, historically dipping as low as 42° F (5.6° C) or as high as 58° F (14.4° C). However, during the 2013-2015 drought when Millerton reservoir's cool water pool was depleted, the San Joaquin River and temperatures at the hatchery have reached 60° F in 2013, 70° F in 2014, and 67° F in 2015. In response, the Conservation Program installed water recirculation and water chiller systems to maintain temperatures at acceptable levels at the Interim Facility.

The SJH effluent is regulated under Clean Water Act National Pollutant Discharge Elimination System (NPDES) permit No. CA0004812 Order No. R5-2004-0118 (General Order), administered by the State Water Resources Control Board (SWRCB). The SWRCB required CDFW to submit a Notice of Applicability for SCARF to be covered under the General Order in 2019. However, until SCARF is operational, CDFW is only required to report monthly use of chemicals at the Interim Facility. Because of planned flow rates at the SCARF to provide sufficient flushing and optimal conditions for fish rearing, temperature increase is anticipated to be minimal and will remain within the guidelines provided by the SWRCB.

Permanent or temporary barriers to juvenile or adult fish passage: Historically, CV spring- and fall-run Chinook salmon populations in Central Valley rivers, including the San Joaquin River, were maintained by isolation through temporal and spatial differences in their run timing and spawning locations (Moyle 2002). Construction of Friant Dam blocked the spawning runs of both CV spring- and fall-run Chinook salmon. Subsequent channel dewatering and degraded water quality soon led to extirpation of both runs. Flow management and habitat restoration are intended to eliminate dewatering and improve water quality within the Restoration Area, but Friant Dam still blocks upstream migration of CV spring-run salmon to their historical spawning reaches, relegating the spring-run to lower river reaches typically used by CV fall-run Chinook salmon. Due to temporal overlap between the CV spring- and fall-run spawning periods, these two runs are vulnerable to spawning interference and genetic interactions in the form of introgression (Tomalty *et al.* 2014). Physically separating the two runs (once populations are established in the San Joaquin River), using temporary weirs will likely be necessary to minimize reproductive interference. For more information regarding the potential environmental effects associated with construction of the SCARF and Related Fisheries Management Actions, see the Draft Environmental Impact Report completed by CDFW (2013).

<u>Hills Ferry Barrier</u>: The Hills Ferry Barrier (HFB) is an existing seasonal weir located approximately 850 feet upstream of the San Joaquin River's confluence of the Merced River. The HFB is funded as mitigation for the Central Valley Project Improvement Act, was not constructed as part of the SJRRP's conservation hatchery program, but it could be used in the future to support hatchery operations. It is currently used to redirect up-migrating adult salmonids during the fall, including CV fall-run Chinook salmon, into suitable spawning habitat in the Merced River. It impedes passage into the San Joaquin River upstream of the confluence with the Merced River, where habitat and water quality remain unsuitable for these fish until volitional passage is re-establish. The HFB is operated every year from mid-September to mid-December. Under the SJRRP, restoration actions would be taken such that habitat in the San Joaquin River upstream of the HFB would be adequate to allow passage. At that point, the HFB may no longer be operated (and possibly removed) to allow CV fall-run Chinook salmon into the Restoration Area or re-operated to serve as a control structure to segregate up-migrating CV

spring- and fall-run Chinook salmon. Such reoperation would involve using the weir only during certain key seasons to minimize hybridization and other interactions between CV spring- and fall-run Chinook salmon.

Segregation would reduce adverse interactions between CV spring- and fall-run Chinook salmon, such as hybridization and redd superimposition. The HFB may also be moved downstream towards the confluence with the Merced River to reduce overtopping and bank erosion that occurs at the current location due to mobile sand substrate. These modifications may involve constructing a permanent concrete sill to stabilize erosion and provide a solid barrier foundation with suitable anchoring points. In addition, methods for removal of invasive water hyacinth (*Eichhornia crassipes*) may be incorporated in the barrier's future design, as well as features for monitoring fish passage through the facility. The HFB may also be used for monitoring of fish populations.

<u>Reach 1A Segregation Weir</u>: A structure similar to the HFB may be constructed in Reach 1A of the San Joaquin River (near the location where Hwy 41 crosses the river), just downstream of where most of the CV spring-run Chinook salmon spawning is expected to occur. The necessity for and exact location, design, and operation of the Reach 1A Separation Weir have not yet been defined, but it would generally serve to minimize hybridization between runs and reduce the likelihood for redd superimposition. Once CV spring- and fall-run Chinook salmon are established in the Restoration Area and the quantity and quality of spawning habitat available to the salmon runs are better understood, an assessment of the necessity for the weir, and if necessary, a suitable location for the weir would be made.

<u>Weirs at Salt and Mud Sloughs and Other False Migration Pathways</u>: Salt and Mud Sloughs are tributaries of the San Joaquin River in Merced County. Each year, some percentage of Chinook salmon are able to swim past the HFB and are then unable to access suitable spawning habitat due to poor habitat conditions (*e.g*., insufficient flow) and barriers that restrict fish passage. Fish that do migrate past the barrier are frequently entrained in Mud and Salt Sloughs, which typically have greater flow than the main stem San Joaquin River during the fall salmon migration period. These fish do not contribute to the CV fall-run Chinook salmon escapement numbers, and may therefore be considered "lost" to the tributary populations. Pursuant to the Stipulation of Settlement in NRDC vs. Rodgers, *et al.*, the SJRRP must evaluate the need to construct seasonal barriers to prevent adult anadromous fish from entering false migration pathways in the area of Salt and Mud Sloughs. Structures similar to those described for the HFB and Reach 1A Separation Weir may be constructed near the entrance to Salt and Mud Sloughs in Reach 5 and may be constructed at various other locations as deemed necessary in the future. The exact location, design, and operation of these weirs have not yet been defined, but they would serve to prevent migrating salmonids from entering these non-suitable areas.

Consistent with current practices at the HFB, CDFW will manage the accumulation of plants, and debris in the vicinity of the segregation or barrier weir(s). The control methods include manual removal of plant material accumulated behind the weir. The weirs will be checked, and maintenance performed, at a minimum frequency of once per day (or as needed) when the weir(s) are in place.

Instream structures: The majority of the SCARF will be constructed on disturbed and developed lands adjacent to the river; a portion of the volitional release channel will be constructed in riparian forest associated with the San Joaquin River (CDFW 2013). The proposed volitional release channels will be connected to SCARF smolt production tanks, allowing fish to be released from the hatchery directly to the river without the need for transport, to maximize imprinting and thereby reduce straying. All tanks would have bottom and side drains to convey accumulated waste and permit volitional release of fish, respectively. A series of concrete channels would be constructed and attached to the side drains of the tanks to provide drainage and volitional fish releases to the secondary channel of the San Joaquin River. Operable openings on the side of the tanks would allow fish to voluntarily enter the release channel system during periods of fish outmigration. The volitional release channel would terminate in the secondary channel of the San Joaquin River where outmigrating fish could enter the river and migrate downstream.

Streambank armoring or alterations: Riparian and aquatic vegetation may be lost as a result of construction of SCARF structures in or near the secondary channel. The majority of the SCARF would be constructed on disturbed or previously developed land. However, SCARF construction activities related to the volitional release channel and return flow outfall could temporarily disturb riparian habitat. As described in the DEIR completed by CDFW (2013), implementation of the described mitigation measures will reduce impacts to a less than significant level.

The installation, removal, or repurposing of fish weirs could also potentially create loose soils and increase erosion on the streambanks. Project activities will be done in such a manner as to not increase erosion within the banks of the river during or immediately following rainfall events. All disturbed soils at project activity sites will be stabilized to reduce erosion potential, both during and following installation of equipment (*e.g.*, weirs, fyke nets, traps, *etc*.). After removal of such equipment, soils shall be stabilized and re-contoured, as necessary.

Pollutant discharge and location(s): The SCARF's intake line will originate in Millerton reservoir upstream of Friant Dam, where there are no listed fish species. The SCARF will be designed to conform to NMFS screening guidelines for effluent discharge. Solid waste from fish culture tanks from the full-scale SCARF will be separated from the effluent using micro screen filtration, stored in a solid waste sump, dried, and removed from the premises. The Interim Facility falls below the NPDES permit requirements due to its size. As noted above, the full-scale SCARF will comply with NPDES permit to ensure effluent discharge will not impact the San Joaquin River. Effluent discharge from the Interim Facility was monitored from mid-2014 to early 2016. Water quality parameters were analyzed for total suspended solids (TSS) and biochemical oxygen demand (BOD). Since most of the results have been "non-detect" for both TSS and BOD, except on two occasions when BOD was measured at 1.0 mg/l, the RWQCB agreed to suspend sample collection and analysis until SCARF is operational. Regarding these water quality parameters, the hatchery effluent has not had any significant effect on receiving waters.

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 a biological 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.

NMFS determined the proposed action is not likely to adversely affect Southern Resident Killer Whales or their critical habitat. Our concurrence is documented in the "Not Likely to Adversely Affect" Determinations section (Section 2.13).

2.1. Analytical Approach

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

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

The designations of critical habitat for CV spring-run Chinook salmon, CCV steelhead, or the sDPS of North American green sturgeon uses the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The ESA Section 7 implementing regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision does not change the scope of our analysis, and in this biological 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 critical 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.

Rangewide Status of the Species and Critical Habitat

This biological 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 biological 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 4. Description of species, current ESA listing classifications, and summary of species status.

Species	Listing Classification and Federal Register Notice	Status Summary
Central Valley spring-run Chinook salmon ESU	Threatened, 70 FR 37160; June 28, 2005	According to the NMFS 5-year species status review (NMFS 2016b), the status of the CV spring-run Chinook salmon ESU, until 2015, has improved since the 2010 5-year species status review. 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. Recent declines of many of the dependent 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. Monitoring data showed sharp declines in adult returns from 2014 through 2018 (CDFW 2018).
California Central Valley steelhead DPS	Threatened, 71 FR 834; January 5, 2006	According to the NMFS 5-year species status review (NMFS 2016a), the status of CCV steelhead appears to have remained unchanged since the 2011 status review that concluded that the DPS was in danger of becoming endangered. Most natural-origin CCV 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 CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to natural-origin fish. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead.

Species	Listing Classification and Federal Register Notice	Status Summary
Southern DPS of North American green sturgeon	Threatened, 71 FR 17757; April 7, 2006	According to the NMFS 5-year species status review (NMFS 2015) and the 2018 final recovery plan (NMFS 2018b), some threats to the species have recently been eliminated, such as take from commercial fisheries and removal of some passage barriers. Also, several habitat restoration actions have occurred in the Sacramento River Basin, and spawning was documented on the Feather River. However, the species viability continues to face a moderate risk of extinction because many threats have not been addressed, and the majority of spawning occurs in a single reach of the main stem Sacramento River. Current threats include poaching and habitat degradation. 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).

Table 5. Description of critical habitat, Listing, and Status Summary.

Critical Habitat	Designation Date and Federal Register Notice	Status Summary
Central Valley spring-run Chinook salmon ESU	September 2, 2005; 70 FR 52488	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 line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. PBFs considered essential to the conservation of the species include: Spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas. 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.

Critical Habitat	Designation Date and Federal Register Notice	Status Summary
California Central Valley steelhead DPS	September 2, 2005; 70 FR 52488	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 bankfull elevation. PBFs considered essential to the conservation of the species include: Spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas. Although the current conditions of PBFs for CCV steelhead critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.

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. 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).

CV spring-run Chinook salmon adults are vulnerable to climate change because they over-summer in freshwater streams before spawning in autumn (Thompson *et al.* 2011). CV spring-run spawn primarily in the tributaries to the Sacramento River. Those tributaries without cold water refugia (usually input from springs), will be more susceptible to impacts of climate change. Although CCV steelhead will experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historical spawning and rearing habitat, the effects may be even greater in some cases, as juvenile CCV 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 CCV steelhead, which range from 14° C to 19° C (57° F to 66° F).

In summary, observed and predicted climate change effects are generally detrimental to the species (McClure 2011, 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).

2.2. 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). For the purposes of this biological opinion, the action area includes the SJRRP Restoration Area, which is the San Joaquin River below Friant Dam to the confluence of the Merced River, including select locations on the Mariposa and Eastside bypasses, and the entrances to the following off-channel sloughs: Mud Slough, Salt Slough, and Newman Wasteway. In addition, because the proposed action includes broodstock collection from Butte Creek, the FRFH, the San Joaquin River tributaries (Merced, Tuolumne, and Stanislaus Rivers), and other streams and rivers that are accessible to CV spring-run Chinook salmon strays, those locales are also part of the Action Area. Transport routes from the broodstock collection locales, and quarantine facilities (i.e. Silverado and CABA), are also included in the Action Area.

2.3. Environmental Baseline

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

2.3.1. Occurrence of Listed Species and Critical Habitat

The federally listed anadromous species that use and occupy the action area are migrating adult and juvenile CCV steelhead and CV spring-run Chinook salmon, and juvenile, subadult and adult sDPS green sturgeon. The action area is within designated critical habitat for CCV steelhead, and CV Chinook spring-run salmon. Butte Creek, a tributary to the Sacramento River, is used by CV spring-run Chinook and CCV steelhead. The FRFH actively produces juvenile CV spring-run Chinook salmon to mitigate the effects Oroville Dam but this permit will only allow for collection of fish from within the hatchery. The San Joaquin River mainstem in the action area is the primary migration corridor for both adult and juvenile CV spring-run Chinook salmon and CCV steelhead life stages spawned in the San Joaquin River Basin to the Delta, which contains important rearing habitat for juveniles. The SJRRP Restoration Area is used by both juvenile and adult CV spring-run Chinook salmon and CCV steelhead but is not critical habitat for either species.

Juvenile (including subadult) sDPS green sturgeon may be present throughout the Delta during every month of the year, whereas spawning and post-spawn adults are unlikely to migrate through the action area because their primary migratory route between the ocean and upstream spawning habitats lies predominantly in the Sacramento River and its tributaries. But recent reports and monitoring focused on white sturgeon have revealed both white and green sturgeon in the San Joaquin River down as far as the Eastside Bypass (a floodway to the San Joaquin River, downstream of the confluence of the Merced) (Demarest 2023).

2.3.1.1 CCV Steelhead

While the action area includes the San Joaquin River, Butte Creek, and FRFH, activities proposed at Butte Creek and FRFH are not expected to have any detectable effect on CCV steelhead beyond those effects that would have occurred anyway without the proposed action. Therefore, this section only includes the status of CCV steelhead in the San Joaquin River component of the action area, and does not include information for CCV steelhead in Butte Creek, or for FRFH.

San Joaquin River and its tributaries: Historical abundance of CCV steelhead in the action area is difficult to determine, but CCV steelhead were once widely distributed, with abundance estimates of 1 to 2 million adults annually, throughout the Central Valley system as a whole (McEwan 2001). The life history strategies of steelhead are variable between individuals, and it is important to note that CCV steelhead are iteroparous (i.e., can spawn more than once in their lifetime) (Busby et al. 1996), and therefore may be expected to emigrate back down the system after spawning. As such, the determination of the presence or absence of CCV steelhead in the Delta accounted for both upstream and downstream migrating adult steelhead (kelts).

Adult CCV steelhead enter freshwater in August (Moyle, 2002) and peak migration of adults moving upriver occurs in August through September (Table 4, Hallock et al. 1957). Adult CCV steelhead will hold until flows are high enough in the tributaries to migrate upstream where they will spawn from December to April (Hallock et al. 1961). After spawning, most surviving steelhead kelts migrate back to the ocean and reach the Sacramento River during March and April, and have a high presence in the Delta in May. Migrating adult CCV steelhead through the San Joaquin River are present from July to March, with highest abundance between December and January (Table 4). Small, remnant populations of CCV steelhead are known to occur in the Stanislaus River and the Tuolumne River and their presence is assumed on the Merced River due to proximity, similar habitats, historical presence, and recent otolith chemistry studies verifying at least one steelhead in the limited samples collected from the river (Zimmerman et al. 2008). These tributaries are part of the action area. Juveniles would emigrate from February through June, with the core of their migration occurring March through May.

SJRRP Restoration Area: Eleven successive years of monitoring from 2012-2022 failed to capture CCV steelhead in Reaches 4B and 5 of the SJRRP Restoration Area, leading to the belief that CCV steelhead have been extirpated from all reaches of the SJRRP Restoration Area (Sutphin and Root 2022). Monitoring for CCV steelhead will continue in the downstream reaches of the SJRRP Restoration Area as part of the CCV steelhead Monitoring Plan, as allowed in ESA Section 10(a)(1)(A) permit 16608-3R (which can be found at https://apps.nmfs.noaa.gov/). Part of the CCV steelhead monitoring plan is to released any trapped CCV steelhead to the confluence with the Merced and not actively move them into the inaccessible spawning reaches of the SJRRP Restoration Area. However, CCV steelhead are capable of accessing Reach 1 during flood conditions, like in 2017, 2019, and 2023, when the river or bypasses flow continuously from Friant Dam to the Merced River confluence.

If CCV steelhead successfully migrate and spawn in Reach 1, juveniles and kelts could emigrate through the action area. These fish would likely experience low survival rates as the conditions would not yet reliably provide suitable rearing or migratory habitat, for the majority of the year; but planned improvements in fish passage and flows may encourage some straying and recolonization of the area, in the near future.

2.3.1.2 CCV steelhead Critical Habitat

While the action area includes the San Joaquin River, Butte Creek, and FRFH, activities proposed at Butte Creek and FRFH are not expected to have any detectable effect on CCV steelhead critical habitat beyond those effects that would have occurred anyway without the proposed action. Therefore, this section only includes the status of CCV steelhead critical habitat in the San Joaquin River and its tributaries component of the action area, and does not include information for CCV steelhead critical habitat in Butte Creek, or for FRFH.

San Joaquin River and its tributaries: The PBFs for CCV steelhead critical habitat in the action area include freshwater migration corridors and rearing habitat. The freshwater migration utility in the action area is of fair quality, since flows of the lower San Joaquin River are typically of adequate magnitude, quality, and temperatures to support adult and juvenile migration. Most of this section of CCV steelhead critical habitat serves as a migration corridor for all of the adults and juveniles produced and supported by the San Joaquin River and its major tributaries.

During the summer months, migration and rearing habitat is of poor quality due to unsuitable water temperatures and low flows. In addition, rearing habitat is poor as the San Joaquin River is leveed and channelized. The floodplain habitat that would otherwise normally exist has been largely removed near the action area due to the high levees, which limits the value of the area for juvenile rearing. Migratory habitat for adults and juveniles would likely not be impacted due to the project timing because the work window is mostly outside of their migration periods.

Even though the habitat has been substantially altered and its quality diminished through years of human actions, its conservation value remains high for the CCV steelhead DPS. A large fraction of the CCV steelhead smolts originating in the San Joaquin River Basin will likely pass downstream through the action area within the San Joaquin River mainstem channel, particularly if there is a fish barrier at the Head of Old River (placed from April to May) to prevent smolt entrance into that route. Likewise, adults migrating upstream to spawn are likely to pass through the action area within the mainstem of the San Joaquin River to reach their upstream spawning areas in the San Joaquin River basin. Therefore, it is of critical importance to the long-term viability of the CCV steelhead to maintain a functional migratory corridor and freshwater rearing habitat through the action area to sustain the Southern Sierra Diversity Group, and provide the necessary spatial diversity to aid in recovery.

SJRRP Restoration Area: There is no CCV steelhead critical habitat in the SJRRP Restoration Area.

2.3.1.3 CV spring-run Chinook salmon

SJRRP Restoration Area: Historically, CV spring-run Chinook salmon spawned in the San Joaquin River from about the present-day location of Friant Dam to as far upstream as Mammoth Pool (River Mile 322) (McBain and Trush 2002). During the late 1930s and early 1940s, as Friant Dam was being constructed, large runs continued to return to the river. After the dam was completed and the reservoir was filling, runs of 30,000 to 50,000 fish continued to return and spawn in the river downstream of Friant Dam. These runs were completely gone by 1950, as diversions from Friant Dam resulted in the river being dry for extended sections starting at Gravelly Ford and below Sack Dam (McBain and Trush 2002). The CV spring-run Chinook salmon occurrence data and other available information suggest CV spring-run Chinook salmon were not recently present within the Restoration Area prior to SJRRP restoration activities.

The SJRRP began reintroduction of CV spring-run Chinook salmon in the main-stem San Joaquin River within the SJRRP Restoration Area in 2014. From 2014-2016, the SJRRP released juveniles from the FRFH into the Restoration Area. Beginning in 2016 and through the present year (2023), juvenile salmon raised in the Conservation Facilities, in Fresno, California, have been released instead of or with FRFH juveniles (NMFS 2023[9]). The reintroduction activities have been successful and CV spring-run Chinook salmon have been documented returning to the SJRRP Restoration Area since 2019 (NMFS 2023). The long-term goal of reintroduction is to aid in the recovery and resiliency of the CV spring-run Chinook salmon ESU.

Returning adult CV spring-run Chinook salmon will be trapped within Reach 5 and hauled to Reach 1 until there is unimpeded passage, which is anticipated to occur in the foreseeable future. With unimpeded passage, there will also be an increased possibility of CV spring-run Chinook salmon from outside the Restoration Area naturally straying into the action area. These fish will be treated as part of the experimental population once they enter the Restoration Area.

When adult CV spring-run Chinook successfully spawn in Reach 1, either after migrating naturally during a flood flow, being released as ancillary broodstock from the Conservation Facilities, or being trapped and hauled from Reach 5, juveniles will emigrate through the proposed action area.

San Joaquin River: Outside of the SJRRP Restoration Area, there is no ongoing monitoring designed to target or detect CV spring-run Chinook salmon within the lower San Joaquin River or its tributaries. Historically, the Stanislaus, Tuolumne, and Merced Rivers provided exceptional habitats for CV spring-run Chinook salmon (Yoshiyama et al. 1996) and were found to be populations capable of persisting in isolation without depending on neighboring watersheds for their persistence (i.e., independent populations) by Lindley et al. 2004.

Until recently, CV spring-run Chinook salmon were considered functionally extirpated from the Southern Sierra Nevada diversity group despite their historical abundance in the San Joaquin River Basin (NMFS 2016c). In the last few years there have been observations of low numbers of CV spring-run Chinook salmon returning to major San Joaquin River tributaries. A genetic

[9] This citation refers the to annual Tech Memo NMFS writes about the SJRRP. Older Tech Memos can be found at: https://www.fisheries.noaa.gov/west-coast/habitat-conservation/san-joaquin-river-restoration.

study showed that the tested adults are CV spring-run Chinook salmon and juveniles caught in the same systems were CV spring-run Chinook salmon as well (Clemento and Garza 2023). This shows that the implementation of reintroduction of the CV spring-run Chinook salmon into the San Joaquin River has begun and has resulted in wild-spawned juvenile CV spring-run Chinook salmon since 2016 (NMFS 2021).

Feather River Fish Hatchery: The CV spring-run Chinook salmon ESU includes all naturally spawned populations in the Feather River as well as fish from the FRFH CV spring-run Chinook salmon program. NMFS' Central Valley Technical Recovery Team believed that the existing CV spring-run Chinook salmon population in the Feather River, including the hatchery fish, may be the only remaining representatives of an important component of the ESU, and that the FRFH CV spring-run Chinook salmon stock may play an important role in the recovery of CV spring run Chinook salmon in the Feather River Basin (Lindley *et al.* 2004).

Before construction of Oroville Dam, CV spring-run Chinook salmon occupied the upper tributaries of the Feather River for spawning. CV spring-run Chinook salmon ascended the Feather River in the spring and summer as sexually immature fish, and develop to maturity by fall and then spawn. Following dam construction, fish passage has been halted on the Feather River at the Fish Barrier Dam downstream of Oroville Dam. For the CV spring-run Chinook salmon that now return to the river, the options are to either spawn naturally in the river, utilizing the remaining habitat in the lower reaches of the Feather River below the Fish Barrier Dam, or to ascend the fish ladder which begins at the Fish Barrier Dam and enters the FRFH where the fish are then artificially propagated.

Adult CV spring-run Chinook salmon enter the Feather River as immature adults from March to June (Reynolds et al. 1993, Yoshiyama et al. 1998, Sommer et al. 2001) and spawn in the autumn during September and October (Sommer et al. 2001). Spawning occurs in gravel beds that are often located at the tails of holding pools (USFWS 1995) and most CV spring-run Chinook salmon spawn in the upper reaches of the low flow channel (CDWR 2007).

Historical and continued introgression between Feather River CV spring- and fall-run Chinook salmon ESUs in the breeding program at the FRFH compromises the long-term genetic integrity of the CV spring-run Chinook salmon population on the Feather River and poses a high extinction risk (Hedgecock et al. 2001; California HSRG 2012). Since 2004, CV spring-run Chinook salmon broodstock have been identified as phenotypic spring run trapped and tagged at the FRFH between April 1 and June 30. As a result of this practice, fall-run are excluded from the spring-run broodstock. Additionally, FRFH has been using genetic testing of gametes of their fall-run broodstock to ensure CV spring-run Chinook salmon are excluded. They have implemented practices to reduce introgression between CV spring- and fall-run Chinook salmon in the hatchery. In the river, large numbers of CV fall- and spring-run Chinook salmon individuals from the FRFH potentially spawn with natural-origin Feather River CV spring- and fall-run Chinook salmon (Palmer-Zwahlen et al. 2019, SWFSC 2022).

These circumstances are deleterious to the long-term viability of the species and the Feather River CV spring-run Chinook salmon population.

Butte Creek: Butte Creek is one of three independent populations CV spring-run Chinook salmon that remains in the Central Valley (Lindley et al. 2004). Water conditions in sections of Butte Creek that contain CV spring-run Chinook salmon habitat are largely managed by the Pacific Gas and Electric (PG&E) De Sabla-Centerville Hydroelectric Project (DSCHP).

Since 1999, the DSCHP was operated under a Project Operations and Maintenance Plan developed each spring in consultation with the state and federal fisheries managers for the protection and enhancement of Chinook salmon and steelhead. Under the plan, water is released from reservoirs on the Feather River, first from Round Valley Reservoir, followed by the release of water from Philbrook Reservoir as high temperatures occur during the summer. The operations have been variably successful, and Butte Creek has experienced recent returns ranging from below 2,000 adults to nearly 20,000 adults (Figure 1; CDFW 2022). Preliminary data for 2023 suggests that the adult return for 2023 is likely to be the lowest in the last 10 years.

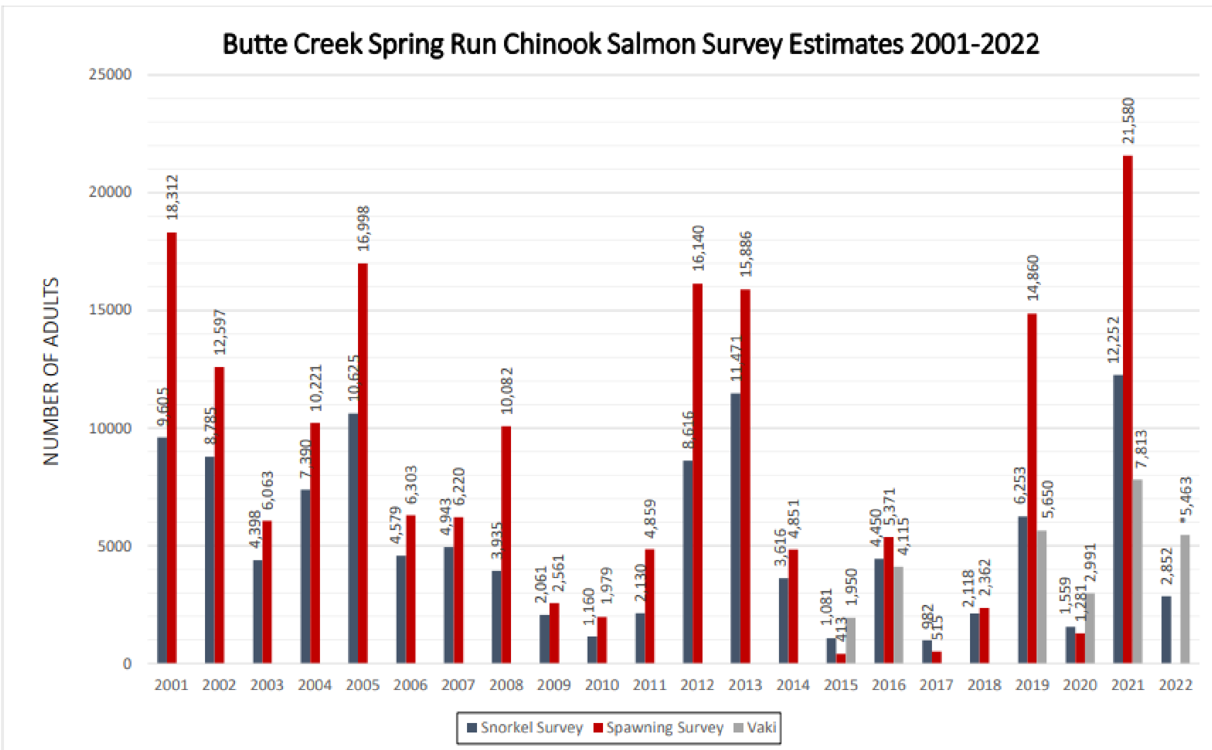

Figure 1. Butte Creek adult CV spring-run Chinook salmon escapement estimates (red bars) from 2001-2021, holding snorkel survey estimates (blue bars) from 2001-2022, and Vaki estimates (gray bars) from 2015, 2016, and 2019-2022. Escapement estimates are not currently available for 2022. *Vaki passage counts for 2022 were incomplete due to equipment failure.

Butte Creek has a genetically distinct and independent CV spring-run Chinook salmon population (SWFSC 2022). Genetic analysis of the Butte Creek population shows no hatchery influence despite of the addition of 200,000 juvenile CV spring-run Chinook salmon from FRFH in the 1980s to supplement low returns (CDFG 1998, Garza and Pearse 2008, Moyle et al. 2008). Based on the analysis thus far, the planted fish appear to have made no significant genetic contribution to the natural Butte Creek population. Aside from the 1986 planting, Butte Creek has not been planted with hatchery fish, and surveys consistently fail to detect significant straying into Butte Creek from other populations (McReynolds et al. 2007).

In 1995 CDFW began monitoring the outmigration of CV spring-run Chinook salmon from Butte Creek. During the 2015-2016 RST trapping period, fish were trapped at the Parrott-Phelan Diversion Dam location along Butte Creek. This site is directly downstream of the CV spring-run Chinook salmon spawning habitat and upstream of the CV fall-run Chinook salmon spawning habitat, although periodically some CV fall-run Chinook salmon do spawn above this site.

Since 2019, California experienced three years of consecutive droughts, resulting in freshwater conditions expected to be detrimental to salmon. In 2021, Butte Creek CV spring-run Chinook salmon suffered significant (92%) pre-spawn mortality due to a pathogen outbreak resulting from a wildfire temporarily preventing access to infrastructure to deliver cold water that was available (Johnson et al 2023). This impact to the spawning potential is considered catastrophic according to criteria proposed by Lindley et al. (2007). Butte Creek CV spring-run Chinook salmon have declined 19% per year in population size (point estimate) over the most recent 10 years (Johnson et al 2023).

2.3.1.4 CV spring-run Chinook salmon Critical Habitat

There is currently no critical habitat designated for CV spring-run Chinook salmon in the San Joaquin River Basin.

Butte Creek is designated as critical habitat for CV spring-run Chinook salmon but the proposed activities do not add any effects not already covered by other permits.

2.3.1.5 sDPS of Green Sturgeon and Critical Habitat

Under historical conditions sDPS green sturgeon likely used the action area for migration and feeding. Following construction of Friant Dam and other large dams on the San Joaquin River tributaries conditions for green sturgeon became unsuitable. With the improved flows provided by the SJRRP Settlement it is anticipated that sDPS green sturgeon will return to the San Joaquin River and inhabit the action area.

There is no designated sDPS Green Sturgeon critical habitat in the action area.

2.3.2. Factors Limiting Species Recovery

The best scientific information available demonstrates that a multitude of factors, past and present, have contributed to the decline of west coast salmonids. NMFS's status reviews, Technical Recovery Team publications, and recovery plans for the listed species considered in this biological opinion identify several factors that have caused them to decline, as well as those that prevent them from recovering (many of which are the same). These include habitat degradation caused by human development and harvest and hatchery practices. Climate change also represents a potentially significant threat to all listed species.

The action area encompasses a portion of the SJRRP Restoration Area, the San Joaquin River, and Butte Creek, which may be used by the CV spring-run Chinook salmon ESU, the CCV steelhead DPS, and the sDPS of North American green sturgeon. Many of the factors affecting these species throughout their range are discussed in the Status of the Species section of this biological opinion. FRFH is not included in this section because it is a hatchery.

SJRRP Restoration Area and the San Joaquin River: The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs affecting listed salmonids and sDPS green sturgeon in the action area. Instream flows during the summer and early fall months have increased over historical levels for deliveries of municipal and agricultural water supplies. Overall, water management now reduces natural variability by creating more uniform flows year-round. Current flood control practices upstream require peak flood discharges to be held back and released over a period of weeks to avoid overwhelming the flood-control structures downstream of the reservoirs (i.e. levees and bypasses). Consequently, managed flows in the mainstem of the river often truncate the peak of the flood hydrograph and extend the reservoir releases over a protracted period. These actions reduce or eliminate the scouring flows necessary to mobilize gravel and clean sediment from the spawning reaches of the river channel and disrupt natural sediment transfer in general.

High water temperatures also limit habitat availability for listed salmonids in the lower San Joaquin River. High summer water temperatures in the lower San Joaquin River can exceed 72° F and create a thermal barrier to the migration of adult and juvenile salmonids (Myers et al. 1998). In addition, water diversions at the dams (i.e., Friant, Goodwin, New Don Pedro, Tulloch, New Exchequer Dams and others) for agricultural and municipal purposes have reduced in-river flows downstream of the dams. These reduced flows frequently result in increased temperatures during the critical summer months which potentially limit the survival of juvenile salmonids (Reynolds et al. 1993) and holding habitat for CV spring-run Chinook salmon.

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 drain water, urban and agricultural runoff from storm events, and high trace element (i.e., heavy metals) concentrations may deleteriously affect early life-stage survival of fish in the San Joaquin River (USFWS 1995).

The transformation of the San Joaquin River from a meandering waterway lined with a dense riparian corridor, to a highly leveed system under varying degrees of control over riverine erosional processes resulted in homogenization of the river, including effects to the river's sinuosity. Flood-control structures reduce sinuosity, where the channel shifts away from being complex and ecologically-rich to a simpler, ecologically-impoverished, single-thread channel (Skidmore and Wheaton 2022). The adverse impacts of post-Anthropocene fluvial responses on sinuosity may help explain historical and ongoing declines in salmonid populations (Powers et al. 2022).

The NMFS recovery plan for salmonids (NMFS 2014) considers the San Joaquin River (Restoration Area), a primary reintroduction area for CV spring-run Chinook salmon, and reintroduction a top priority recovery action. These ongoing efforts are expected to contribute to the recovery of the species.

Butte Creek: The primary concerns reported in the 2016, 5-year status review (NMFS 2016b) continue to be water diversions resulting in low flows and warm water temperatures during adult migration, holding, spawning, and juvenile rearing, particularly in drier. Along with, uncertainty of continued operation of the DeSabla-Centerville Hydroelectric Project (P-803). Summer flows in Butte Creek are augmented by cold water storage from this hydroelectric project including an inter-basin diversion from the West Branch of the Feather River. This inter-basin transfer of cold water has created favorable conditions for CV spring-run Chinook salmon. Without this cold-water input, water temperatures and flows would likely be inadequate to support the Butte Creek CV spring-run Chinook salmon spawning population.

Increased frequency and severity of large, unprecedented wildfires. The 2018 Camp Fire caused significant habitat damage in the Butte Creek watershed that caused significant reduction and loss of riparian habitat, as well as increased landslides and sediment input to the waterways with the subsequent loss of spawning habitat affecting the Butte Creek populations (Maina and Siirila-Woodburnm 2020).

Delayed migration due to invasive aquatic plant species in the Sutter Bypass and Butte Sink. In recent years the amount of invasive aquatic plants have clogged migration pathways for both adults and juveniles. This problem is exacerbated by multiple years of drought.

Butte Slough Outfall Gates facility, located at the historical mouth of Butte Creek at the Sacramento River. In 2018, a fish kill occurred in the area and is likely associated with salmonids migrating through the facility, and 48 adult salmon carcasses were found by the downstream gates of the facility. Based on the genetic samples, the 48 fish are believed to be Butte Creek origin CV spring-run Chinook salmon. The facility was built in the 1930s for flood and irrigation purposes, and is now owned/operated by the California Department of Water Resources. Butte Creek was redirected to flow through the Sutter Bypass, where it now enters into the Sacramento River. Prior to 2018, it was not well documented that adults or juveniles were still actively using the facility as a migration corridor. Since 2018, some preliminary research from the SWFSC has shown that juvenile CV spring-run Chinook salmon still out-migrate through this facility (Cordoleani 2020). High prespawn mortality events due to issues with management of the cold-water pool used to supplement summer temps on Butte Creek. In 2021, a wildfire prevented management of flows and contributed to the loss of over 90% of the holding population (Johnson et al. 2023).

2.4. Effects on ESA Protected species and on Designated Critical Habitat

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).

The analyzed factors are explained further in Section 2.1.1.

2.4.1. Factors Considered When Analyzing Hatchery Effects

NMFS has extensive experience with hatchery programs and has developed and published a series of guidance documents for designing and evaluating hatchery programs following best available science. These documents are available upon request from the NMFS Salmon Management Division in Portland, Oregon. "Pacific Salmon and Artificial Propagation under the Endangered Species Act" (Hard et al. 1992) was published shortly following the first ESA listings of Pacific salmon on the West Coast and it includes information and guidance that is still relevant today. In 2000, NMFS published "Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units" (McElhany et al. 2000) and then followed that with a "Salmonid Hatchery Inventory and Effects Evaluation Report" for hatchery programs up and down the West Coast (NMFS 2004). In 2005, NMFS published a policy that provided greater clarification and further direction on how it analyzes hatchery effects and conducts extinction risk assessments (NMFS 2005). NMFS then updated its inventory and effects evaluation report for hatchery programs on the West Coast (Jones 2006) and followed that with "Artificial Propagation for Pacific Salmon: Assessing Benefits and Risks & Recommendations for Operating Hatchery Programs Consistent with Conservation and Sustainable Fisheries Mandates" (NMFS 2008a). More recently, NMFS published its biological analysis and final determination for the harvest of Puget Sound Chinook salmon which included discussion on the role and effects of hatchery programs (NMFS 2011).

A key factor in analyzing a hatchery program for its effects, positive and negative, on the status of salmon and steelhead are the genetic resources that reside in the program. Genetic resources that represent the ecological and genetic diversity of a species can reside in a hatchery program. "Hatchery programs with a level of genetic divergence relative to the local natural population(s) that is no more than what occurs within the ESU are considered part of the ESU and will be included in any listing of the ESU" (NMFS 2005). NMFS monitors hatchery practices for whether they promote the conservation of genetic resources included in an ESU or steelhead DPS and updates the status of genetic resources residing in hatchery programs every five years. Jones (2011) provides the most recent update of the relatedness of Pacific Northwest hatchery programs to 18 salmon ESUs and steelhead DPSs listed under the ESA. Generally speaking, hatchery programs that are reproductively connected or "integrated" with a natural population, if one still exists, and that promote natural selection over selection in the hatchery, contain genetic resources that represent the ecological and genetic diversity of a species and are included in an ESU or steelhead DPS.

When a hatchery program actively maintains distinctions or promotes differentiation between hatchery fish and fish from a native population, then NMFS refers to the program as "isolated". Generally speaking, isolated hatchery programs have a level of genetic divergence, relative to the local natural population(s), that is more than what occurs within the ESU and are not considered part of an ESU or steelhead DPS. They promote domestication or selection in the hatchery over selection in the wild and select for and culture a stock of fish with different phenotypes, for example different ocean migrations and spatial and temporal spawning distribution, compared to the native population (extant in the wild, in a hatchery, or both). For Pacific salmon, NMFS evaluates extinction processes and effects of the proposed action beginning at the population scale (McElhany et al. 2000). NMFS defines population performance measures in terms of natural-origin fish and four key parameters or attributes: abundance, productivity, spatial structure, and diversity and then relates effects of the proposed action at the population scale to the MPG level and ultimately to the survival and recovery of an entire ESU or DPS. "Because of the potential for circumventing the high rates of early mortality typically experienced in the wild, artificial propagation may be useful in the recovery of listed salmon species. However, artificial propagation entails risks as well as opportunities for salmon conservation" (Hard et al. 1992).

A proposed action is analyzed for effects, positive and negative, on the attributes that define population viability, including abundance, productivity, spatial structure, and diversity. The effects of a hatchery program on the status of an ESU or steelhead DPS "will depend on which of the four key attributes are currently limiting the ESU, and how the hatchery fish within the ESU affect each of the attributes" (70 FR 37215, June 28, 2005). The presence of hatchery fish within the ESU can positively affect the overall status of the ESU by increasing the number of natural spawners, by serving as a source population for repopulating unoccupied habitat and increasing spatial distribution, and by conserving genetic resources. "Conversely, a hatchery program managed without adequate consideration can affect a listing determination by reducing adaptive genetic diversity of the ESU, and by reducing the reproductive fitness and productivity of the ESU". NMFS also analyzes and takes into account the effects of hatchery facilities.

NMFS' analysis of the proposed action is in terms of effects it would be expected to have on ESA-listed species and on designated critical habitat, based on the best scientific information on the general type of effect of that aspect of hatchery operation in the context of the specific application in the San Joaquin River. This allows for quantification (wherever possible) of the various factors of hatchery operation to be applied to each applicable life-stage of the listed species at the population level, which in turn allows the combination of all such effects with other effects accruing to the species to determine the likelihood of posing jeopardy to the species as a whole (Section 2.7).

The effects, positive and negative, for two categories of hatchery programs are summarized in Table 6. In general, effects range from beneficial to negative for programs that use local fish[10] for hatchery broodstock and from negligible to negative when a program does not use local fish for broodstock[11]. Hatchery programs can benefit population viability but only if they use genetic resources that represent the ecological and genetic diversity of the target or affected natural population(s). When hatchery programs use genetic resources that do not represent the ecological and genetic diversity of the target or affected natural population(s), NMFS is interested in how effective the program will be at isolating hatchery fish and avoiding co-occurrence and effects that potentially disadvantage fish from natural populations. The range in effects for a specific hatchery program are refined and narrowed after available scientific

[10] The term "local fish" is defined to mean fish with a level of genetic divergence relative to the local natural population(s) that is no more than what occurs within the ESU or steelhead DPS (70 FR 37215, June 28, 2005).
[11] Exceptions include restoring extirpated populations and gene banks.

information and the circumstances and conditions that are unique to individual hatchery programs are accounted for.

Table 6. Overview of the range in effects on natural population viability parameters from two categories of hatchery programs. The range in effects are refined and narrowed after the circumstances and conditions that are unique to individual hatchery programs are accounted for.

Natural population viability parameter	Hatchery broodstock originate from the local population and are included in the ESU or DPS	Hatchery broodstock originate from a nonlocal population or from fish that are not included in the same ESU or DPS
Productivity	**Positive to negative effect** Hatcheries are unlikely to benefit productivity except in cases where the natural population's small size is, in itself, a predominant factor limiting population growth (*i.e.*, productivity) (NMFS 2004).	**Negligible to negative effect** This is dependent on differences between hatchery fish and the local natural population (*i.e.*, the more distant the origin of the hatchery fish the greater the threat), the duration and strength of selection in the hatchery, and the level of isolation achieved by the hatchery program (*i.e.*, the greater the isolation the closer to a negligible affect).
Diversity	**Positive to negative effect** Hatcheries can temporarily support natural populations that might otherwise be extirpated or suffer severe bottlenecks and have the potential to increase the effective size of small natural populations. Broodstock collection that homogenizes population structure is a threat to population diversity.	**Negligible to negative effect** This is dependent on the differences between hatchery fish and the local natural population (*i.e.*, the more distant the origin of the hatchery fish the greater the threat) and the level of isolation achieved by the hatchery program (*i.e.*, the greater the isolation the closer to a negligible affect).
Abundance	**Positive to negative effect** Hatchery-origin fish can positively affect the status of an ESU by contributing to the abundance and productivity of the natural populations in the ESU (70 FR 37204, June 28, 2005, at 37215).	**Negligible to negative effect** This is dependent on the level of isolation achieved by the hatchery program (*i.e.*, the greater the isolation the closer to a negligible affect), handling, RM&E and facility operation, maintenance and construction effects.
Spatial Structure	**Positive to negative effect** Hatcheries can accelerate re-colonization and increase population spatial structure, but only in conjunction with remediation of the factor(s) that limited spatial structure in the first place. "Any benefits to spatial structure over the long term depend on the degree to which the hatchery stock(s) add to (rather than replace) natural populations" (70 FR 37204, June 28, 2005 at 37215).	**Negligible to negative effect** This is dependent on facility operation, maintenance, and construction effects and the level of isolation achieved by the hatchery program (*i.e.*, the greater the isolation the closer to a negligible affect).

Information that NMFS needs to analyze the effects of a hatchery program on ESA-listed species must be included in an HGMP. Draft HGMPs are reviewed by NMFS for their sufficiency before formal review and analysis of the proposed action can begin.

Analysis of an HGMP or proposed action for its effects on ESA-listed species and on designated critical habitat depends on seven factors. These factors are:

1. the hatchery program does or does not promote the conservation of genetic resources that represent the ecological and genetic diversity of a salmon ESU or steelhead DPS,
2. hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities,
3. hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas,
4. hatchery fish and the progeny of naturally spawning hatchery fish in the migration corridor, estuary, and ocean,
5. RM&E that exists because of the hatchery program,
6. the operation, maintenance, and construction of hatchery facilities that exist because of the hatchery program, and
7. fisheries that exist because of the hatchery program, including terminal fisheries intended to reduce the escapement of hatchery-origin fish to spawning grounds.

The analysis assigns an effect for each factor from the following categories. The categories are:

1. positive or beneficial effect on population viability,
2. negligible effect on population viability, and
3. negative effect on population viability.

"The effects of hatchery fish on the status of an ESU will depend on which of the four key attributes are currently limiting the ESU, and how the hatchery within the ESU affect each of the attributes" (NMFS 2005). The category of affect assigned is based on an analysis of each factor weighed against the affected population(s) current risk level for abundance, productivity, spatial structure and diversity, the role or importance of the affected natural population(s) in ESU or steelhead DPS recovery, the target viability for the affected natural population(s), and the Environmental Baseline including the factors currently limiting population viability.

2.4.1.1 Factor 1. The hatchery program does or does not promote the conservation of genetic resources that represent the ecological and genetic diversity of a salmon ESU or steelhead DPS

This factor considers broodstock practices and whether they promote the conservation of genetic resources that represent the ecological and genetic diversity of a salmon ESU or steelhead DPS.

A primary consideration in analyzing and assigning effects for broodstock collection is the origin and number of fish collected. The analysis considers whether broodstock are of local origin and the biological pros and the biological cons of using ESA-listed fish (natural or hatchery-origin) for hatchery broodstock. It considers the maximum number of fish proposed for collection and the proportion of the donor population tapped to provide hatchery broodstock. "Mining" a natural population to supply hatchery broodstock can reduce population abundance and spatial structure. Also considered here is whether the program "backfills" with fish from outside the local or immediate area.

Many of the broodstock collection activities will be conducted opportunistically through coordination and collaboration with existing hatchery programs and research projects. Given that CV spring-run Chinook salmon are the primary target of these activities, encounters with non-target ESA-listed species are likely to be minimal. Non-listed CV fall-run Chinook salmon may be encountered during the proposed broodstock collection activities, however the timing and location of collections and the genetic sampling of collected individuals will help to minimize these encounters. Therefore, fall-run will not be crossed with CV spring-run Chinook salmon and CV spring-run Chinook salmon genetics will be preserved and hybrids will not be produced.

Feather River Fish Hatchery: The SJRRP staff will assist with the spawning activities at FRFH to track each cross made, ensuring that egg collections for the SJRRP are from crossed parents exhibiting the CV spring-run Chinook salmon phenotype. Ovarian fluid samples will be collected from adult females to determine the presence of pathogens. Once preferred crosses of eggs are determined, SJRRP staff will segregate the permitted number of eggs for transport to a quarantine facility for pathology studies. Eggs are preferred for collection because of the ability to target genetically diverse individuals and collect temporal diversity, while maintaining low risk to the donor population. Furthermore, collection at this life stage provides greater survival to adulthood in a controlled environment when compared to rearing in the wild, thereby reducing population level impacts. Eggs also provide the least amount of risk associated with disease transfer due to their ability to withstand disinfection and many pathogens are not vertically transmitted from parent to ova.

As previously mentioned, broodstock collection activities at the FRFH for the SJRRP are conducted opportunistically during routine hatchery operations. Only fish tagged during the springtime (exhibiting the spring-run phenotype) will be used as broodstock, reducing the likelihood that CV fall-run Chinook salmon are used as broodstock, but juveniles will also be genetically tested before being incorporated into broodstock.

Butte Creek: Juvenile collections on Butte Creek will use existing juvenile monitoring activities (permitted annually by the ESA Section 4d process, 2024 permit # 27549) to minimize potential disturbance to the population. These monitoring activities include the RST and side diversion trap at the Parrot-Phelan diversion near the City of Chico, Butte County, California. Collections on Butte Creek will occur throughout the outmigration period in order to capture the genetic diversity for the source population in the broodstock. A small number of various sized juveniles would be randomly selected to prevent collecting siblings. Juveniles would be held in tanks or cages near the collection site until the target number of individuals, for a collection event, is collected. After collection, broodstock would be transferred and held for quarantine and fish health assessment prior to being transported to the Conservation Facilities.

In some cases, capture locations may result in the capture of both CV fall- and spring-run Chinook salmon. However, CV fall-run Chinook salmon are not listed under the ESA and encounters with other ESA-listed salmonids during broodstock collections in Butte Creek are not anticipated. If, after initial collections, it becomes evident that size selection would be useful to eliminate CV fall-run Chinook salmon individuals from the sample, then that may be used. In these scenarios, larger yearling CV spring-run Chinook salmon may be targeted, as they are most readily distinguished from fall-run Chinook salmon. Collected fish will be genetically tested and PIT tagged to verify CV spring-run Chinook salmon origin sometime after they reach a minimum fork length of 65 millimeters and may not occur until after juveniles are transferred to the Conservation Facilities.

San Joaquin River: Lack of river connectivity for volitional outmigration of juveniles and migration of returning adults is a significant impairment to the establishment of a self-sustaining population. These connectivity constraints will remain in place until the long delayed SJRRP channel and passage improvement are complete. As more significant numbers of naturalized fish return to the system, they will continue to encounter the passage impediment until connectivity is re-established. To address these impacts, the Conservation Program will implement the reintroduction actions with the intent of minimizing the effects from the lack of volitional passage. The reintroductions are likely to benefit the naturalized CV spring-run Chinook salmon elsewhere in the San Joaquin River watershed by bolstering their numbers and their genetic diversity. When the naturalized populations are re- established the Conservation Facilities operations will likely be discontinued.

The reintroduced fish are likely to interact with other listed salmonid populations, including endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), CV spring-run Chinook salmon from other runs in the ESU, and threatened CCV steelhead, while outmigrating or rearing in the Delta, the San Francisco Estuary and Pacific Ocean. The reintroduced fish may negatively impact other salmonids through a variety of interactions, most notably induced behavioral changes in wild fish, competition for limited resources, depensatory predation, and disease transfers in areas where they co-occur (Reisenbichler *et al.* 2004). While in freshwater, juvenile Chinook salmon feed predominantly on aquatic insects and other invertebrates and are unlikely to be significant predators on other salmonids (Unger 2004, Rundio and Lindley 2007).

Various Other Sources: Collections from other sources will be opportunistic. Other methods of broodstock collection will not be utilized if there is risk to other ESA listed anadromous fish populations. Methods of collection will not differ from what is already described but will need to be optimized for the specific location conditions.

Adult Trap and Haul: If volitional adult passage is not possible due to conditions that prevent volitional passage, adult trapping and collections will occur in reaches downstream of the first passage barrier and fish will be transported to suitable habitat upstream of identified passage barriers. Fyke traps/nets, or weirs will be deployed in multiple locations in the Restoration Area, connected sloughs, or at fish passage facilities, dip nets, and hand seines will be used to capture adults that stray into smaller irrigation canals. Genetic tissue sampling from live fish will occur at downstream trapping locations prior to transport into the upper reaches. These fish will be externally tagged prior to release to assess spawning success. Acoustic tags and/or PIT tags may also be used for tracking purposes. Further, these tags can be used after genetic evaluation to track spawning adults.

A fyke net has the potential to cause a fish to lose scale and dermal mucus from contact with the net, wing walls, or capture net. Also, fish can become over crowded if traps are not cleared often enough. The permit conditions stipulate measures that will mitigate or avoid such factors that commonly lead to stress and trauma from handling, and thus minimize the harmful effects of capturing and handling fish.

2.4.1.2 Factor 2. Hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities

NMFS also analyzes the effects of hatchery fish and the progeny of naturally spawning hatchery fish on the spawning grounds. There are two aspects to this part of the analysis: genetic effects and ecological effects. NMFS generally views genetic effects as detrimental because at this time, based on the weight of available scientific information, we believe artificial breeding and rearing is likely to result in some degree of genetic change and fitness reduction in hatchery fish and in the progeny of naturally spawning hatchery fish relative to desired levels of diversity and productivity for natural populations. Hatchery fish thus pose a threat to natural population rebuilding and recovery when they interbreed with fish from natural populations.

However, NMFS recognizes that there are benefits as well, and that the risks just mentioned may be outweighed under circumstances where demographic or short-term extinction risk to the population is greater than risks to population diversity and productivity. Conservation hatchery programs may accelerate recovery of a target population by increasing abundance faster than may occur naturally (Waples 1999). Hatchery programs can also be used to create genetic reserves for a population to prevent the loss of its unique traits due to catastrophes (Ford 2011). Furthermore, NMFS also recognizes there is considerable uncertainty regarding genetic risk. The extent and duration of genetic change and fitness loss and the short and long-term implications and consequences for different species, for species with multiple life-history types, and for species subjected to different hatchery practices and protocols remains unclear and will be the subject of further scientific investigation. As a result, NMFS believes that hatchery intervention is a legitimate and useful tool to alleviate short-term extinction risk, but otherwise managers will seek to limit interactions between hatchery and natural-origin fish and implement hatchery practices that harmonize conservation with the implementation of treaty Indian fishing rights and other applicable laws and policies (NMFS 2011).

Hatchery fish can have a variety of genetic effects on natural population productivity and diversity when they interbreed with natural-origin fish. Although there is biological interdependence between them, NMFS considers three major areas of genetic effects of hatchery programs: within-population diversity, outbreeding effects, and hatchery-induced selection. As we have stated above, in most cases, the effects are viewed as risks, but in small populations these effects can sometimes be beneficial, reducing extinction risk.

Within-population genetic diversity is a general term for the quantity, variety and combinations of genetic material in a population (Busack and Currens 1995). Within-population diversity is gained through mutations or gene flow from other populations (described below under outbreeding effects) and is lost primarily due to genetic drift, a random loss of diversity due to population size. The rate of loss is determined by the population's effective population size (N_e), which can be considerably smaller than its census size. For a population to maintain genetic diversity reasonably well, the effective size is likely to be in the hundreds (*e.g.*, Lande and Barrowclough 1987), and diversity loss can be severe if N_e drops to a few dozen.

Hatchery programs, simply by virtue of creating more fish, can increase N_e. In very small populations this can be a benefit, making selection more effective and reducing other small population risks (e.g., Lacy 1987, Whitlock 2000, Willi *et al.* 2006). Conservation hatchery programs can thus serve to protect genetic diversity; several, such as the Snake River sockeye salmon program are important genetic reserves. However, hatchery programs can also directly depress N_e by two principal methods. One is by the simple removal of fish from the population so that they can be used in the hatchery. If a substantial portion of the population is taken into hatchery, the hatchery becomes responsible for that portion of the effective size, and if the operation fails, the effective size of the population will be reduced (Waples and Do 1994). N_e can also be reduced considerably below the census number of broodstock by using a skewed sex ratio, spawning males multiple times (Busack 2007), and by pooling gametes. Pooling semen is especially problematic because when semen of several males is mixed and applied to eggs, a large portion of the eggs may be fertilized by a single male (Gharrett and Shirley 1985, Withler 1988). Factorial mating schemes, in which fish are systematically mated multiple times, can be used to increase N_e (Fiumera *et al.* 2004, Busack and Knudsen 2007). An extreme form of N_e reduction is the Ryman-Laikre effect (Ryman and Laikre 1991, Ryman *et al.* 1995), when N_e is reduced through the return to the spawning grounds of large numbers of hatchery fish from very few parents.

Inbreeding depression, another N_e-related phenomenon, is caused by the mating of closely related individuals (e.g., sibs, half-sibs, cousins). The smaller the population, the more likely spawners will be related. Related individuals are likely to contain similar genetic material, and the resulting offspring may then have reduced survival because they are less variable genetically or have double doses of deleterious mutations. The lowered fitness of fish due to inbreeding depression accentuates the genetic risk problem, helping to push a small population toward extinction.

Outbreeding effects are caused by gene flow from other populations. Gene flow occurs naturally among salmon and steelhead populations, a process referred to as straying (Quinn 1993, 1997). Natural straying serves a valuable function in preserving diversity that would otherwise be lost through genetic drift and in re-colonizing vacant habitat, and straying is considered a risk only when it occurs at unnatural levels or from unnatural sources. Hatchery programs can result in straying outside natural patterns for two reasons. First, hatchery fish may exhibit reduced homing fidelity relative to natural-origin fish (Grant 1997, Quinn 1997, Jonsson et al. 2003, Goodman 2005), resulting in unnatural levels of gene flow into recipient populations, either in terms of sources or rates. Second, even if hatchery fish home at the same level of fidelity as natural origin fish, their higher abundance can cause unnatural straying levels into recipient populations. One goal for hatchery programs is to ensure that hatchery practices do not lead to higher rates of genetic exchange with fish from natural populations than would occur naturally (Ryman 1991). Rearing and release practices and ancestral origin of the hatchery fish can all play a role in straying (Quinn 1997).

Gene flow from other populations can have two effects. Gene flow can increase genetic diversity (e.g., Ayllon et al. 2006) which can be a benefit in small populations, but it can also alter established allele frequencies and co-adapted gene complexes, and reduce the population's level of adaptation, a phenomenon called outbreeding depression (Edmands 2007, McClelland and Naish 2007). In general, the greater the geographic separation between the source or origin of hatchery fish and the recipient natural population, the greater the genetic difference between the two populations (ICTRT 2007), and the greater potential for outbreeding depression. For this reason, NMFS advises hatchery action agencies to develop locally derived hatchery broodstocks. Additionally, unusual rates of straying into other populations within or beyond the population's MPG or ESU or a steelhead DPS can have a homogenizing effect, decreasing intra-population genetic variability (e.g., Vasemagi et al. 2005), and increasing risk to population diversity, one of the four attributes measured to determine population viability. Reduction of within-population and among-population diversity can reduce adaptive potential.

The proportion of hatchery fish among natural spawners is often used as a surrogate measure of gene flow. Appropriate cautions and qualifications will be considered when using this proportion to analyze hatchery affects. Adult salmon may wander on their return migration, entering and then leaving tributary streams before finally spawning (Pastor 2004). These "dip-in" fish may be detected and counted as strays, but may eventually spawn in other areas, resulting in an overestimate of the number of strays that potentially interbreed with the natural population (Keefer et al. 2008). Caution must also be taken in assuming that strays contribute genetically in proportion to their abundance. Several studies demonstrate little genetic impact from straying despite a considerable presence of strays in the spawning population (Saisa et al. 2003, Blankenship et al. 2007). The causative factors for poorer breeding success of strays are likely similar to those identified as responsible for reduced productivity of hatchery-origin fish in general, e.g., differences in run and spawn timing, spawning in less productive habitats, and reduced survival of their progeny (Reisenbichler and McIntyre 1977, Leider et al. 1990, McLean et al. 2004, Williamson et al. 2010).

Hatchery-induced selection (often called domestication) occurs when selection pressures imposed by hatchery spawning and rearing differ greatly from those imposed by the natural environment and causes genetic change that is passed on to natural populations through interbreeding with hatchery-origin fish, typically from the same population. These differing selection pressures can be a result of differences in environments or a consequence of protocols and practices used by a hatchery program. Hatchery selection can range from relaxation of selection, that would normally occur in nature, to selection for different characteristics in the hatchery and natural environments, to intentional selection for desired characteristics (Waples 1999).

Genetic change and fitness reduction resulting from hatchery-induced selection depends on: (1) the difference in selection pressures; (2) the exposure or amount of time the fish spends in the hatchery environment; and, (3) the duration of hatchery program operation (i.e., the number of generations that fish are propagated by the program). On an individual level, exposure time in large part equates to fish culture, both the environment experienced by the fish in the hatchery and natural selection pressures, independent of the hatchery environment. On a population basis, exposure is determined by the proportion of natural-origin fish being used as hatchery broodstock, the proportion of hatchery-origin fish spawning in the wild (Lynch and O'Hely 2001, Ford 2002), and the number of years the exposure takes place. In assessing risk or determining impact, all three levels must be considered. Strong selective fish culture with low hatchery-wild interbreeding can pose less risk than relatively weaker selective fish culture with high levels of interbreeding.

Most of the empirical evidence of fitness depression due to hatchery-induced selection comes from studies of species that are reared in the hatchery environment for an extended period – one to two years – prior to release (Berejikian and Ford 2004). Exposure time in the hatchery for fall and summer Chinook salmon and Chum salmon is much shorter, just a few months. One especially well-publicized steelhead study (Araki et al. 2007, Araki et al. 2008), showed dramatic fitness declines in the progeny of naturally spawning hatchery steelhead. Researchers and managers alike have wondered if these results could be considered a potential outcome applicable to all salmonid species, life-history types, and hatchery rearing strategies. Critical information for analysis of hatchery-induced selection includes the number, location and timing of naturally spawning hatchery fish, the estimated level of interbreeding between hatchery-origin and natural-origin fish, the origin of the hatchery stock (the more distant the origin compared to the affected natural population, the greater the threat), the level and intensity of hatchery selection and the number of years the operation has been run in this way. Ecological effects for this factor (i.e., hatchery fish and the progeny of naturally spawning hatchery fish on the spawning grounds) refer effects from competition for spawning sites and redd superimposition, contributions to marine derived nutrients, and the removal of fine sediments from spawning gravels. Ecological effects on the spawning grounds may be positive or negative. To the extent that hatcheries contribute added fish to the ecosystem, there can be positive effects. For example, when anadromous salmonids return to spawn, hatchery-origin and natural-origin alike, they transport marine-derived nutrients stored in their bodies to freshwater and terrestrial ecosystems. Their carcasses provide a direct food source for juvenile salmonids and other fish, aquatic invertebrates, and terrestrial animals, and their decomposition supplies nutrients that may increase primary and secondary production (Kline et al. 1990, Piorkowski 1995, Larkin and Slaney 1996, Gresh et al. 2000, Murota 2003, Quamme and Slaney 2003, Wipfli et al. 2003). As a result, the growth and survival of juvenile salmonids may increase (Hager and Noble 1976, Bilton et al. 1982, Holtby 1988, Ward and Slaney 1988, Hartman and Scrivener 1990, Johnston et al. 1990, Larkin and Slaney 1996, Quinn and Peterson 1996, Bradford et al. 2000, Bell 2001, Brakensiek 2002).

Additionally, studies have demonstrated that perturbation of spawning gravels by spawning salmonids loosens cemented (compacted) gravel areas used by spawning salmon (e.g., Montgomery et al. 1996). The act of spawning also coarsens gravel in spawning reaches, removing fine material that blocks interstitial gravel flow and reduces the survival of incubating eggs in egg pockets of redds.

The added spawner density resulting from hatchery-origin fish spawning in the wild can have negative consequences in that to the extent there is spatial overlap between hatchery and natural spawners, the potential exists for hatchery-derived fish to superimpose or destroy the eggs and embryos of ESA listed species. Redd superimposition has been shown to be a cause of egg loss in pink salmon and other species (e.g., Fukushima et al. 1998).

The analysis also considers the effects from encounters with natural-origin that are incidental to the conduct of broodstock collection. NMFS analyzes effects from sorting, holding, and handling natural-origin fish in the course of broodstock collection. Some programs collect their broodstock from fish volunteering into the hatchery itself, typically into a ladder and holding pond, while others sort through the run at large, usually at a weir, ladder, or sampling facility. Generally speaking, the more a hatchery program accesses the run at large for hatchery broodstock, e.g. the more fish that are handled or delayed during migration, the greater the negative effect on natural-origin and hatchery-origin fish that are intended to spawn naturally and to ESA-listed species. The information NMFS uses for this analysis includes a description of the facilities, practices, and protocols for collecting broodstock, the environmental conditions under which broodstock collection is conducted, and the encounter rate for ESA-listed fish.

NMFS also analyzes the effects of structures, either temporary or permanent, used to collect hatchery broodstock. Analysis includes effects on fish, juveniles and adults, from encounters with these structures and effects on habitat conditions that support and promote viable salmonid populations.Factor 3. Hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas

2.4.1.3 Factor 3. Hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas

NMFS analyzes the potential for competition, predation, and premature emigration when the progeny of naturally spawning hatchery fish and hatchery releases share juvenile rearing areas. Generally speaking, competition and a corresponding reduction in productivity and survival may result from direct interactions when hatchery-origin fish interfere with the accessibility to limited resources by natural-origin fish or through indirect means, when the utilization of a limited resource by hatchery fish reduces the amount available for fish from the natural population (SIWG 1984). Naturally produced fish may be competitively displaced by hatchery fish early in life, especially when hatchery fish are more numerous, are of equal or greater size, when hatchery fish take up residency before naturally produced fry emerge from redds, and if hatchery fish residualize. Hatchery fish might alter naturally produced salmon behavioral patterns and habitat use, making them more susceptible to predators (Hillman and Mullan 1989, Steward and Bjornn 1990). Hatchery-origin fish may also alter naturally produced salmonid migratory responses or movement patterns, leading to a decrease in foraging success (Hillman and Mullan 1989, Steward and Bjornn 1990). Actual impacts on naturally produced fish would thus depend on the degree of dietary overlap, food availability, size-related differences in prey selection, foraging tactics, and differences in microhabitat use (Steward and Bjornn 1990).

Competition may result from direct interactions, or through indirect means, as when utilization of a limited resource by hatchery fish reduces the amount available for naturally produced fish (SIWG 1984). Specific hazards associated with competitive impacts of hatchery salmonids on listed naturally produced salmonids may include competition for food and rearing sites (NMFS 2012). In an assessment of the potential ecological impacts of hatchery fish production on naturally produced salmonids, the Species Interaction Work Group (SIWG 1984) concluded that naturally produced coho and Chinook salmon and steelhead are all potentially at "high risk" due to competition (both interspecific and intraspecific) from hatchery fish of any of these three species. In contrast, the risk to naturally produced pink, chum, and sockeye salmon due to competition from hatchery salmon and steelhead was judged to be low.

Several factors influence the risk of competition posed by hatchery releases: whether competition is intra- or interspecific; the duration of freshwater co-occurrence of hatchery and natural-origin fish; relative body sizes of the two groups; prior residence of shared habitat; environmentally induced developmental differences; and, density in shared habitat (Tatara and Berejikian 2012). Intraspecific competition would be expected to be greater than interspecific, and competition would be expected to increase with prolonged freshwater co-occurrence. Although newly released hatchery smolts are commonly larger than natural-origin fish, and larger fish usually are superior competitors, natural-origin fish have the competitive advantage of prior residence when defending territories and resources in shared natural freshwater habitat. Tatara and Berejikian (2012) further reported that hatchery-induced developmental differences from co-occurring natural-origin fish life stages are variable and can favor both hatchery- and natural-origin fish. They concluded that of all factors, fish density of the composite population in relation to habitat carrying capacity likely exerts the greatest influence.

En masse hatchery salmon smolt releases may cause displacement of rearing naturally produced juvenile salmonids from occupied stream areas, leading to abandonment of advantageous feeding stations, or premature out-migration (Pearsons et al. 1994). Pearsons et al. (1994) reported small-scale displacement of juvenile naturally produced rainbow trout from stream sections by hatchery steelhead. Small-scale displacements and agonistic interactions observed between hatchery steelhead and naturally produced juvenile trout were most likely a result of size differences and not something inherently different about hatchery fish.

A proportion of the smolts released from a hatchery may not migrate to the ocean but rather reside for a period of time in the vicinity of the release point. These non-migratory smolts (residuals) may directly compete for food and space with natural-origin juvenile salmonids of similar age. They also may prey on younger, smaller-sized juvenile salmonids. Although this behavior has been studied and observed, most frequently in the case of hatchery steelhead, residualism has been reported as a potential issue for hatchery coho salmon (*Oncorhynchus kisutch*) and Chinook salmon as well. Adverse impacts from residual Chinook salmon and coho hatchery salmon on naturally produced salmonids is definitely a consideration, especially given that the number of smolts per release is generally higher, however the issue of residualism for these species has not been as widely investigated compared to steelhead. Therefore, for all species, monitoring of natural stream areas in the vicinity of hatchery release points may be necessary to determine the significance or potential effects of hatchery smolt residualism on natural-origin juvenile salmonids. The risk of adverse competitive interactions between hatchery-origin and natural-origin fish will be minimized by:

- Releasing hatchery smolts that are physiologically ready to migrate. Hatchery fish released as smolts emigrate seaward soon after liberation, minimizing the potential for competition with juvenile naturally produced fish in freshwater (Steward and Bjornn 1990, California HSRG 2012).

- Operating hatcheries such that hatchery fish are reared to sufficient size that smoltification occurs in nearly the entire population.
- Releasing hatchery smolts in lower river areas, below areas used for stream-rearing naturally produced juveniles.
- Monitoring the incidence of non-migratory smolts (residuals) after release and adjusting rearing strategies, release location and timing if substantial competition with naturally rearing juveniles is determined likely.

Critical to analyzing competition risk is information on the quality and quantity of spawning and rearing habitat in the action area[12], including the distribution of spawning and rearing habitat by quality and best estimates for spawning and rearing habitat capacity. Additional important information includes the abundance, distribution, and timing for naturally spawning hatchery fish and natural-origin fish; the timing of emergence; the distribution and estimated abundance for progeny from both hatchery and natural-origin natural spawners; the abundance, size, distribution, and timing for juvenile hatchery fish in the action area; and the size of hatchery fish relative to co-occurring natural-origin fish.

Another potential ecological effect of hatchery releases is predation. Salmon and steelhead are piscivorous and can prey on other salmon and steelhead. Predation, either direct (direct consumption) or indirect (increases in predation by other predator species due to enhanced attraction), can result from hatchery fish released into the wild. Considered here is predation by hatchery-origin fish and by the progeny of naturally spawning hatchery fish and by avian and other predators attracted to the area by an abundance of hatchery fish. Hatchery fish originating from egg boxes and fish planted as non-migrant fry or fingerlings can prey upon fish from the local natural population during juvenile rearing. Hatchery fish released at a later stage, so they are more likely to emigrate quickly to the ocean, can prey on fry and fingerlings that are encountered during the downstream migration. Some of these hatchery fish do not emigrate and instead take up residence in the stream (residuals) where they can prey on stream-rearing juveniles over a more prolonged period. The progeny of naturally spawning hatchery fish also can prey on fish from a natural population and pose a threat. In general, the threat from predation is greatest when natural populations of salmon and steelhead are at low abundance and when spatial structure is already reduced, when habitat, particularly refuge habitat, is limited, and when environmental conditions favor high visibility.

SIWG (1984) rated most risks associated with predation as unknown, because there was relatively little documentation in the literature of predation interactions in either freshwater or marine areas. More studies are now available, but they are still too sparse to allow many generalizations to be made about risk. Newly released hatchery-origin yearling salmon and steelhead may prey on juvenile fall Chinook and steelhead, and other juvenile salmon in the freshwater and marine environments (Hargreaves and LeBrasseur 1986, Hawkins and Tipping 1999, Pearsons and Fritts 1999). Low predation rates have been reported for released steelhead juveniles (Hawkins and Tipping 1999, Naman and Sharpe 2012). Hatchery steelhead timing and release protocols used widely in the Pacific Northwest were shown to be associated with

[12] Action area" means all areas to be affected directly or indirectly by the action in which the effects of the action can be meaningfully detected and evaluated.

negligible predation by migrating hatchery steelhead on fall Chinook fry, which had already emigrated or had grown large enough to reduce or eliminate their susceptibility to predation when hatchery steelhead entered the rivers (Sharpe et al. 2008). Hawkins (1998) documented hatchery CV spring-run Chinook salmon yearling predation on naturally produced fall Chinook salmon juveniles in the Lewis River. Predation on smaller Chinook salmon was found to be much higher in naturally produced smolts (coho salmon and cutthroat, predominately) than their hatchery counterparts.

Predation may be greatest when large numbers of hatchery smolts encounter newly emerged fry or fingerlings, or when hatchery fish are large relative to naturally produced fish (SIWG 1984). Due to their location in the stream or river, size, and time of emergence, newly emerged salmonid fry are likely to be the most vulnerable to predation. Their vulnerability is believed to be greatest immediately upon emergence from the gravel and then their vulnerability decreases as they move into shallow, shoreline areas (USFWS 1994). Emigration out of important rearing areas and foraging inefficiency of newly released hatchery smolts may reduce the degree of predation on salmonid fry (USFWS 1994).

Some reports suggest that hatchery fish can prey on fish that are up to 1/2 their length (Pearsons and Fritts 1999, HSRG 2004) but other studies have concluded that salmonid predators prey on fish 1/3 or less their length (Horner 1978, Hillman and Mullan 1989, Beauchamp 1990, Cannamela 1992, CBFWA 1996). Hatchery fish may also be less efficient predators as compared to their natural-origin conspecifics, reducing the potential for predation impacts (Sosiak et al. 1979, Bachman 1984, Olla et al. 1998).
The hatchery program will implement the following steps to reduce or avoid the threat of predation:

- Releasing all hatchery fish as actively migrating smolts through volitional release practices so that the fish migrate quickly seaward, limiting the duration of interaction with any co-occurring natural-origin fish downstream of the release site.
- Ensuring that a high proportion of the population have physiologically achieved full smolt status. Juvenile salmon tend to migrate seaward rapidly when fully smolted, limiting the duration of interaction between hatchery fish and naturally produced fish present within, and downstream of, release areas.
- Releasing hatchery smolts in lower river areas near river mouths and below upstream areas used for stream-rearing young-of-the-year naturally produced salmon fry, thereby reducing the likelihood for interaction between the hatchery and naturally produced fish.
- Operating hatchery programs and releases to minimize the potential for residualism.

2.4.1.4 Factor 4. Hatchery fish and the progeny of naturally spawning hatchery fish in the migration corridor, in the estuary, and in the ocean

Based on a review of the scientific literature, NMFS' conclusion is that the influence of density dependent interactions on the growth and survival of salmon and steelhead is likely small compared with the effects of large-scale and regional environmental conditions and, while there is evidence that large-scale hatchery production can effect salmon survival at sea, the degree of effect or level of influence is not yet well understood or predictable. The same thing is true for mainstem rivers and estuaries. NMFS will watch for new research to discern and to measure the frequency, the intensity, and the resulting effect of density-dependent interactions between hatchery and natural-origin fish. In the meantime, NMFS will monitor emerging science and information and will consider that re-initiation of an ESA section 7 consultation is required in the event that new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation (50 CFR 402.16).

2.4.1.5 Factor 5. Research, monitoring, and evaluation that exists because of the hatchery program

NMFS analyzes proposed RM&E for its effects on listed species and on designated critical habitat. In general, negative effects to the fish from RM&E are weighed against the value or benefit of new information, particularly information that tests key assumptions and that reduces critical uncertainties. RM&E actions including but not limited to collection and handling (purposeful or inadvertent), holding the fish in captivity, sampling (e.g., the removal of scales and tissues), tagging and fin-clipping, and observation (in-water or from the bank) can cause harmful changes in behavior and reduced survival. These effects are not to be confused with handling effects analyzed under broodstock collection. NMFS also considers the overall effectiveness of the RM&E program. There are five factors that NMFS takes into account when it assesses the beneficial and negative effects of hatchery RM&E: (1) the status of the affected species and effects of the proposed RM&E on the species and on designated critical habitat, (2) critical uncertainties over effects of the proposed action on the species, (3) performance monitoring and determining the effectiveness of the hatchery program at achieving its goals and objectives, (4) identifying and quantifying collateral effects, and (5) tracking compliance of the hatchery program with the terms and conditions for implementing the program. After assessing the proposed hatchery RM&E and before it makes any recommendations to the action agencies, NMFS considers the benefit or usefulness of new or additional information, whether the desired information is available from another source, the effects on ESA-listed species, and cost.

Hatchery actions also must be assessed for masking effects. Masking occurs when hatchery fish included in the proposed action mix with and are not identifiable from other fish. The effect of masking is that it undermines and confuses RM&E and status and trends monitoring. Both adult and juvenile hatchery fish can have masking effects. When presented with a proposed hatchery action, NMFS analyzes the nature and level of uncertainties caused by masking and whether and to what extent listed salmon and steelhead are at increased risk. The analysis takes into account the role of the affected salmon and steelhead population(s) in recovery and whether unidentifiable hatchery fish compromise important RM&E.

The primary effect of the proposed RM&E activities on ESA-listed species would be in the form of capturing and handling the fish. While the proposed activity would provide a net-benefit by transporting the fish to areas that have access to more suitable habitat, and by providing valuable monitoring and research data, capturing, handling, and releasing fish generally leads to stress and other sub-lethal effects, but the fish do sometimes die from such processes. The following subsections describe the types of RM&E activities being proposed. The activities would be carried out by trained professionals using established protocols. The effects of the activities have been well documented and are discussed in detail below.

Observing/Harassing: For some parts of the proposed studies, listed fish would be observed in water (e.g., by visual underwater surveys for monitoring). Direct observation is the least disruptive method for determining a species' presence/absence and estimating their relative numbers. Its effects are also generally the shortest-lived and least harmful of the research activities discussed because a cautious observer can effectively obtain data while only slightly disrupting the fishes' behavior. Harassment is the primary form of take associated with these observation activities, and few if any injuries (and no deaths) are expected to occur particularly in cases where the researchers observe from the streambanks or by swimming in the water with snorkel and mask. Because these effects are small, there is little a researcher can do to mitigate them except to avoid disturbing sediments, gravels, and, to the extent possible, the fish themselves, and allow any disturbed fish the time they need to reach cover.

Capturing/Handling: Any physical handling can be stressful to fish (Sharpe et al. 1998). The primary contributing factors to stress and death from handling are excessive doses of anesthetic, differences in water temperature between the location of capture and wherever the fish are held, unsuitable DO conditions, the amount of time that fish are held out of the water, and physical trauma. Stress on salmonids increases rapidly from handling if the water temperature exceeds 18º C or DO is below saturation. Fish transferred to holding tanks can experience trauma if care is not taken in the transfer process. The fish can experience stress and injury from overcrowding in traps if the traps are not emptied regularly. Debris buildup at traps can also kill or injure fish if the traps are not cleared regularly (Sharpe et al. 1998). Upon issuance, the section 10(a)(1)(A) permit conditions will stipulate measures that will mitigate or avoid such factors that commonly lead to stress and trauma from handling, and thus minimize the harmful effects of capturing and handling fish. These measures will reflect the best practices the SJRRP biologists have refined during adult trap and haul efforts since 2019[13] and will be designed to maximize survival during transport while allowing for fish to be captured for transport. Without capture and transport these fish would not have access to spawning habitat therefor the temperatures allowed for permissible handing will be higher than in other areas. When these measures are followed, fish typically recover fairly rapidly from handling, though a small proportion may be injured or killed.

Weirs: Weirs have long been used to capture migrating fish in flowing waters. Floating weirs create a temporary barrier in a channel and direct migrating fish through a single opening where they can be enumerated. Capture of adult salmonids by weirs is common practice in order to collect information regarding; (1) the number of adult salmon and steelhead entering a watershed; (2) the run timing of adult salmon and steelhead in a watershed; (3) the age, sex and length composition of the salmon that have achieved escapement into a watershed; and (4) the genetic composition of fish passing through the weir (i.e., hatchery versus natural). Such information pertaining to the run size, timing, age, sex and genetic composition of salmon and steelhead returning to the respective watershed can provide managers valuable information to refine existing management strategies.

A resistance board weir consists primarily of an array of rectangular panels made of evenly spaced pickets aligned parallel to the direction of flow. The upstream end of each panel is hinged to a rail that is anchored to the substrate and the downstream end of the panel is lifted above the surface by a resistance board that planes upward in flowing water. When all components are

[13] Adult trap and haul reports can be found at https://www.restoresjr.net/

installed, the resulting barrier inhibits fish from migrating upstream except through the passing chute, yet allows water to pass. A passing chute on one of the panels guides fish into a livebox where they can be visually counted, electronically counted or captured, before being allowed to pass upstream.

Resistance board weirs are also easy to maintain because the upstream end of the weir is attached to the river bottom and the downstream floating end collapses under the weight of a person or two. Most debris can be passed down river without interrupting fish monitoring operations. The effects associated with temporary barriers such as resistance board weirs can be minor so long as debris is cleared regularly and live wells or holding areas are checked at least once daily.

Some weirs have a trap to capture fish. Weirs with or without a trap, have the potential to delay migration. All weir projects will adhere to the draft NMFS West Coast Region Weir Guidelines. The Weir Guidelines require the following: (1) traps must be checked and emptied daily; (2) all weirs must be inspected and cleaned of any debris daily; (3) the development and implementation of monitoring plans to assess passage delay; and (4) a development and implementation of a weir operating plan. These guidelines are intended to help improve fish weir design and operation in ways to limit fish passage delays and increase weir efficiency.

Fyke Traps: Fyke traps are essentially large cylinders open at one end and contain two funnels which act as a one-way passage for fish and direct them into a pot or impounding area. The traps are fished with the back or open end downstream. The two funnels face the same way, with the small openings upstream, and a fish must swim through both to enter the pot. The funnels and the exterior of the trap are covered with wire mesh netting. Captured fish are removed with a dip net through a door on the top of the pot or impounding area which opens into the pot.

To process fish, the trap will be rolled up the bank very slowly. If it is apparent that there is a large catch, overcrowding of the fish will be avoided by stopping the trap while it is fairly deep in the water. Fish can then be dipped out of the holding area until the density becomes low again. The trap can then be rolled a little farther up the bank or out of the water and the fishing process repeated. If the trap is moved slowly, the fish remain relatively calm and the likelihood of injure or mortality is reduced.

Seines and Block Nets: A seine is a net that traps fish by encircling them with a long wall of webbing. Typically, the top edge of a seine has floats, the bottom edge is weighted, and the seine has a brail (wooden pole) on each end. As the net is closed the fish become concentrated in the net. Seines are usually large enough that they are fished by two or more people though can be small enough to be fished by one person. Generally, seines are set in an arc around the targeted fish and then dragged to shore. Seines are effective for sampling littoral areas of lentic habitats. In lotic habitats, seines are most easily used in areas of low velocity, but can be used in high velocity areas if the brails are held in place while someone approaches the net from upstream, herding fish into the net. To be most effective, a seine needs to be deployed quickly enough that the target species cannot escape the encircling net. Accordingly, habitat structure and complexity negatively influence seine efficiency by reducing the speed at which one deploys a seine and by offering escape cover. Small fish can be gilled in the mesh of a seine. Scales and dermal mucus can be abraded by contacting the net. Fish can be suffocated if they are not quickly removed from the net after the net is removed from the water to process the fish. Also, the fish can be crushed by the handler when removing the net from the water.

While capturing fish with seine or block nets, fish may be injured or killed. Small fish may be gilled in the mesh of a seine and potentially injured. Fish can be suffocated if they are not quickly removed from the net after the net is removed from the water to process the fish. Scales and dermal mucus can be abraded if fish contact the net. Also, the fish can be crushed by the handler when removing the net from the water. To reduce the risk of injury to fishes, researchers will use seines with knotless nylon mesh to minimize scale and mucus abrasion. Seine tows will be of short duration and distance to prevent suffocation and to ensure that no debris (rocks, logs, etc.) are trapped in the seine that may suffocate or crush fish. Researchers will select the smallest mesh-size seine that is appropriate to achieve sampling objectives to reduce the probability that smaller fish will become gilled in the net.

Rotary Screw Traps: The trapping, capturing, or collecting and handling of juvenile fish using RSTs is likely to cause some stress on ESA-listed fish. However, fish typically recover rapidly from handling procedures. Stress on salmonids increases rapidly from handling if the water temperature exceeds 64.4° F (18° C) or if DO is below saturation. Additionally, stress can occur if there are more than a few degrees difference in water temperature between the stream/river and the holding tank.

The potential for unexpected injuries or mortalities among listed fish is reduced in a number of ways. In general, traps are checked at least daily and usually fish are handled in the morning. This ensures that the water temperature is at its daily minimum when fish are handled. Fish will not be handled if the water temperature exceeds 22.5° C. Care must be taken when transferring fish from the trap to holding areas; this often means using sanctuary nets when transferring fish to holding containers to avoid potential injuries. Appropriate anesthetics must be used to calm collected fish. Captured fish must be allowed to fully recover before release.

Dip Nets: Dip nets are bag-shaped nets affixed to a frame attached to a handle. The net is placed under the fish and then lifted from the water in a scooping motion. Dip nets are useful when collecting fish that have been trapped by other methods, such as electrofishing or trap nets. Scales and mucus can be abraded by the net, and fish can be crushed by the frame when the handler is attempting to catch them.

Tissue Sampling/Fin Clipping: Tissue sampling is a practice used to characterize genetic "uniqueness" and level of genetic diversity within a population. Tissue samples will be small (< 1.0 cm^2), collected from soft pelvic or caudle fin tissues using sharp scissors. Tissue samples will be preserved in individually labeled vials containing 95 percent ethanol.

Fin clipping is the process of removing part or all of one or more fins to alter a fish's appearance. When entire fins are removed, it is expected they will not grow back. Although researchers have used all fins for marking at one time or another, the current preference is to clip the adipose, pelvic, or pectoral fins. Marks can also be made by punching holes or cutting notches in fins, severing individual fin rays (Welch and Mills 1981), or removing single prominent fin rays (Kohlhorst 1979). Studies have examined the effects of fin clips on fish growth, survival, and behavior and in general, fin clips do not generally alter fish growth. Studies comparing the growth of clipped and unclipped fish generally have shown no differences between them (e.g., Brynildson and Brynildson 1967). Wounds caused by fin clipping usually heal quickly, especially those caused by partial clips.

Mortality among fin-clipped fish is variable. Some immediate mortality may occur during the marking process, especially if fish have been handled extensively for other purposes. Delayed mortality depends, at least in part, on fish size; small fishes have often been found to be susceptible to it and Coble (1961) suggested that fish less than 90 millimeters are at particular risk. The degree of mortality among individual fishes also depends on which fin is clipped. Studies show that adipose- and pelvic-fin-clipped coho salmon fingerlings have a 100 percent recovery rate (Stolte 1973). Recovery rates are generally recognized as being higher for adipose and pelvic-fin-clipped fish in compared to those clipped on the pectoral, dorsal, and anal fins (Nicola and Cordone 1973). Clipping adipose and pelvic fins probably kills fewer fish because these fins are not as important as other fins for movement or balance (McNeil and Crossman 1979). Mortality is generally higher when the major median and pectoral fins are clipped. Mears and Hatch (1976) showed that clipping more than one fin may increase delayed mortality.

Researchers will follow several precautionary measures to reduce the risk of stress and injury to ESA-listed salmonids from tissue sampling and fin-clipping, including: (1) only a small amount of fin tissue (not more than 1.0 cm^2) will be collected from any fin, but primarily the upper lobe of the caudal fin; (2) fin-clips will be collected only from ESA-listed salmonids which appear to be in good condition and are not exhibiting injuries or abnormal behavior; and (3) all ESA-listed salmonids will be closely observed and allowed to recover before release.

Tagging: Techniques such as PIT tagging, coded wire tagging, and the use of radio transmitters/acoustic tags are common to many scientific research efforts using ESA-listed species. All sampling, handling, and tagging procedures have an inherent potential to stress, injure, or kill marked fish. This section discusses each of the marking processes and its associated risks.

A PIT tag is usually inserted into the body cavity of the fish in front of the pelvic girdle. PIT tags have very little effect on growth, mortality, or behavior. The few reported studies of PIT tags have shown no effect on growth or survival (Prentice et al. 1987, Jenkins and Smith 1990, Prentice et al. 1990). For example, in a study between the tailraces of Lower Granite and McNary Dams (225 kilometers), Hockersmith et al. (2000) concluded the performance of yearling Chinook salmon was not adversely affected by gastrically- or surgically implanted sham radio tags or PIT-tags. Additional studies have shown growth rates among PIT-tagged Snake River (Idaho) juvenile fall-run Chinook salmon in 1992 (Rondorf and Miller 1994) were similar to growth rates for salmon that were not tagged (Conner et al. 2001). Prentice et al. (1984) also found that PIT-tagging did not substantially affect survival in juvenile salmonids.

CWTs are made of magnetized, stainless-steel wire with distinctive notches that can be coded for such data as species, brood year, hatchery of origin, and etc. (Nielsen 1992). CWTs are intended to remain in the animal indefinitely, making them ideal for long term, population-level assessments. The tag is injected into the nasal cartilage causes little direct tissue damage

(Bergman et al. 1968, Bordner et al. 1990). The conditions under which CWTs may be inserted are similar to those required for applying PIT tags.

A major advantage to using CWTs is they have a negligible effect on the biological condition or response of tagged salmon; however, if the tag is placed too deeply in the snout of a fish, it may kill the fish, reduce its growth, or damage olfactory tissue (Fletcher et al. 1987, Peltz and Miller 1990). This latter effect can create problems for species like salmon because they use olfactory clues to guide their spawning migrations (Morrison and Zajac 1987).

For researchers to determine (after the initial tagging) which fish possess CWTs, it is necessary to mark the fish externally (usually by clipping the adipose fin) when the CWT is implanted. One major disadvantage to recovering data from CWTs is that the fish must be killed for the tag to be removed. However, this is not a significant problem because researchers generally recover CWTs from salmon that have been taken during the course of commercial and recreational harvest (and are therefore already dead). CWTs are also collected during Escapement Surveys (i.e., carcass surveys) and from hatchery broodstock (post-spawned carcasses).

The other primary method for tagging fish is to implant them with acoustic tags, radio tags, or archival loggers. The two techniques involve stomach or cavity implants. Stomach implants require pushing the tag past the esophagus with a plunger. Stomach insertion does not cause a wound and does not interfere with swimming. This technique is benign when salmon are in the portion of their spawning migrations during which they do not feed (Nielsen 1992). In addition, for short-term studies, stomach tags allow faster post-tagging recovery and interfere less with normal behavior than do tags attached in other ways.

Cavity implants are usually directed at the juvenile life stage and these tags do not interfere with feeding or movement. However, the tagging procedure is difficult, requiring considerable experience and care (Nielsen 1992). Because the tag is placed in the body cavity, it is possible to injure a fish’s internal organs. Infections of the sutured incision and the body cavity itself are also possible, especially if the tag and incision are not treated with antibiotics (Chisholm and Hubert 1985, Mellas and Haynes 1985).

Fish with internal tags often die at higher rates than fish tagged by other means because tagging is a complicated and stressful process. Mortality is both acute (occurring during or soon after tagging) and delayed (occurring long after the fish have been released into the environment). Acute mortality is caused by trauma induced during capture, tagging, and release. Delayed mortality occurs if the tag or the tagging procedure harms the animal in direct or subtle ways. Tags may cause wounds that do not heal properly, may make swimming more difficult, or may make tagged animals more vulnerable to predation (Howe and Hoyt 1982, Matthews and Reavis 1990, Moring 1990). Tagging may also reduce fish growth by increasing the energetic costs of swimming and maintaining balance. As with the other forms of tagging and marking, researchers will keep the harm caused by tagging to a minimum by following the conditions in the permits as well as any other permit-specific requirements.

2.4.1.6 Factor 6. Construction, operation, and maintenance, of facilities that exist because of the hatchery program

The construction/installation, operation, and maintenance of hatchery facilities can alter fish behavior and can injure or kill eggs, juveniles and adults. It can also degrade habitat function and reduce or block access to spawning and rearing habitats altogether. Here, NMFS analyzes changes to riparian habitat, channel morphology and habitat complexity, in-stream substrates, and water quantity and water quality attributable to operation, maintenance, and construction activities and confirms whether water diversions and fish passage facilities are constructed and operated consistent with NMFS criteria.

2.4.1.7 Factor 7. Fisheries that exist because of the hatchery program

There are two aspects of fisheries that are potentially relevant to NMFS' analysis of HGMP effects in a section 7 consultation. One is where there are fisheries that exist because of the HGMP (i.e. the fishery is an interrelated and interdependent action) and listed species are inadvertently and incidentally taken in those fisheries. The other is when fisheries are used as a tool to prevent the hatchery fish associated with the HGMP, including hatchery fish included in an ESA-listed ESU or steelhead DPS, from spawning naturally. "Many hatchery programs are capable of producing more fish than are immediately useful in the conservation and recovery of an ESU and can play an important role in fulfilling trust and treaty obligations with regard to harvest of some Pacific salmon and steelhead populations. For ESUs listed as threatened, NMFS will, where appropriate, exercise its authority under section 4(d) of the ESA to allow the harvest of listed hatchery fish that are surplus to the conservation and recovery needs of the ESU, in accordance with approved harvest plans" (NMFS 2005). In any event, fisheries must be strictly regulated based on the take, including catch and release effects, of ESA-listed species.

2.4.2. Effects of the Proposed Action

Analysis of the proposed action identified three factors that are likely to have a beneficial effect on CV spring-run Chinook salmon, CCV steelhead, and the sDPS of green sturgeon and on designated critical habitat. All other factors considered are likely to have negligible effects. An overview of the analysis is described below.

2.4.2.1 Factor 1. The hatchery program does promote the conservation of genetic resources that represent the ecological and genetic diversity of a salmon ESU or steelhead DPS

One overarching goal of the SJRRP is to restore a CV spring-run Chinook salmon population to the San Joaquin River, as agreed upon in the Settlement. Since the completion of Friant Dan, the San Joaquin River population of CV spring-run Chinook salmon was extirpated and remaining CV spring-run Chinook salmon populations are at various risk of extinction throughout the ESU. A specific goal of the SJRRP Fisheries Management Work Group is to promote and protect genetic diversity within the reestablishing populations while safeguarding against negative genetic effects to out-of-basin source and non-target populations. To capture the most genetic diversity while minimizing impacts to the source populations, broodstock, collections will continue every year for at least two generations (i.e., six years), as guided by population growth of the wild San Joaquin River population and source population status. Annual broodstock collections will initially be focused on CV spring-run Chinook salmon from FRFH and will expand to include collections from wild stocks in Butte Creek (depending on escapement numbers and over all wild population condition), and depending on escapement numbers, returning adults and any stray CV spring-run Chinook salmon that enter the Restoration Area, the San Joaquin River, or other sources that may be available for use as broodstock.

Reintroduction contributes to conservation and recovery by improving spatial structure, productivity, diversity, and abundance of the CV spring-run Chinook salmon ESU. Use of broodstock collection methods (a) protective of source populations, (b) hatchery management strategies that are protective of the genetic integrity of the broodstock population, and (c) conservative release/collection strategies, the SJRRP Conservation Program will likely have a beneficial effect to the CV spring-run Chinook salmon ESU.

2.4.2.2 Factor 2. Hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities

The SJRRP Conservation Program is attempting to reintroduce fish into a location where they were entirely extirpated. Therefore, hatchery fish and the progeny of naturally spawning hatchery fish are unlikely to adversely affect natural-origin fish, since until the reintroduced population becomes established, there are no natural origin fish to adversely affect.

Once the reintroduced population becomes established in the Restoration Area, there is a possibility that continued hatchery operations could adversely affect that population. Fortunately, the HGMP guidelines are designed to conserve and promote genetics from significant impacts. Specifically, the HGMP was developed to protect natural section processes to promote adaptation to conditions in the San Joaquin River. Genetic monitoring of the reintroduced population using parentage analysis will provide the Conservation Program with information on the frequency of outcrossed matings and their relative survival in the Restoration Area and whether to incorporate them into hatchery matings.

The Conservation Program will use a broodstock and adult spawning approach to minimize adverse genetic and ecological impacts to natural fish. Ideally, the Conservation Program would not change the genetic characteristics of the source population and would produce offspring for release that display the full range of genetic diversity found in the source population. Over time, selection on the natural population is expected to eliminate outbreeding depression as the reintroduced populations comingle. The duration of the Conservation Program will depend on the SJRRP’s success in establishing a self-sustaining population of CV spring-run Chinook salmon in the San Joaquin River. As the natural population establishes, hatchery production would be phased out with less than 15 percent of the Chinook salmon population of hatchery origin ten years after full-scale releases. Once the San Joaquin River population is reestablished, a maximum of 10 percent of the naturalized run in the San Joaquin River may be collected to serve as broodstock, unless returns are so low that the naturalized run is unlikely to produce enough offspring to expect an escapement in future years.

2.4.2.3 Factor 3. Hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas

Potential ecological effects of releasing juvenile hatchery-origin CV spring-run Chinook from the SJRRP Conservation Facilities include predation, competition/displacement, and disease. Deleterious ecological impacts to natural origin CV spring-run Chinook salmon or other ESA-listed salmonids are not anticipated, primarily due to the lack of natural origin CV spring-run Chinook salmon close to the release locations, for the early life of the permit. Once the population becomes established, impacts to natural origin juvenile fish will be minimized by the strategies described in the HGMP. After salmon are re-established in the San Joaquin River, consideration will be given to the size of hatchery fish at time of release and timing of release to minimize the risk of predation and competition with the natural-origin fish. Even initially, the CV spring-run Chinook salmon releases may interact with listed fish during outmigration, rearing in the San Francisco Estuary, in the ocean, and by straying during spawning migration. The reintroduced fish are likely to interact with other listed salmonid populations, including the endangered Sacramento River winter-run Chinook salmon and the threatened CCV steelhead. Negative interactions may include induced behavioral changes in wild fish, competition for limited resources, depensatory predation, disease transfers, and interbreeding. Release methods can influence all of these potential interactions.

Induced behavioral changes in wild fish, competition for limited resources, and depensatory predation are all aggravated by large releases of hatchery fish. Initially, releases from the Conservation Facilities will be small in number and will present limited risk in these areas. As release sizes increase, allocation of reintroduced fish between the release of eggs and of juveniles will spread out the period over which juveniles are entering the system, reducing the risk to listed species in the action area. For juveniles raised at the Conservation Facilities, volitional release will allow for gradual introduction of the juveniles into the San Joaquin River, further reducing the risk to listed species. Reintroductions will be adaptively managed to minimize impacts on other listed species. In the hatchery facilities, growth during smolt production will be modulated to meet Conservation Program goals for release size and release timing to avoid possible impacts to the wild population. To prevent transfer of disease from the hatchery population to the wild population, a suite of protocols are in place as described in the HGMP.

2.4.2.4 Factor 4. Hatchery fish and the progeny of naturally spawning hatchery fish in the migration corridor, estuary, and ocean

The number of individuals released by the Conservation Facilities (max of approximately 1.2 million individuals; CDFW 2023) is low compared to the total number of juveniles released in Central Valley; more than 32 million fall-run Chinook salmon, 2 million CV spring-run Chinook salmon, 1 million late fall-run Chinook salmon, 0.25 million winter-run Chinook salmon, and 2 million steelhead are released annually from six hatcheries producing anadromous salmonids in the Central Valley (Letvin et al 2021). Therefore, the proposed action is unlikely to exacerbate the density-dependent effects on ESA-listed species in the Lower San Joaquin River, in the estuary, or in the Pacific Ocean, an area with an already depressed population of anadromous fish populations. However, there is little information available that directly addresses the effects of density dependence on survival and growth in natural populations of Pacific salmon. Many of the ecological consequences of releasing hatchery fish into the wild are poorly defined.

The currently available information does not support a meaningful causal link to a particular category of hatchery programs based on available information. The scale of hatchery production proposed in this action and considered in this biological opinion will likely have a negligible effect on the survival and recovery of the CV spring-run Chinook salmon ESU.

NMFS will continue to monitor emerging science and information and will reinitiate section 7 consultation in the event new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation (50 CFR 402.16).

2.4.2.5 Factor 5. Research, monitoring, and evaluation that exists because of the hatchery program

The RM&E activities included as part of the proposed action will have a positive effect on ESA-listed species in the upper San Joaquin River Basin. As described in Section 1.3.1.5, the proposed action includes a suite of surveys, monitoring actions, and potential studies for various life stages of CV spring-run Chinook salmon to inform management actions for the SJRRP. Monitoring related to various performance indicators (e.g., fish health, genetic distribution, growth, survival and movement in the natural environment) is a crucial component of the larger SJRRP.

The SJRRP is a largescale restoration program with multiple in-stream research and monitoring components to evaluate the effectiveness of the program related to hatchery operations and changes to river conditions. Monitoring for listed fish occurs at multiple life stages, including egg/fry, juvenile adult, and carcass.

CCV steelhead and sDPS of green sturgeon are not the target species but some may be captured during ongoing monitoring actions. Because the majority of the fish that would be captured are expected to recover with no ill effects. The proposed RM&E activities may remove a maximum of six natural-origin adult CCV steelhead, four natural-origin juvenile CCV steelhead, and no green sturgeon annually. These are small effects, and most likely the actual effect would be smaller as the mortality and take is estimated conservatively to provide a buffer to address unusual and unpredictable events.

Overall, there would be a small impact on the species' abundance. Any impact on listed species productivity would likely be positive, as captured fish would be translocated to locations with better access to more suitable spawning habitat. Effects on species spatial structure or diversity would be minimal, but overall the permitted actions are a component of the SJRRP, which aims to increase the spatial diversity of anadromous salmonids in the Central Valley. An effect of the research that cannot be quantified is the conservation benefit to the species resulting from the research. Results from this research is expected to assist in providing information on occurrence and return timing of listed salmonids in the Restoration Area. Collection of this data is necessary for understanding potential benefits of the SJRRP. All research findings will be used to benefit ESA-listed salmonids through improved conservation and management practices.

2.4.2.6 Factor 6. Construction, operation, and maintenance of facilities that exist because of the hatchery program

Operations and maintenance activities included in the proposed action will have a negligible effect on ESA-listed species in the Upper San Joaquin River basin. There are no construction activities included in the proposed action. Construction of Conservation Facilities has either been previously completed (i.e., Interim Facility, SIRF) or is under construction (SCARF). Further information on the potential environmental effects associated with construction of the SCARF can be found in the DEIR completed by CDFW (2013). In either case, construction, operation, and maintenance of the facilities, while related to the proposed action in that they are a component of the SJRRP, are not part of the proposed action of issuing Permit 20571-2R or approving the HGMP.

2.4.2.7 Factor 7. Fisheries that exist because of the hatchery program

The Pacific Fishery Management Council (PFMC), established by the 1976 Magnuson/Stevens Fishery Conservation and Management Act to manage near-shore ocean fisheries, works with the CDFW to manage the ocean salmon fishery off the California Coast. The PFMC manages fisheries based on a number of objectives detailed in its Salmon Fishery Management Plan and evaluated annually in its Review of Ocean Salmon Fisheries. The Conservation Program is an integrated recovery hatchery, which is not primarily intended to produce adult salmon for harvest but rather to promote recovery. Harvest may be an ancillary benefit as the San Joaquin River population grows. There are active commercial (ocean) and recreational (ocean and inland) fisheries for Chinook salmon in California. As a result, some San Joaquin River CV spring-run Chinook salmon may be taken in those fisheries. Estimated future harvest rates on fish propagated by the Conservation Program are difficult to calculate. Although ocean (commercial) harvest rates may remain similar to those estimated between 1995 and 2006, ocean harvest rates can vary annually based on the regulations established by the Pacific States Marine Fisheries Commission and CDFW. Although freshwater recreational harvest of CV spring-run Chinook salmon is currently prohibited, a recreational fishery may develop under 4(d) regulations when salmon begin returning in the significant numbers anticipated in the Settlement.

2.4.3. Effects of the Action on Critical Habitat

This consultation analyzed the proposed action for its effects on designated critical habitat and has determined that operation of the hatchery program will have a negligible effect on critical habitat. Critical habitat for CV spring-run Chinook salmon and the sDPS of green sturgeon is currently not designated in the San Joaquin Basin, and is not designated for CCV steelhead upstream of the confluence of the Merced River. Therefore, the only portions of the action area that could affect critical habitat would be in Butte Creek or the FRFH. Collections from FRFH will be made directly from the hatchery and no actions are proposed within the Feather River. Collections in Butte Creek will only be made from the RST that is already permitted (and analyzed). These activities are not expected to affect the PBFs in the Action Area.

2.5. 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 to distinguish between the action area's future environmental conditions caused by global climate change that are part of the environmental baseline *vs.* cumulative effects. All relevant future climate-related environmental conditions in the action area are described earlier in Section 2.4.

2.5.1. Agricultural Practices

Agricultural practices in the San Joaquin River and Delta will adversely affect riparian and wetland habitats through upland modifications of the watershed that lead to increased siltation or reductions in water flow in stream channels flowing into the Delta. Unscreened agricultural diversions throughout the San Joaquin River and Delta entrain and kill fish, including juvenile salmonids. Grazing activities from dairy and cattle operations degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which then flow into the receiving waters of the San Joaquin River and Delta. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may adversely affect salmonid reproductive success and survival rates (Dubrovsky et al. 1998a, Dubrovsky et al. 1998b, Daughton 2003).

2.5.2. Water Diversions

Water diversions for irrigated agriculture, municipal and industrial use, hydropower generation, and managed wetlands are found throughout the Central Valley. Thousands of small and medium-size water diversions exist along the Sacramento River, San Joaquin River, their tributaries, and the Delta, and many of them remain unscreened. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile ESA-listed anadromous species. For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001). As of 2001, most of the 370 water diversions operating in Suisun Marsh are unscreened (Herren and Kawasaki 2001). Currently, almost no water diversions in the action area are properly screened.

2.5.3. Aquaculture and Fish Hatcheries

More than 32 million fall-run Chinook salmon, two million CV spring-run Chinook salmon, 1 million late fall-run Chinook salmon, 0.25 million winter-run Chinook salmon, and two million steelhead are released annually from six hatcheries producing anadromous salmonids in the Central Valley. These facilities are operated to mitigate for habitat loss due to dam construction.

The loss of this available habitat has resulted in dramatic reductions in natural population abundance. The high level of hatchery production in the Central Valley can result in high harvest-to-escapements ratios for natural stocks. California salmon fishing regulations are set according to the combined abundance of hatchery and natural stocks, which can lead to overexploitation and reduction in the abundance of wild populations that are indistinguishable and exist in the same ecosystems as hatchery populations.

Releasing large numbers of hatchery fish can also pose a threat to wild Chinook salmon and steelhead stocks through the spread of disease, genetic impacts, competition for food and other resources between hatchery and wild fish, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production. Impacts of hatchery fish can occur in both freshwater and the marine ecosystems. Limited marine carrying capacity has implications for naturally produced fish experiencing competition with hatchery production (HSRG 2004). Increased salmonid competition in the marine environment may also decrease growth and size at maturity, and reduce fecundity, egg size, age at maturity, and survival (Bigler et al. 1996). Ocean events cannot be predicted with a high degree of certainty at this time. Until good predictive models are developed, there will be years when hatchery production may be in excess of the marine carrying capacity, placing depressed natural fish at a disadvantage by directly inhibiting their opportunity to recover.

2.5.4. Urbanization

Increases in urbanization can impact habitat by altering watershed characteristics, and changing both water use and stormwater runoff patterns. For example, the general plans for the cities of Stockton, Brentwood, Lathrop, Tracy and Manteca and their surrounding communities anticipate rapid growth for several decades to come. The anticipated growth would occur along both the I-5 and US-99 transit corridors in the east and Highway 205/120 in the south and west. Increased growth would place additional burdens on resource allocations, such as water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities..

2.5.5. Recreation (including hiking, camping, fishing, and hunting)

Expected recreation impacts to salmonids include increased turbidity, impacts to water quality, barriers to movement, and changes to habitat structures. Streambanks, riparian vegetation, and spawning redds can be disturbed wherever human use is concentrated. Fishing within the action area, typically for introduced species or non-listed rainbow trout, is expected to continue subject to CDFW regulations. Fishing for CV spring-run Chinook salmon directly is prohibited in the San Joaquin River. The level of impact to CV spring-run Chinook salmon within the action area from angling is unknown, but is expected to remain at current levels.

Boating is also expected to increase and typically result in increased wave action and propeller wash in waterways. This potentially would degrade riparian and wetland habitat by eroding channel banks and midchannel islands, thereby causing an increase in siltation and turbidity. Boat wakes and propeller wash also churn up benthic sediments thereby potentially re-suspending contaminated sediments and degrading areas of submerged vegetation. This in turn would reduce habitat quality for the invertebrate forage base required for the survival of juvenile salmonids and other anadromous fishes using the system. Increased recreational boat operation in the San Joaquin River and Delta is anticipated to result in more contamination from the operation of gasoline and diesel powered engines on watercraft entering the water bodies of the San Joaquin River and Delta.

2.5.6. Subsidence and Groundwater

Surface water and groundwater are hydraulically linked in the Delta-Mendota subbasin, and this linkage is critically important in creating habitat for CCV steelhead, CV spring-run Chinook salmon, and sDPS of North American green sturgeon. In addition, CV fall-run Chinook salmon are an important commercial and recreational sportfish under the MSA. Where the groundwater aquifer supplements streamflow, the influx of cold, clean water is important for maintaining temperature and flow volume in the river. Excessive pumping of water from these aquifer-stream complexes likely adversely affects salmon and steelhead habitat by lowering groundwater levels and interrupting hyporheic flow between the aquifer and stream. Continuous over pumping of ground water in the San Joaquin River Basin has led to subsidence (the gradual caving or sinking of an area of land) in specific areas near the San Joaquin River, causing the flows and capacity of the surrounding area to be negatively affected. Without intervention, like the Sustainable Groundwater Management Act, these problems will likely continue to worsen.

2.6. 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 biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

2.6.1. Central Valley spring-run Chinook salmon

At the ESU level, the spatial diversity within the CV spring-run Chinook salmon ESU is increasing and spring-run are present (albeit at low numbers in some cases) in all diversity groups. The persistence of the CV spring-run Chinook salmon population in Battle Creek and increasing abundance in Clear Creek is benefiting the viability of CV spring-run Chinook salmon (Johnson et al. 2023).

Similarly, the reappearance of CV spring-run Chinook salmon to the San Joaquin River tributaries may be the beginning of natural reoccupation processes in rivers where they were once extirpated. Active reintroduction efforts, including the SJRRP, show promise and will be necessary to recovery.

The strongest wild populations of CV spring-run Chinook salmon (Butte, Mill and Deer Creeks) have all seen recent declines in numbers and increased risk of extinction (Johnson et al. 2023). The recent catastrophic declines of the independent and dependent populations, high prespawn mortality during the 2012-2015 and 2020-2022 droughts, uncertainty of juvenile survival due to the drought and variable ocean conditions, and the straying rate of FRFH CV spring-run Chinook salmon to other CV spring-run Chinook salmon populations are all causes for concern for the long-term viability of the ESU (Johnson et al. 2023, SWFSC 2022).

The CV spring-run Chinook salmon ESU may be affected by commercial and recreational fisheries. The effects of this take were analyzed in separate ESA consultations (NMFS 2000) but the ESU as a whole has degraded since this analysis which would likely change the analysis (Johnson et al. 2023, SWFSC 2022). Fisheries and harvest managers reevaluate exploitation rates and harvest strategies on an annual basis to ensure that fisheries for CV fall- and late fall-run Chinook salmon provide for the survival and recovery of the listed ESUs.

Climate change is a key aspect of stress for ESA-listed salmonids in the Central Valley. Lindley et al. (2007) summarized several studies (Hayhoe et al. 2004, Dettinger et al. 2004, VanRheenen et al. 2004) of how climate change is expected to alter the Central Valley, and based on these studies, described the possible effects to anadromous salmonids. Climate models for the Central Valley are broadly consistent in that temperatures in the future will warm significantly, total precipitation may decline, the variation in precipitation may substantially increase (i.e., more frequent flood flows and critically dry years), and snowfall will decline significantly (Lindley et al. 2007). Not surprisingly, temperature increases are expected to limit the amount of suitable habitat available to anadromous salmonids. The potential for more frequent flood flows is expected to reduce the abundance of populations, as egg scour becomes a more common occurrence. The increase in the occurrence of critically dry years also would be expected to reduce abundance as, in the Central Valley, low flows during juvenile rearing and outmigration are associated with poor survival (Kjelson and Brandes 1989, Baker and Morhardt 2001). In addition to habitat effects, climate change may also impact Central Valley salmonids through community effects. For example, warmer water temperatures would likely increase the metabolism of predators, reducing the survival of juvenile salmonids (Vigg and Burley 1991). Petersen and Kitchell (2001) showed that on the Columbia River, pikeminnow predation on juvenile salmon during the warmest year was 96 percent higher than during the coldest. In summary, climate change is expected to exacerbate existing stressors and pose new threats to all Central Valley salmonids by reducing the quantity and quality of inland habitat (Lindley et al. 2007).

2.6.1.1 Hatchery Effects

NMFS analyzes seven factors to determine the effects of a hatchery program on ESA-listed species and on designated critical habitat (Section 2.5.1) and for the proposed action at SJRRP Conservation Facilities, all of the factors considered are expected to have beneficial or negligible effects on CV spring-run Chinook salmon.

Proposed action-related stressors could reduce the abundance and productivity of CV spring-run Chinook salmon; however, the level of impacts resulting from the project are generally low. Overall, proposed activities are expected to improve spatial structure and diversity of CV spring-run Chinook salmon. This is primarily due to the fact that the Conservation Facilities are operated as a Conservation Hatchery with the overall purpose of enhancing the natural population of CV spring-run Chinook salmon in the San Joaquin Basin, while promoting the recovery of the species through contribution to reintroduction efforts.

2.6.1.2 Broodstock Collection

Adverse effects associated with the proposed action may occur as handling, stress, delayed migration, injury, or mortality. Annual broodstock collections will initially be focused on CV spring-run Chinook salmon from FRFH and will expand to include collections from wild stocks in Butte Creek, and depending on escapement numbers, returning adults and any stray CV spring-run Chinook salmon that enter the Restoration Area, the San Joaquin River, and other areas that may be available for use as broodstock. However, broodstock collection from FRFH would only occur if the hatchery is able to produce more than its own production targets; broodstock collection from Butte Creek would be dependent on annual escapement and would be conservative for the genetic integrity and population abundance of the source population; and broodstock collection from the San Joaquin would follow HGMP protocols that promote genetics that have experienced any degree of natural selection. The SJRRP Conservation Program is expected to have a beneficial effect on the ecological and genetic resources available for the CV spring-run Chinook salmon ESU. This is due to using broodstock collection strategies that are protective of source populations, hatchery management strategies that are protective of the genetic integrity of the broodstock population, and release/collection strategies that are conservative for the genetic integrity of the population that are expected to develop in the Restoration Area. Therefore, any adverse effects associated with this activity are expected to have a low level of impact to the CV spring-run Chinook salmon ESU.

2.6.1.3 Research, Monitoring, and Evaluation

RM&E could also result in potential adverse effects to CV spring-run Chinook salmon. However, the overall impact of RM&E is considered to be negligible, if not beneficial. The CV spring-run Chinook salmon being reintroduced to the San Joaquin River (and those subject to RM&E activities), are classified as a NEP of CV spring-run Chinook salmon (78 FR 79622, December 31, 2013) with limited take prohibitions. Therefore, this species and the associated estimated take has been included in this document for informational purposes.

Even when comparing the estimate take against the larger population, the projected total lethal take for all research and monitoring activities represents a small percentage of the species' total abundance. In addition, the number of fish that would actually be taken would most likely be smaller than the amounts authorized because (a) we developed conservative estimates of abundance, as described in Section 2.2 and (b) researchers generally request more take than will actually occur. It is therefore likely that researchers will take fewer fish than estimated, and therefore the actual effect is likely lower than anticipated.

For over two decades, research and monitoring activities conducted on anadromous salmonids in California have provided resource managers with important and useful information on anadromous fish populations. Issuing research authorizations including those being contemplated in this biological opinion NMFS has allowed information to be acquired that has enhanced resource managers' abilities to make more informed decisions to sustain anadromous salmonid populations, mitigate adverse impacts on endangered and threatened salmon, steelhead, and green sturgeon and implement recovery efforts.

2.6.1.4 Summary

Added to the Environmental Baseline and the Effects of the proposed action are the effects of future state, private, or tribal activities, not involving Federal activities, within the Action Area. To the extent those same activities are reasonably certain to occur in the future, their future effects are included in the cumulative effects analysis. Many of the state and private activities identified in the Baseline are anticipated to occur at similar levels of intensity into the future. The recovery plan for Central Valley salmon and steelhead (NMFS 2014) describes the on-going and proposed state, and local government actions targeted to reduce known threats to ESA-listed CV spring-run Chinook salmon in the San Joaquin River. It is acknowledged, however, that such future state, tribal, and local government actions will likely be in the form of legislation, administrative rules, or policy initiatives, and land use and other types of permits and that government actions are subject to political, legislative and fiscal uncertainties.

This analysis has considered the potential effects of the proposed action, combined with the Environmental Baseline and Cumulative Effects, and determined that the proposed action will not appreciably reduce the likelihood of survival and recovery of CV spring-run Chinook salmon ESU.

2.6.2. California Central Valley steelhead

The current assessment of the CCV steelhead DPS concluded that the DPS was in the "Moderate" risk category (SWFSC 2022) for extinction. This is driven by the increase in adult returns to hatcheries from their recent lows, but the status of naturally produced fish remains poor; yet, improvements to the total population sizes does not warrant a downgrading of the DPS extinction risk. In fact, the lack of improved natural production as estimated by samples taken at Chipps Island, and low abundances coupled with large hatchery influence in the Southern Sierra Nevada Diversity group is cause for concern (Williams et al. 2016, SWFSC 2022). As in the previous assessments (Good et al. 2005; Williams et al. 2011), the CCV steelhead DPS continues be at risk of extinction.

As set out in the Environmental Baseline (Section 2.4), extensive habitat elimination and degradation has been a primary factor leading to the threatened status of CCV steelhead. Physical habitat modifications (e.g., dam construction and channel modifications) and many other anthropogenic effects on habitat have diminished the viability of the DPS. The general baseline stress regime for steelhead in the freshwater, estuarine, and marine environment is similar to that of CV spring-run Chinook salmon, with an exception that there is no targeted ocean fishery for steelhead. Descriptions of baseline stressors to CCV steelhead are provided in Sections 2.2 and 2.4.

The steelhead DPS may be affected by inland fisheries. Fisheries and harvest managers reevaluate exploitation rates and harvest strategies on an annual basis. Since the recreational fishery is regulated to protect natural-origin steelhead, managers do not consider the impacts significant, although this has not been analyzed through ESA Section 7 consultation. However, because the sizes of CCV steelhead populations are largely unknown, it is difficult to make conclusions about the impact of the fishery (Good et al. 2005).

As described for CV spring-run Chinook salmon above, climate change is a key aspect of stress for ESA-listed salmonids in the Central Valley.

2.6.2.1 Hatchery Effects

NMFS analyzes seven factors to determine the effects of a hatchery program on ESA-listed species and on designated critical habitat (Section 2.4.1) and for the proposed action, all of the factors considered are not expected to have significant effects on CCV steelhead.

The level of impacts on CCV steelhead abundance and productivity resulting from the project are generally low. Proposed activities are not likely to affect spatial structure or diversity of CCV steelhead because the hatchery facilities are located outside of the area currently used by juvenile and adult CCV steelhead.

2.6.2.2 Broodstock Collection

Adverse effects may occur as handling, stress, delayed migration, injury, or mortality. However, broodstock collection from FRFH will have no effect on CCV steelhead because collection will only be from within the hatchery. CCV steelhead are believed to be extirpated from the SJRRP Restoration Area, and while some may return as conditions improve, encounters are expected to be low. And although information is limited on the annual abundance of CCV steelhead in Butte Creek, again estimated numbers are low. Therefore, this activity is expected to have a low level of impact to the CCV steelhead salmon ESU.

ESA-listed natural-origin CCV steelhead may be encountered in the SJRRP Restoration Area or the San Joaquin River and other streams while trapping CV spring-run Chinook salmon broodstock. Several methods will be used to reduce incidental impacts of trapping (section 2.5.2.).

We expect the detrimental effects on the species to be minimal and those impacts would only be seen in terms of minor reductions in adult abundance and productivity. And because these reductions are minor, the actions in combination would have no appreciable effect on the species' diversity or spatial structure.

2.6.2.3 Research, Monitoring, and Evaluation

RM&E activities could result in potential adverse effects to CCV steelhead. However, the overall impact of RM&E is considered to be negligible, if not beneficial. The resulting information continues to improve our knowledge of the respective species' life histories, specific biological requirements, migration timing, responses to human activities (positive and negative), and survival in the rivers and ocean. The collection and dissemination of that information, as a whole, is important to the species' survival.

In addition, the true numbers of fish that would actually be taken is likely smaller than exempted because (a) we develop conservative estimates of abundance (section 2.2) and (b) researchers generally request more take than will occur. It is therefore likely that researchers take fewer fish than estimated, and that the effect is likely lower than the numbers stated in the Table 7 below.

If researchers were to take the maximum estimated number of individuals, the effects of the losses would be small, and because they would be spread out over the species' entire range, they would be restricted to reductions in the species' total abundance and productivity. The amounts of mortality that could result from this permit are due to efforts to remove the fish from a location without suitable habitat and translocate them to a location where they have access to suitable spawning habitat. Therefore, any losses that would be incurred would be in the context of activities that would have a net benefit for the species.

2.6.2.4 Summary

Added to the Environmental Baseline and effects of the proposed action are the effects of future state, private, or tribal activities, not involving Federal activities, within the action area. To the extent those same activities are reasonably certain to occur in the future, their future effects are included in the cumulative effects analysis. Many of the activities identified in the Baseline are anticipated to occur at similar levels of intensity into the future. The final recovery plan for Central Valley salmon and steelhead (NMFS 2014) describes, in detail, the on-going and proposed state, and local government actions that are targeted to reduce known threats to ESA-listed CCV steelhead in the San Joaquin River. It is acknowledged, however, that such future actions will likely be in the form of legislation, administrative rules, or policy initiatives, and land use and other types of permits, and that government actions are subject to political, legislative and fiscal uncertainties. What is certain is that inaction will lead to further degradation.

This analysis has considered the potential effects of the proposed action, combined with the Environmental Baseline and Cumulative Effects, and determined that the proposed action will not appreciably reduce the likelihood of survival and recovery of CCV steelhead DPS.

2.6.3. Southern Distinct Population Segment of Green Sturgeon

The activities contemplated in this biological opinion are predicted to adversely affect a few sDPS of green sturgeon. Overall, there would be a very small impact on the species' abundance. Overall, the effect on the species would likely be positive, as captured fish would contribute to overall knowledge of the population in the San Joaquin River basin of which there is little information. Effects on species spatial structure or diversity would be minimal.

There is no critical habitat for the sDPS of green sturgeon in the Action Area.

This analysis has considered the potential effects of the proposed action, combined with the Environmental Baseline and Cumulative Effects, and determined that the proposed action will not appreciably reduce the likelihood of survival and recovery of the sDPS of green sturgeon.

2.7. 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 the cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of CV spring-run Chinook salmon, CCV steelhead, or the sDPS of green sturgeon or destroy or adversely modify their designated critical habitat.

2.8. 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. The incidental take described below in Section 2.9.1 is only for CCV steelhead and the sDPS of green sturgeon that could be encountered when collecting broodstock or during RM&E.

CV spring-run Chinook salmon are currently being reintroduced to the San Joaquin River, and are classified as a NEP of CV spring-run Chinook salmon (78 FR 79622, December 31, 2013). This species has been included in this document for informational purposes for conferencing. The unintentional, incidental take of these fish within the Restoration Area would be exempt from the prohibitions of section 9 of the ESA. In addition, an incidental take statement is not required under ESA section 7(b)(4) for this conferencing opinion for NEP CV spring-run Chinook salmon.

In this instance, and for the actions considered in this biological opinion, there is no incidental take exempted for CV spring-run Chinook salmon. The reason for this is that the take contemplated in this document would be carried out under a permit which constitutes an otherwise lawful activity covered under the NEP designation (78 FR 79622, December 31, 2013) that allows USFWS and CDFW to directly take CV spring-run Chinook salmon. The actions are direct take rather than incidental take because their actual purpose is to take the animals while carrying out a permitted activity. Thus, the take of CV spring-run Chinook cannot be considered "incidental" under the definition given above. Nonetheless, one of the purposes of an incidental take statement is to document the quantity or extent of take beyond which individuals carrying out an action cannot exceed without being in violation of the ESA section 9 take prohibitions. That purpose is fulfilled here through the documentation of direct take and the effects are described in sections 1.3 and 2.5. Those quantities constitute limits on both the amount and extent of take allowed per year. This concept is also reflected in the reinitiation clause (Section 2.11).

2.8.1. Amount or Extent of Take

As a condition of the permit upon issuance, the permit holder must ensure that listed species are only taken at the levels, by the means, in the areas, and for the purposes stated in the permit application. The amount of incidental take requested, which is the amount of take considered in this biological opinion, is detailed in the permit application, and in the following Table 12.

The only form of take of ESA-listed CV spring-run Chinook salmon is direct take, under the Section 10 Authorizations (Permit 20571-2R[14]) for the hatchery programs (Tables 7-10). However, NMFS also expects that incidental take of ESA-listed CCV steelhead and the sDPS of green sturgeon is reasonably certain to occur as a result of the Proposed Action for the following factors (Table 12).

Factor 5: Research, monitoring, and evaluation that exists because of the hatchery program

Listed salmonids will also be taken as a result RM&E activities. Research and monitoring activities authorized in the previously authorized permit has also been compliant with take limits. Please see Table 7 below for incidental take information from Factor 5.

[14] https://apps.nmfs.noaa.gov/

Table 7. Annual Authorized Take for ESA Section 10(a)(1)(A) Permit 20571-2R by ESU, Life Stage, Origin, and Activity for SJRRP Hatchery Source Stock Collection – Butte Creek. Take in this table is for accounting purposes only. Annual numbers of animals taken under this permit can be found in annual reports on the NMFS APPS website[14].

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Juvenile	Male And Female	2,700	1,802	Collect, Sample, and Transport Live Animal	Trap, Screw	Anesthetize; Fin Clip – Mark; Tag, Acoustic or Sonic (Internal); Tag, Coded-wire; Tag, Floy; Tag, PIT; Tissue Sample Fin or Opercle	May collect juveniles from diversion trap at same site due to conditions at site total take will not exceed listed take numbers. Indirect mortality includes all losses from egg to adult lifestage.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Juvenile	Male And Female	210	0	Intentional (Directed) Mortality	Hand and/or Dip Net	Tissue Sample (Other Internal Tissues)	Pathology testing for broodstock health assessment prior to transfer to the SCARF or Interim Facility.

Table 8. Annual Authorized Take for ESA Section 10(a)(1)(A) Permit 20571-2R by ESU, Life Stage, Origin, and Activity for SJRRP Hatchery Source Stock Collection – Feather River Fish Hatchery. Take in this table is for accounting purposes only. Annual numbers of animals taken under this permit can be found in annual reports on the NMFS APPS website[14].

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Intact Adipose	Egg	Unknown	5,400	3,995	Collect, Sample, and Transport Live Animal	Hand and/or Dip Net		Broodstock collection

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Intact Adipose	Juvenile	Male and Female	240	0	Intentional (Directed) Mortality	Hand and/or Dip Net	Tissue sample (other internal tissues)	Pathology testing for broodstock health prior to transfer to SCARF or Interim Facility, 60 fish per lot up to 4 lots.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Juvenile	Male and Female	1,000	0	Intentional (Directed) Mortality	Hand and/or Dip Net	Anesthetize; Fin clip - mark; Tag, Acoustic or Sonic (Internal); Tag, Coded-Wire; Tag, Floy; Tag, PIT; Tissue Sample Fin or Opercle	Sacrificed as part of CWT process to set correct tag depth. Up to 25 individuals per day may be sacrificed not to exceed 1,000 total. Includes all sources.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Egg	Unknown	80,000	38,823	Collect, Sample, and Transport Live Animal	Hand and/or Dip Net	Anesthetize; Dye Injection (tattoo, photonic); Fin clip - mark; Paint, Stain or Dye Immersion; Tag, Acoustic or Sonic (Internal); Tag, Coded-Wire; Tag, PIT; Tissue Sample Fin or Opercle	Translocated reared and released to San Joaquin River, indirect mortality is estimated form egg to release size.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Juvenile	Male and Female	100	0	Intentional (Directed) Mortality	Hand and/or Dip Net	Tissue sample (other internal tissues)	Pre-release health assessment for fish from FRFH.

Table 9. Annual Authorized Take for ESA Section 10(a)(1)(A) Permit 20571-2R by ESU, Life Stage, Origin, and Activity for SJRRP Hatchery Source Stock Collection – San Joaquin River. Take in this table is for accounting purposes only. Annual numbers of animals taken under this permit can be found in annual reports on the NMFS APPS website[14].

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Egg	Unknown	1,000	711	Collect, Sample, and Transport Live Animal	Hand and/or Dip Net	Anesthetize; Fin clip - mark; Tag, Acoustic or Sonic (Internal); Tag, Coded-Wire; Tag, PIT; Tissue Sample Fin or Opercle	Egg extraction from redds by excavation or egg pump (approx. 20/redd), indirect mortality includes mortality from egg to adult lifestage
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Juvenile	Male and Female	2,700	100	Collect, Sample, and Transport Live Animal	Trap, RST	Anesthetize; Fin clip - mark; Tag, Acoustic or Sonic (Internal); Tag, Coded-Wire; Tag, PIT; Tissue Sample Fin or Opercle	Weir, Beach Seine, and/or fyke net may also be used if conditions are appropriate. Includes San Joaquin River tributaries.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Juvenile	Male and Female	280	0	Intentional (Directed) Mortality	Trap, RST	Tissue sample (other internal tissues)	Total number of fish for pathology, 70 per collection up to 4 collections. Includes San Joaquin River tributaries.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Adult	Male and Female	250	13	Collect, Sample, and Transport Live Animal	Net, Fyke	Fin clip - mark; Tag, Acoustic or Sonic (Internal); Tag, Floy; Tag, PIT; Tissue Sample Fin or Opercle; Tissue Sample Otolith;	Adult weir or hand/dip net may also be used if conditions are appropriate. Includes San Joaquin River tributaries.

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
									Tissue Sample Scale	
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Adult	Male and Female	250	13	Collect, Sample, and Transport Live Animal	Net, Fyke	Anesthetize; Fin clip - mark; Tag, Acoustic or Sonic (Internal); Tag, Coded-Wire; Tag, Floy; Tag, PIT; Tissue Sample Fin or Opercle; Tissue Sample Otolith; Tissue Sample Scale	Adult weir or hand/dip net may also be used if conditions are appropriate. Includes San Joaquin River tributaries.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Fry	Unknown	400	207	Collect, Sample, and Transport Live Animal	Trap, not listed here	Anesthetize; Fin clip - mark; Tag, Coded-Wire; Tag, PIT; Tissue Sample Fin or Opercle	Emergence traps; broodstock collection.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Fry	Unknown	600	0	Intentional (Directed) Mortality	Trap, not listed here	Tissue Sample Fin or Opercle	Emergence traps; direct mortality for genetic analysis.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Juvenile	Male and Female	2,700	100	Collect, Sample, and Transport Live Animal	Trap, RST	Anesthetize; Fin clip - mark; Tag, Coded-Wire; Tag, PIT; Tissue Sample Fin or Opercle	Weir, beach seine, and/or fyke net may also be used if conditions are appropriate. Includes San Joaquin River tributaries.

Table 10. Annual Authorized Take for ESA Section 10(a)(1)(A) Permit 20517-2R by ESU, Life Stage, Origin, and Activity for SJRRP Hatchery Releases – Juvenile Production and Ancillary Broodstock. Take in this table is for accounting purposes only. Annual numbers of animals taken under this permit can be found in annual reports on the NMFS APPS website[14].

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Juvenile	Male and Female	1,250,000	37,500	Collect, Sample, and Transport Live Animal	Hand and/or Dip Net	Fin clip - mark; Paint, Stain or Dye Immersion; Tag, Acoustic or Sonic (Internal); Tag, Coded-Wire; Tag, PIT; Tissue Sample Fin or Opercle	Releases from facility, 3% indirect mortality from handling, transport and release.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Juvenile	Male and Female	320	0	Intentional (Directed) Mortality	Hand and/or Dip Net	Tissue sample (other internal tissues)	Pre-release health assessment, 20 fish per release group, up to 16 release groups.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Juvenile	Male and Female	5,400	75	Collect, Sample, and Transport Live Animal	Hand and/or Dip Net	Fin clip - mark; Tag, Acoustic or Sonic (External); Tag, Acoustic or Sonic (Internal); Tag, Coded-Wire; Tag, Floy; Tag, PIT; Tissue Sample Fin or Opercle	Release of ancillary broodstock into river at age-0 or 1.
Salmon, Chinook	Central Valley spring-run	Listed Hatchery Adipose Clip	Juvenile	Male and Female	100	0	Intentional (Directed) Mortality	Hand and/or Dip Net	Fin clip - mark; Tag, Acoustic or Sonic (External);	Pre-release health screening of age-0

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
	(NMFS Threatened)								Tag, Acoustic or Sonic (Internal); Tag, Coded-Wire; Tag, Floy; Tag, PIT; Tissue Sample Fin or Opercle	to age-1ancillary broodstock.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Subadult/ Adult	Male and Female	2,500	75	Collect, Sample, and Transport Live Animal	Hand and/or Dip Net	Fin clip - mark; Tag, Coded-Wire; Tissue sample (other internal tissues)	Release of ancillary broodstock, age >1 year.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Subadult/ Adult	Male and Female	100	0	Intentional (Directed) Mortality	Hand and/or Dip Net	Tissue sample (other internal tissues)	Pre-release health screening for release of ancillary broodstock, age >1 year.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Intact Adipose	Egg	Unknown	600,000	600,000	Unknown	N/A	Anesthetize; Fin clip - mark; Tissue sample (other internal tissues); Tissue Sample Fin or Opercle; Tissue Sample Otolith	Indirect mortality from rearing fish from egg to release size (estimated to be no more than 50% indirect mortality of the maximum annual juvenile production).
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Adult	Male and Female	2,000	0	Intentional (Directed) Mortality	Hand and/or Dip Net	Anesthetize; Tissue sample (other internal tissues); Tissue Sample Fin or Opercle	Accounting for mortality from spawning fish in captive broodstock.

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Subadult	Male and Female	180	0	Intentional (Directed) Mortality	Hand and/or Dip Net	Tissue sample (other internal tissues)	Annual Fish Health Certification requires the sacrifice of 60 fish of varying sizes for health assessment; 1 certification event per facility, up to 3 certification events per year.

Table 11. Annual accounting of individuals for Activity for Research, Monitoring, and Evaluation Activities in the SJRRP Restoration Area. The Central Valley spring-run Chinook salmon in this table are part of a non-essential experimental population. The numbers in this table are only for accounting and monitoring purposes.

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Adult	Male and Female	2,500	0	Observe/Harass	Observations at weirs, fish ladders, dams or in river where no trapping occurs		Monitor for returning adults with a camera unit.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Adult	Male and Female	2,500	0	Observe/Harass	Observations at weirs, fish ladders, dams or in river where no trapping occurs		Monitor for returning adults with a camera unit.
Salmon, Chinook	Central Valley spring-run	Listed Hatchery	Adult	Male and Female	500	0	Observe/Harass	Observations at weirs, fish ladders, dams		Monitor for returning adults with a camera unit.

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
	(NMFS Threatened)	Intact Adipose						or in river where no trapping occurs		
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Adult	Male and Female	2,500	50	Collect, Sample, and Transport Live Animal	Net, Fyke	Tag, Floy; Tag, PIT; Tissue Sample Fin or Opercle; Tissue Sample Scale	Capture and transport of returning adults to spawning grounds. Fish will only be transported if necessary. Disc tags may be used instead of floy tags. Additional capture methods (adult weir, seine, trammel net, fyke trap may be used).
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Adult	Male and Female	2,500	50	Collect, Sample, and Transport Live Animal	Net, Fyke	Tag, Acoustic or Sonic (Internal); Tag, Floy; Tag, PIT; Tissue Sample Fin or Opercle; Tissue Sample Scale	Capture and transport of returning adults to spawning grounds. Fish will only be transported if necessary. Disc tags may be used instead of floy tags. Additional capture methods (adult weir, seine, trammel net, fyke trap may be used).
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Intact Adipose	Adult	Male and Female	100	2	Collect, Sample, and Transport Live Animal	Net, Fyke	Tag, Acoustic or Sonic (Internal); Tag, Floy; Tag, PIT;	Capture and transport of returning adults to spawning grounds. Fish will only be

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
									Tissue Sample Fin or Opercle; Tissue Sample Scale	transported if necessary. Disc tags may be used instead of floy tags. Additional capture methods (adult weir, seine, trammel net, fyke trap may be used).
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Adult	Male and Female	2,500	50	Collect, Sample, and Transport Live Animal	Hand and/or Dip Net		We will survey barriers, sloughs, and backwater areas for any fish that get past the trap and collect with dip nets. Capture and transport of returning adults to spawning grounds. Disc tags may be used instead of floy tag.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Adult	Male and Female	2,500	50	Collect, Sample, and Transport Live Animal	Hand and/or Dip Net		We will survey barriers, sloughs, and backwater areas for any fish that get past the trap and collect with dip nets. Capture and transport of returning adults to spawning grounds. Disc tags may be used instead of floy tag.

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Intact Adipose	Adult	Male and Female	100	5	Collect, Sample, and Transport Live Animal	Hand and/or Dip Net		We will survey barriers, sloughs, and backwater areas for any fish that get past the trap and collect with dip nets. Capture and transport of returning adults to spawning grounds. Disc tags may be used instead of floy tag.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Adult	Male and Female	2,500	0	Observe/Harass	Visual Surveys		Snorkel / visual observation of adult fish in upper reaches of San Joaquin River.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Adult	Male and Female	2,500	0	Observe/Harass	Visual Surveys		Snorkel / visual observation of adult fish in upper reaches of San Joaquin River.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Intact Adipose	Adult	Male and Female	100	0	Observe/Harass	Visual Surveys		Snorkel / visual observation of adult fish in upper reaches of San Joaquin River.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Adult	Male and Female	2,500	0	Observe/Harass	Spawning Surveys		Redd surveys to identify locations and quantity of spawning redds.
Salmon, Chinook	Central Valley spring-run	Listed Hatchery Adipose Clip	Adult	Male and Female	2,500	0	Observe/Harass	Spawning Surveys		Redd surveys to identify locations

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
	(NMFS Threatened)									and quantity of spawning redds.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Intact Adipose	Adult	Male and Female	100	0	Observe/Harass	Spawning Surveys		Redd surveys to identify locations and quantity of spawning redds.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Spawned Adult/ Carcass	Male and Female	2,500	0	Observe/Sample Tissue Dead Animal	Hand and/or Dip Net	Fin clip - mark; Tag, Floy; Tissue sample (other internal tissues); Tissue Sample Fin or Opercle; Tissue Sample Otolith; Tissue Sample Scale	Carcass surveys by boat and foot.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Spawned Adult/ Carcass	Male and Female	2,500	0	Observe/Sample Tissue Dead Animal	Hand and/or Dip Net	Fin clip - mark; Tag, Floy; Tissue sample (other internal tissues); Tissue Sample Fin or Opercle; Tissue Sample Otolith; Tissue Sample Scale	Carcass surveys by boat and foot.
Salmon, Chinook	Central Valley spring-run	Listed Hatchery	Spawned Adult/ Carcass	Male and Female	2,500	0	Observe/Sample Tissue Dead Animal	Hand and/or Dip Net	Fin clip - mark; Tag, Floy; Tissue	Carcass surveys by boat and foot.

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
	(NMFS Threatened)	Intact Adipose							sample (other internal tissues); Tissue Sample Fin or Opercle; Tissue Sample Otolith; Tissue Sample Scale	
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Fry	Unknown	60,000	6,000	Capture/Handle /Release Fish	Trap, not listed here		Emergence trap on redds. Assumes 20 redds and up to 3000 fry emerging per redd. Fry are counted a subsample measured and released. Assumed a 10% total mortality rate.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Juvenile	Unknown	120,000	2,400	Capture/Mark, Tag, Sample Tissue/Release Live Animal	Net, Fyke, RST	Dye Injection (tattoo, photonic); Fin clip - mark; Tissue Sample Fin or Opercle; Tissue Sample Scale	Rotary screw trap sampling. Fish will be counted measured and released, a subset of fish may be marked moved upstream and released for trap efficiency calculations, Fin clips may also be taken from a subset of individuals for genetic analysis.

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Listed Hatchery Adipose Clip	Juvenile	Unknown	120,000	2,400	Capture/Mark, Tag, Sample Tissue/Release Live Animal	Net, Fyke, RST	Dye Injection (tattoo, photonic); Fin clip - mark; Tissue Sample Fin or Opercle; Tissue Sample Scale	Rotary screw trap sampling. Fish will be counted measured and released, a subset of fish may be marked moved upstream and released for trap efficiency calculations, Fin clips may also be taken from a subset of individuals for genetic analysis.
Salmon, Chinook	Central Valley spring-run (NMFS Threatened)	Natural	Juvenile	Unknown	750,000	15,000	Capture/Mark, Tag, Sample Tissue/Release Live Animal transport	Weir, surface collector, RST, CBFRF	Dye Injection (tattoo, photonic); Finclip - mark; Tissue Sample Fin or Opercle	This effort will be to assist fish with emigrating out of the system when they are not able to migrate out on their own due to river conditions such as no flow connectivity in low water years. Juveniles will be collected then transported.

Table 12. Annual Incidental Take by DPS, Life Stage, Origin, and Activity for Research, Monitoring, and Evaluation Activities in the SJRRP Restoration Area.

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Incidental Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
Steelhead	Unspecified	Natural	Adult	Male and Female	100	0	Observe/Harass	Observations at weirs, fish ladders, dams or in river where no trapping occurs		Monitor for returning adults with a camera unit.
Steelhead	Unspecified	Natural	Adult	Male and Female	50	2	Capture/Handle /Release Fish	Net, Fyke		Incidental capture of Steelhead while targeting Chinook Salmon
Steelhead	Unspecified	Listed Hatchery Adipose Clip	Adult	Male and Female	50	2	Capture/Handle /Release Fish	Net, Fyke		Incidental capture of Steelhead while targeting Chinook Salmon.
Green Sturgeon	Southern DPS (NMFS Threatened)	Natural	Adult	Unkno wn	3	0	Capture/Handle /Release Fish	Net, Fyke		Incidental capture of Green Sturgeon while targeting Chinook Salmon.
Steelhead	Unspecified	Natural	Adult	Male and Female	50	2	Capture/Handle /Release Animal	Hand and/or Dip Net		While surveying for Chinook at barriers, sloughs and backwater areas we may encounter a Steelhead. Any Steelhead encountered will be released back to where they came.

Species	Stock/ Listing Unit	Production/ Origin	Lifestage	Sex	Incidental Take	Authorized Indirect Mortality	Take Action	Observe/ Collect Method	Procedures	Details
Steelhead	Unspecified	Listed Hatchery Adipose Clip	Adult	Male and Female	50	2	Capture/Handle /Release Animal	Hand and/or Dip Net		While surveying for Chinook at barriers, sloughs and backwater areas we may encounter a Steelhead. Any Steelhead encountered will be released back to where they came.
Steelhead	Unspecified	Natural	Adult	Male and Female	50	0	Observe/Harass	Visual Surveys		Snorkel / visual observation of adult fish in upper reaches of San Joaquin River. Target is Chinook, but observations of Steelhead will be recorded.
Steelhead	Unspecified	Listed Hatchery Adipose Clip	Adult	Male and Female	50	0	Observe/Harass	Visual Surveys		Snorkel / visual observation of adult fish in upper reaches of San Joaquin River. Target is Chinook, but observations of Steelhead will be recorded.
Steelhead	Unspecified	Natural	Juvenile	Unkno wn	100	2	Capture/Handle /Release Fish	Trap, RST	T-Bar	Potential incidental capture of Steelhead in rotary screw traps targeting Chinook Salmon.

2.8.2. Effect of the Take

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

2.8.3. 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).

In addition the conditions for monitoring and research described in Section 1.3.1.5 above, NMFS concludes that the following reasonable and prudent measures are necessary and appropriate to minimize effects to listed species.

1. Measures shall be taken by the USFWS, SJRRP agencies (applicants) to follow all conditions specified in the permit (20571-2R), as well as, guidelines specified in this opinion.

2. Measures shall be taken to produce an annual report on the status of collections and summary of the coming year's proposed collections, submitted to NMFS and CDFW. The report will become part of the annual report required for the permit to be submitted on the Applications and Permits for Protected Species (APPS) site[15].

2.8.4. 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 Action Agencies 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: *"The applicants follow all conditions specified in the permit (20571-2R), as well as, guidelines specified in this opinion.*"
    a. The Permit Holder shall follow all Special Conditions outlined in 10(a)(1)(A) permit 20571-2R.
    b. Provide advance notice of any change in program operation and implementation that may increase the amount or extent of take, or results in an effect of take not previously considered.
    c. Notify NMFS within 48 hours after knowledge of exceeding authorized take. The applicants shall submit a written report, and/or convene a discussion with NMFS

[15] https://apps.nmfs.noaa.gov/

2. The following terms and conditions implement reasonable and prudent measure 2: "Produce a*n annual report on the status of collections and summary of the coming year's proposed collections will be submitted to NMFS and CDFW. The report will become part of the annual report required for the permit to be submitted on the Applications and Permits for Protected Species (APPS) site*[10]."
   a. Year-End Report: A year-end report shall be submitted on the APPS website by December 31 of each year. This document will summarize the permitted hatchery activities, the actual take of ESA-listed salmonids that occurred during the year, any adaptive processes under review, and any differences between the anticipated actions and what occurred.

      USFWS shall provide a comprehensive annual report to NMFS each year through NMFS' APPS site[10] (as described in Term and Condition 4a). USFWS shall also provide the following on an annual or as needed basis: (1) Donor Stock Collection Plan; (2) notices of fish releases (as described in Term and Condition 1a and 2a); and the Year-End Report (as described in Term and Condition 4a). All reports, as well as all other notifications required in the permit, shall be submitted electronically to the NMFS point of contact for this program:

      Hilary Glenn, 916 200 8211, hilary.glenn@noaa.gov or ccvo.consultationrequests@noaa.gov

      Written materials may also be submitted to:
      NMFS -West Coast Region
      Attn: Hilary Glenn
      California Central Valley Office
      650 Capitol Mall, Suite 5-100
      Sacramento, California 95814

2.9. 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).

1. The USFWS, in cooperation with the NMFS and other entities, should continue to investigate the level of ecological interactions between hatchery-produced CV spring-run Chinook salmon and naturally produced Chinook salmon within the San Joaquin River Basin to identify additional methods to minimize these interactions.

2.10. Reinitiation of Consultation

This concludes formal consultation for the Issuance of ESA Section 10(a)(1)(A) Scientific Research and Enhancement Permit 20571-2R for the Reintroduction of CV spring-run Chinook salmon to the San Joaquin River from the Merced River confluence to Friant Dam.

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 biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

In the context of this biological opinion, there is no incidental take anticipated of CV spring-run Chinook salmon and the reinitiation trigger set out in § 402.16(a)(1) is not applicable. If any of the direct take amounts specified in this biological opinion's effects analysis (Section 2.5) are exceeded, reinitiation of formal consultation will be required because the regulatory reinitiation triggers set out in §402.16(a)(2) and/or (a)(3) will have been met.

2.11. "Not Likely to Adversely Affect" Determinations

NMFS has determined that, while the proposed action may affect Southern Resident killer whales, due to their dependence on Chinook salmon as a prey item, the proposed action is not likely to adversely affect SDPS Southern Resident killer whales. This determination was made pursuant to Section 7(a)(2) of the ESA implementing regulations at 50 CFR Part 402, and agency guidance for preparation of letters of concurrence[16], and is described here.

The applicable standard to find that a proposed action is "not likely to adversely affect" ESA listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial[17]. Beneficial effects are contemporaneous positive effects without any adverse effects on the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are extremely unlikely to occur.

2.11.1. Southern Resident Killer Whales Determination

The Southern Resident killer whale DPS composed of J, K, and L pods was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). The final rule listing Southern Resident killer whales as endangered identified several potential factors that may have caused their decline or may be limiting recovery. These are: quantity and quality of prey, toxic chemicals which accumulate in top predators, and disturbance from sound and vessel traffic. The rule also identified oil spills as a potential risk factor for this species. The final recovery plan includes more information on these potential threats to Southern Resident killer whales (NMFS 2008c). NMFS published the final rule designating critical habitat for Southern Resident killer whales on

[16] Memorandum from D. Robert Lohn, Regional Administrator, to ESA consultation biologists (guidance on informal consultation and preparation of letters of concurrence) (January 30, 2006).
[17] U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Endangered Species Act consultation handbook: procedures for conducting section 7 consultations and conferences. March 1998. Final p.3-12.

November 29, 2006 (71 FR 69054). Critical habitat includes approximately 2,560 square miles of inland waters including Puget Sound, but does not include areas with water less than 20 feet deep relative to extreme high water. The PCEs of Southern Resident killer whale critical habitat are: (1) Water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging.

Southern Resident killer whales spend considerable time in the Georgia Basin from late spring to early autumn, with concentrated activity in the inland waters of Washington State around the San Juan Islands. By early autumn, the range of the whales, particularly J pod, expands to Puget Sound. By late fall, the Southern Resident killer whales make frequent trips to the outer coast and are seen less frequently in the inland waters. In the winter and early spring, Southern Resident killer whales move into the coastal waters along the outer coast from southeast Alaska south to central California.

Southern Resident killer whales consume a variety of fish and one species of squid, but salmon, and Chinook salmon in particular, are their primary prey (review in NMFS 2008c). Ongoing and past diet studies of Southern Resident killer whales conduct sampling during spring, summer and fall months in inland waters of Washington State and British Columbia (i.e., Ford and Ellis 2006; Hanson et al. 2010, ongoing research by the Northwest Fisheries Science Center (NWFSC)). Therefore, the majority of our knowledge of diet is specific to inland waters and less is known about their diet off the Pacific Coast. However, chemical analyses support the importance of salmon in the year-round diet of Southern Resident killer whales (Krahn et al. 2002, Krahn et al. 2007). Prey and fecal samples recently collected during the winter and spring indicates a diet dominated by salmonids, particularly Chinook salmon, with the presence of lingcod and halibut (Ford et al 2016). The predominance of Chinook salmon in the Southern Resident killer whales' diet when in inland waters, even when other species are more abundant, combined with information indicating that the killer whales consume salmon year-round, makes it reasonable to expect that they predominantly consume Chinook salmon when available in coastal waters.

Adverse effects to Southern Resident killer whales associated with the proposed action are not likely to occur. Conversely, Southern Resident killer whales could benefit slightly from hatchery production of CV spring-run Chinook salmon due to an increased forage base of salmon, which is their principal prey item. Without hatchery production, in absence of the historic spawning habitat for Chinook salmon, Southern Resident killer whales would need to expend additional energy to locate and capture available prey. Such a scenario would be expected to decrease the resiliency of Southern Resident killer whale to stochastic events, and further reduce the viability of the DPS. Therefore, the hatchery production associated with the proposed action will result in beneficial effects to Southern Resident killer whales.

2.11.2. Conclusion

NMFS concludes that all effects of the proposed action are not likely to adversely affect SDPS Southern Resident killer whales, nor would it adversely affect or modify their designated critical habitat. Effects to Southern Resident killer whales will be beneficial due to an increase in prey items.

2.11.3. Reinitiation

This concludes informal ESA consultation on this action in accordance with 50 CFR 402.14 (b)(1), and MSA consultation in accordance with 50 CFR 600.920 (e)(3). USFWS and U.S. Bureau of Reclamation must reinitiate consultation on this action if new information becomes available, or if circumstances occur that may affect listed species, designated critical habitat, or EFH in a manner, or to an extent, not previously considered.

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 descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The proposed action is the implementation of one hatchery program in the San Joaquin River Basin, as described in detail in Section 1.3. The action area of the proposed action includes habitat described as EFH for Chinook salmon. Because EFH has not been described for steelhead, the analysis is restricted to the effects of the proposed action on EFH for Chinook salmon.

The area affected by the proposed action includes the San Joaquin River from Friant Dam downstream to the confluence of the San Joaquin and Merced Rivers.

As described by PFMC (2003):

> "Freshwater EFH for [C]hinook salmon consists of four major components, (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and adult holding habitat."

The aspects of EFH that might be affected by the proposed action include effects of hatchery operations on ecological interactions in spawning and rearing areas.

3.2. Adverse Effects on Essential Fish Habitat

The proposed action generally does not have effects on the major components of EFH. Spawning and rearing locations and adult holding habitat are not expected to be affected by operation of the program, as no modifications to these areas would occur, and no structures that would impede migration are included or proposed to be constructed. Potential effects on EFH by the proposed action are only likely to occur in the migration corridor in the San Joaquin River.

As described in Section 2.4.2, water withdrawal for hatchery operations can adversely affect salmon by reducing streamflow, impeding migration, or reducing other stream-dwelling organisms that could serve as prey for juvenile salmonids. Water withdrawals can also kill or injure juvenile salmonids through impingement upon inadequately designed intake screens or by entrainment of juvenile fish into the water diversion structures. The proposed hatchery program includes designs to minimize each of these effects. Criteria for surface water withdrawal are set to avoid impacts on CV spring-run Chinook salmon and CCV steelhead spatial structure. Further, the amount of water to be removed will be largely returned to the river approximately 0.5 miles from the point of withdrawal and the intake is screened in compliance with NMFS criteria.

The PFMC (2003) recognized concerns regarding the "genetic and ecological interactions of hatchery and wild fish… [which have] been identified as risk factors for wild populations." The biological opinion describes in considerable detail the impacts hatchery programs might have on natural populations (Section 2.4.1). Hatchery fish returning to the San Joaquin River are expected to largely spawn in Reach 1. Competition is not anticipated as these fish are being reintroduced to the San Joaquin River, an area where salmon and steelhead have been previously extirpated. Some CV spring-run Chinook from the SJRRP's Conservation Program will stray into other rivers and tributaries, but likely not in numbers that would cause the carrying capacities of natural production areas to be exceeded, or that would result in increased incidence of disease or increases in predators. Predation by adult hatchery-origin Chinook salmon on juvenile natural origin Chinook salmon would be minimal due to timing differences and the fact that adult salmon stop feeding by the time they reach spawning areas, and predation by juvenile offspring of hatchery salmon on juvenile natural-origin Chinook salmon would not occur for reasons discussed in Section 2.4.2.

3.3. Essential Fish Habitat Conservation Recommendations

For each of the potential adverse effects by the proposed action on EFH for Chinook salmon, NMFS believes that the proposed action, as described in the HGMP (CDFW 2023), and the ITS (Section 2.9) includes the best approaches to avoid or minimize those adverse effects. The Reasonable and Prudent Measures and Terms and Conditions included in the ITS constitute

NMFS recommendations to address potential EFH effects. USFWS shall ensure that the ITS, including Reasonable and Prudent Measures and implementing Terms and Conditions are carried out.

To address the potential effects on EFH of hatchery fish on natural fish in natural spawning and rearing areas, the PFMC (2003) provided an overarching recommendation that hatchery programs:

> "[c]omply with current policies for release of hatchery fish to minimize impacts on native fish populations and their ecosystems and to minimize the percentage of nonlocal hatchery fish spawning in streams containing native stocks of salmonids."

NMFS adopts this recommendation as a specific conservation recommendation for this proposed action. The biological opinion explicitly discusses the potential risks of hatchery fish on fish from natural populations and their ecosystems, and describes operation and monitoring appropriate to minimize these risks on Chinook salmon in the San Joaquin River basin. In abiding by the Terms and Conditions of the biological opinion, the NMFS considers the USFWS will be implementing the EFH conservation recommendation.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the Federal agency 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 USFWS 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 biological opinion addresses these DQA components, documents compliance with the DQA, and certifies that this biological 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 biological opinion are the applicants and funding/action agenvies listed on the first page. Individual copies of this biological opinion were provided to the applicants. The document will be available within 2 weeks at the NOAA Library Institutional Repository (https://repository.library.noaa.gov/welcome). The format and naming adhere 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 part 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this biological 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 reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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