DRAFT Environmental Assessment

Draft Environmental Assessment for the Designation and Authorization for Release of Nonessential Experimental Populations of Sacramento River Winter-run and Central Valley Spring-run Chinook Salmon in the McCloud and Upper Sacramento Rivers above Shasta Dam under Endangered Species Act Section 10(j)

NATIONAL MARINE FISHERIES SERVICE

WEST COAST REGION

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Draft Environmental Assessment

Designation and Authorization for Release of Nonessential Experimental Populations of Sacramento River Winter-run and Central Valley Spring-run Chinook Salmon in the McCloud and Upper Sacramento Rivers above Shasta Dam under Endangered Species Act Section 10(j)

Proposed Action: NOAA's National Marine Fisheries Service (NMFS) proposes to:

(1) Designate and authorize release of nonessential experimental populations of Sacramento River winter-run Chinook salmon and Central Valley spring-run Chinook salmon pursuant to the Endangered Species Act section 10(j) in the McCloud and Upper Sacramento Rivers above Shasta Dam; and

(2) Establish take prohibitions for the nonessential experimental populations and exceptions for particular activities under ESA section 4(d)

Type of Statement: Environmental Assessment (Draft)

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APE	Area of Potential Effects
BMP	Best Management Practice
BO	Biological Opinion
CCV	California Central Valley
CDFW	California Department of Fish and Wildlife
CEQA	
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CV	Central Valley
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
DPS	Distinct Population Segment
DWR	Department of Water Resources
EA	Environmental Assessment
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FERC	Federal Energy Regulatory Commission
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
GHG	Green House Gas
HGMP	Hatchery and Genetic Management Plan
ITS	Incidental Take Statement
IUCN	International Union for Conservation of Nature
MMWAT	Monthly Maximum Weekly Average Temperature
NEPs	Nonessential Experimental Populations
NGO	
NFH	National Fish Hatchery
NMFS	National Marine Fisheries Service
NTU	Nephelometric Turbidity Units
OHP	State of California Office of Historic Preservation
PG&E	Pacific Gas & Electric
RWQCB	
RM	River Mile
RPA	Reasonable and Prudent Alternative
SDFPE	Shasta Dam Fish Passage Evaluation
SR	Sacramento River
STNF	
SWP	State Water Project
TRT	Technical Review Team
UKTR	Upper Klamath-Trinity Rivers
USFWS	United States Fish and Wildlife Service

USFS	United States Forest Service
USGS	United States Geological Survey

1.0 INTRODUCTION AND BACKGROUND

The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) proposes to establish rules pursuant to sections 10(j) and 4(d) of the Endangered Species Act (ESA) (16 United States Code [U.S.C.] 1531 *et seq.*) to designate and authorize the release of nonessential experimental populations (NEPs or experimental populations) of Sacramento River (SR) winter- run Chinook salmon (*Oncorhynchus tshawytscha*) and Central Valley (CV) Chinook salmon (*O. tshawytscha*) upstream of Shasta Dam (the NEP Area) under ESA section 10(j) (16 USC 1531(5)(c)(2); 16 USC 1535(a)).

NMFS' rulemaking establishes rules pursuant to sections 10(j) and 4(d) of the ESA (16 United States Code [U.S.C.] 1531 et seq.) to designate and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and establish "take" prohibitions for the NEPs and exceptions for particular activities. NMFS rulemaking generally prohibits take of members of the NEPs when in the NEP Area, but provides exceptions to take prohibitions for particular activities, including take that is incidental to an otherwise lawful activity and is unintentional, not due to negligent conduct.

NMFS prepared this Environmental Assessment (EA) pursuant to the National Environmental Policy Act (NEPA) (16 U.S.C. 4321 et seq.), Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR parts 1500-1508), and NOAA policies and procedures implementing NEPA. This EA is prepared using the 1978 CEQ NEPA regulations. NEPA reviews initiated prior to the effective date of the 2020 CEQ regulations may be conducted using the 1978 version of the regulations. The effective date of the 2020 CEQ NEPA Regulations was September 14, 2020. This review began on February 27, 2017, and the agency has decided to proceed under the 1978 regulations.

ESA section 10(j) provides NMFS the authority to designate a population of listed species as an "experimental population." This designation allows NMFS to authorize the release of such a population outside of the species' current range when doing so will further the conservation of the listed species.

When designating a population as an experimental population, additional classification to the population is required under the ESA. NMFS must determine whether the population is "essential" to the continued existence of the listed species (i.e., loss of the experimental populations would appreciably reduce the likelihood of the survival of the species in the wild).

If not, the population would be classified as "nonessential" (i.e., release of the population will further the conservation of the species, but loss of the population would not appreciably reduce the likelihood of the survival of the species in the wild). Additionally, protective regulations often accompany an experimental population designation under ESA section 10(j). Under ESA section 4(d), "take" restrictions can be established and limited when doing so would provide for the conservation of the species.

SR winter-run Chinook salmon are listed as "endangered" under the ESA. CV spring-run Chinook salmon are listed as a "threatened" species under the ESA. Rates of decline for salmon and steelhead (*O. mykiss*) in the Central Valley increased following construction of major dams and water project facilities (NMFS 2014), which primarily occurred around the mid-1900s. These water development projects in general, and dams in particular, block upstream migration of Chinook salmon and steelhead to spawning and rearing habitats, and alter flow, gravel\large wood supply, and water temperature regimes downstream.

In 2014, NMFS issued a recovery plan that prioritized reintroduction into historical habitats as an essential recovery action for SR winter-run and CV spring-run Chinook salmon Evolutionarily Significant Units (ESUs). The NEP Area was identified as a high priority for reintroduction in the recovery plan (NMFS 2014).

NOAA Fisheries vulnerability assessments have determined that the future viability of anadromous migratory salmon is at high risk due to impacts from climate change (Crozier et al. 2019). Thus, reintroduction into cold water habitats upstream of large Central Valley reservoirs is a high priority for long-term conservation and recovery of listed Central Valley salmon and steelhead, as outlined in NOAA Fisheries' Central Valley Recovery Plan, the State's 2016 Water Action Plan (referenced by the new 2020 Water Resilience Portfolio) and Sacramento Valley Salmon Resiliency Strategy, the California Department of Fish and Wildlife's (CDFW) State Wildlife Action Plan and associated California State Wildlife Action Plan (SWAP) and the Winnemem Wintu Tribe's Salmon Restoration Plan.

Until the construction of the Shasta Dam, large numbers of Sacramento River winter-run Chinook salmon (winter-run Chinook salmon) spawned in the Upper Sacramento, Pit, and McCloud rivers. But with the construction of the dam, winter-run Chinook salmon have been prevented from accessing high quality, high elevation, cold water spawning and rearing habitats. Climate change and drought have added threats to winter-run Chinook salmon's long-term survival, with warmer

waters impacting historic current spawning and rearing sites. Now, winter-run survive by spawning in the heavily managed and sometimes unnaturally warm Sacramento River below Shasta Dam, where their numbers have since dwindled. For instance, only about 5% of winter-run Chinook salmon eggs incubating in the river survived the 2014-2015 California drought due to warmer than usual water releases from Shasta Dam.

Shasta Salmonid Juvenile Collection System – In February 2022, the California Department of Water Resources (DWR) received $1.5 million in funding for the Juvenile Salmonid Collection System (JSCS) Pilot Project in the McCloud Arm of Shasta Lake —the first step of a program to return winter-run Chinook salmon to their historical habitats. The goal of the project is to test a system that would improve fish passage around high-head dams through the efficient collection and downstream passage for juvenile fish migrating out to the ocean. The success of this project is an integral step in the reintroduction of native salmonids back into historical spawning and rearing tributaries of the Upper Sacramento River system.

In search of a fish passage solution, the JSCS Project will test an experimental, adaptive, and mobile guidance and capture system designed to collect out-migrating salmon. The proposed experimental evaluation approach will determine if the system creates the desired conditions to guide fish, control water temperatures, and manage debris. No fish were used to test the collection efficiency of the system during the initial year of testing. It's anticipated that juvenile winter-run Chinook salmon could be used in future testing. The JSCS design and evaluation team is led by DWR in partnership with NOAA Fisheries, the California Department of Fish and Wildlife, the Winnemem Wintu Tribe, and others.

Sacramento winter-run Chinook salmon "Urgent Actions" - In response to entering a third consecutive year of drought, NOAA Fisheries, the United States Fish and Wildlife Service (USFWS), and CDFW (fish agencies) initiated discussions in the late winter and early spring of 2022 to identify urgent actions to protect winter Chinook salmon in the Sacramento River. Water temperature modeling results in February and March 2022 indicated that Shasta Reservoir coldwater storage was insufficient to protect this species. The modeled water temperature and resultant egg and fry survival projections for summer and early fall showed very high mortality numbers for early life stages of winter-run Chinook salmon. With estimated anticipated temperature dependent mortality greater than 90% for eggs and fry, the agencies considered the potential future condition to be catastrophic to the species following 88% mortality in 2020 and

97% mortality in 2021 at the egg to fry (ETF) stage. A third year of high ETF mortality– especially as high as projected – would have arguably decimated an endangered species that exhibits predominantly a three-year life cycle. To minimize the impacts of the continued drought on spring-run and winter-run Chinook salmon, NMFS and other agencies identified a series of urgent actions to implement in 2022 including incubating a portion of winter-run Chinook salmon eggs from Livingston Stone National Fish Hatchery (NFH) along the McCloud River (the McCloud Action). The purposes of the McCloud Action are to: (1) provide an additional winter-run Chinook salmon egg incubation and rearing location to spread the risk of adverse impacts to early life stages caused by extreme drought; (2) collect information on the Remote-Site Incubator (RSI) system and rotary screw traps as a means to inform future winter-run Chinook salmon recovery actions on the McCloud River; and (3) study juvenile winter-run Chinook salmon growth, survival, and outmigration timing in their historical habitat to inform the long-term recovery planning.

As part of the McCloud Action, NMFS, CDFW, and the Winnemem Wintu Tribe housed winter-run chinook eggs in incubators on the banks of the McCloud River well upstream of Shasta Reservoir. This was intended to provide guaranteed cold water to the eggs and therefore increase their likelihood of survival. Approximately 40,000 eggs from the hatchery were incubated at a site on the McCloud River. Once hatched a few weeks later, free swimming winter-run Chinook salmon were in the McCloud River for the first time in over 80 years. Hundreds of juvenile fish from those incubators were captured in the McCloud River downstream of the incubators and translocated around Shasta Reservoir to a release site in the Sacramento River below Keswick Dam to continue rearing and outmigrating. It's anticipated that NMFS, CDFW, and the Winnemem Wintu Tribe will continue moving winter-run Chinook salmon upstream of Shasta Dam into the future.

By letter dated August 5, 2022, the U.S. Forest Service, Shasta Trinity National Forest requested NMFS take actions necessary to designate winter-run Chinook salmon as an experimental population under section 10(j) of the Endangered Species Act:

> "*As previously discussed, for any future actions to relocate winter-run Chinook salmon above Shasta Dam, the Forest Service requests that National Marine Fisheries Service designate any Sacramento River winter-run Chinook salmon upstream of Shasta Dam as a nonessential experimental population under ESA section 10(j). This designation will*

safeguard continued management of National Forest System lands while simultaneously conserving the endangered winter-run Chinook salmon."

Currently, SR winter-run and CV spring-run Chinook salmon spawning is limited to the mainstem Sacramento River downstream of Shasta and Keswick Dams that block access to historical cold water summer spawning and rearing habitats. Shasta Dam and reservoir were constructed in 1945, are owned and operated by Reclamation in conjunction with other facilities to provide flood damage reduction, irrigation, municipal and industrial water supply, manage instreamflows and to generate hydropower.

NMFS' proposed action is to:

(1) Designate and authorize release of nonessential experimental populations of SR winter-run and CV spring-run Chinook salmon pursuant to ESA section 10(j) in the McCloud and Upper Sacramento Rivers above Shasta Dam (the NEP Area); and

(2) Establish take prohibitions for the NEPs in the NEP Area and exceptions for particular activities under ESA section 4(d).

1.1. Federal Lead and Cooperating Agencies

NMFS is the lead agency in this NEPA process. Cooperating agencies in this NEPA process include the U.S. Forest Service (USFS) – Shasta Trinity National Forest (STNF) and California Department of Fish and Wildlife (CDFW).

1.2. Overview of the ESA Section 10(j) Designation Regulatory Framework

1.2.1 The Endangered Species Act

The ESA (16 U.S.C. 1531 *et seq*.) authorizes the Secretaries of the Interior and of Commerce (Secretaries) to list species as threatened and endangered and to provide for their conservation through critical habitat designation, protective regulations, recovery plans, Federal agency consultation, and permitting. As an agency within the Department of Commerce, NMFS has been delegated the authority to implement the Secretary of Commerce's responsibilities under the ESA for marine and anadromous species. SR winter-run Chinook salmon and CV spring-run Chinook salmon are ESA-listed anadromous species.

The statutory criteria for designating an experimental population are in ESA section 10(j). ESA section 10(j)(1) provides "the term 'experimental population' means any population (including

any offspring arising solely therefrom) authorized by the Secretary for release under paragraph (2), but only when, and at such times as, the population is wholly separate geographically from nonexperimental populations of the same species" (16 U.S.C. 1539(j)(1)). For the designations being considered in this EA, individuals of the proposed experimental populations are geographically separate when upstream of Shasta Dam in the NEP Area and not geographically separate when downstream of the Shasta and Keswick Dams in the lower Sacramento River, and all other downstream areas throughout their lifecycle. Consequently, individual SR winter-run and CV spring-run Chinook salmon from the proposed experimental populations, when downstream of Shasta and Keswick Dams, are afforded the same take prohibitions and protections as the individuals throughout the designated SR winter-run and CV spring-run Chinook salmon ESUs.

1.2.2 Sacramento River Winter-run Chinook Salmon ESA Listing

NMFS listed the SR winter-run Chinook salmon ESU as endangered under the ESA on January 4, 1994 (59 Fed. Reg. 440) and reaffirmed this status on June 28, 2005 (70 Fed. Reg. 37160), August 15, 2011 (76 Fed. Reg. 50448), April 14, 2014 (79 Fed. Reg. 20802), and May 26, 2016 (81 Fed. Reg. 33468). Section 9 of the ESA prohibits take of the endangered SR winter-run Chinook salmon. The State of California listed SR winter-run Chinook salmon as endangered in 1989 under the California Endangered Species Act (CESA). The listed ESU (Figure 1) is composed of a single population that includes all naturally spawned SR winter-run Chinook salmon in the Sacramento River and its tributaries (70 Fed. Reg. 37160, June 28, 2005), as well as SR winter-run Chinook salmon that are part of the conservation hatchery program at the Livingston Stone National Fish Hatchery (NFH) (R. Jones, NMFS, letter to Chris Yates, NMFS, September 28, 2015, regarding inclusion of Livingston Stone NFH fish in the ESU; 81 Fed. Reg. 33468, May 26, 2016).

Designated critical habitat of SR winter-run Chinook salmon (58 Fed. Reg. 33212, June 16, 1993) includes: (1) the Sacramento River from Keswick Dam, Shasta County (River Mile (RM) 302) to Chipps Island (RM 0) at the westward margin of the Delta; (2) all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; (3) all waters of San Pablo Bay westward of the Carquinez Bridge; and (4) those waters north of San Francisco-Oakland Bay Bridge.

Figure 1 Current and historical range of SR winter-run Chinook salmon.

1.2.3 Central Valley Spring-run Chinook Salmon ESA Listing

NMFS listed the CV spring-run Chinook salmon ESU as threatened on September 16, 1999 (64 Fed. Reg. 50394) and reaffirmed this status in a final rule on June 28, 2005 (70 Fed. Reg. 37160), and five-year reviews announced on August 15, 2011 (76 Fed. Reg. 50447), and May 26, 2016 (81 Fed. Reg. 33468). On January 9, 2002 (67 Fed. Reg. 1116), NMFS issued protective regulations under ESA section 4(d) for the threatened CV spring-run Chinook salmon that apply the take prohibitions of section 9(a)(1) of the ESA except for listed exceptions (50 CFR 223.203) (subsection 1.2.3). The State of California listed CV spring-run Chinook salmon as threatened in 1999 under the California Endangered Species Act (CESA).

The listed ESU (Figure 1) includes all naturally spawned populations of CV spring-run Chinook salmon originating from the Sacramento River and its tributaries, as well as the Feather River Hatchery (FRH) CV Spring-run Chinook Salmon Program (79 Fed. Reg. 20802, April 14, 2014). The ESU is currently limited to: (a) independent populations in Mill, Deer, and Butte Creeks, (b) persistent and presumably dependent populations in the Feather and Yuba Rivers, (c) persistent and presumably dependent populations in Big Chico, Antelope, and Battle Creeks, and (d) a few ephemeral or dependent populations in the northwestern California region (e.g., Beegum, Clear, and Thomes Creeks). Significant areas of historical habitat, mostly in the upper watersheds, are blocked by a series of dams in the Sacramento and San Joaquin basins (Figure 1). The San Joaquin River watershed downstream of tributary dams is accessible, but populations were largely extirpated until recent reintroduction efforts in the mainstem of the San Joaquin River went into effect.

Designated critical habitat of CV spring-run Chinook salmon (70 Fed. Reg. 52488, September 2, 2005) occupies 37 hydrologic subareas within the freshwater and estuarine range of the ESU, and includes approximately 1,373 miles (2,197 kilometers (km)) of occupied stream habitat and approximately 427 square miles (1,102 square km) of estuarine habitat in San Francisco-San Pablo-Suisun Bay.

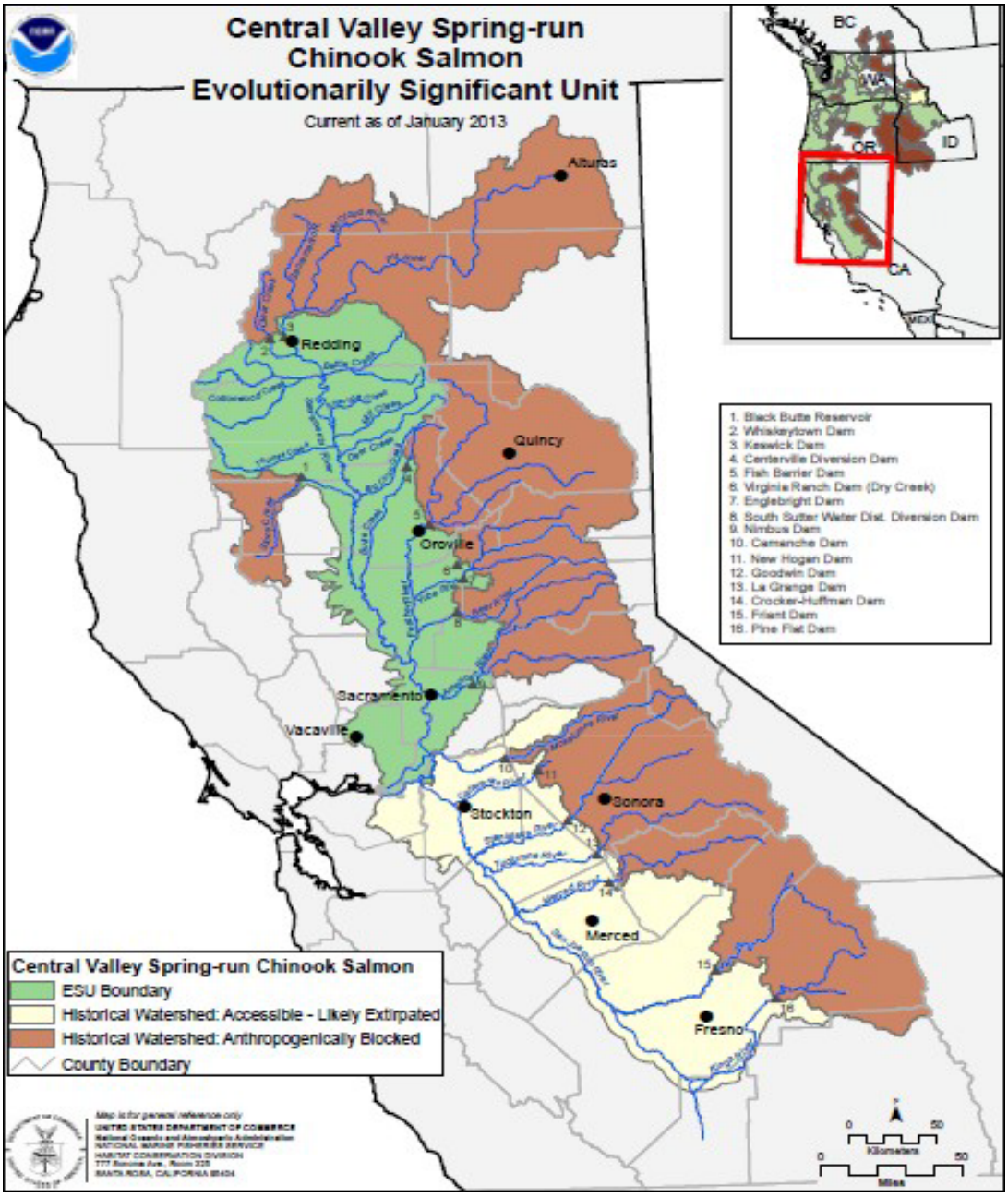

Figure 2. Current and historical range of CV spring-run Chinook salmon.

1.2.4 Experimental Populations under ESA section 10(j)

1.2.4.1 Congressional History and Intent

When Congress enacted the ESA, it intended that Federal agencies would cooperate with states and other interested parties (through Federal financial assistance and a system of incentives) to develop and maintain conservation programs, and to resolve water resource issues in concert with the conservation of listed species (16 U.S.C. 1531(5)(c)(2); 16 U.S.C. 1535). When Congress amended the ESA in 1982, it added section 10(j) to reduce opposition to the reintroduction of listed species outside of their current range, and to give the Secretaries flexibility and discretion in ESA management for purposes of species conservation. "Congress added section 10(j) to the Endangered Species Act in 1982 to address the Fish and Wildlife Service's and other affected agencies' frustration over political opposition to reintroduction efforts perceived to conflict with human activity. Although the Secretary already had authority to conserve a species by introducing it in areas outside its current range, Congress hoped the provisions of section 10(j) would mitigate landowner fears that experimental populations would halt development projects, and, with the clarification of the legal responsibilities incumbent with the experimental populations, actually encourage private parties to host such populations on their lands." *Wyoming Farm Bureau Federation v. Babbitt*, 199 F.3d 1224, 1231-1232 (10th Cir. 2000) (citing 16 U.S.C. § 1539(j); H.R. Rep. No. 97–567, at 8 (1982), *reprinted in* 1982 U.S.C.C.A.N. 2807, 2808, 2817); *see also Forest Guardians v. U.S. Fish and Wildlife Service*, 611 F.3d 692, 705 (10th Cir. 2010) (quoting *Wyoming Farm Bureau Federation*, 199 F.3d at 1231-1232). Congress designed ESA section 10(j) to provide Federal agencies with more flexibility and discretion in managing the reintroduction of listed species. *Wyoming Farm Bureau Federation*, 199 F.3d at 1233; *see also Forest Guardians*, 611 F.3d at 705. ESA section 10(j) was also designed to encourage the recovery of species through population re-establishment with the cooperation of state and local entities (Wolok 1996).

Congress viewed ESA section 10(j) as an opportunity "to encourage the recovery of species through population re-establishment with the cooperation of, not despite, state and local groups." (Wolok 1996). As such, Congress intended that regulations promulgated by the Services to designate experimental populations "should be viewed as an agreement among the Federal agencies, the state fish and wildlife agencies and any landowners involved" (Wolok 1996 quoting H.R. Rep. No. 567, 97th Cong., 2d Sess. 34 (1982)).

1.2.4.2 Statutory and Regulatory Framework

Before authorizing the release of any experimental population, NMFS must "by regulation identify the population and determine, on the basis of the best available information, whether or not such population is essential to the continued existence of … [the listed] species" (ESA section 10(j)(2)(B)).

An experimental population is treated as a threatened species, except that non-essential populations do not receive the benefit of certain protections normally applicable to threatened species (ESA section 10(j)(2)(C)). For endangered species, section 9 of the ESA prohibits take of those species. For a threatened species, ESA section 9 does not specifically prohibit take of those species, but the ESA instead authorizes NMFS to adopt regulations under section 4(d) to prohibit take or that it deems necessary and advisable for species conservation. The proposed experimental populations of SR winter-run and CV spring-run Chinook salmon must generally be treated as threatened species. Therefore, we propose to issue tailored protective regulations under ESA section 4(d) for the proposed experimental populations of SR winter-run and CV spring-run Chinook salmon to identify take prohibitions to provide for the conservation of the species with exceptions for particular activities.

1.2.4.3 ESA Section 10(j) Regulations

In 2016, NMFS promulgated regulations to guide implementation of ESA section 10(j) (81 Fed. Reg. 33416, May 26, 2016; codified at 50 CFR 222.501-222.504). NMFS must apply these regulations to the Proposed Action considered in this EA. NMFS' regulations define an essential experimental population as one "*whose loss would be likely to appreciably reduce the likelihood of the survival of the species in the wild*." All other experimental populations are classified as nonessential (50 CFR 222.501(b)). This definition was directly derived from the legislative history of the ESA amendments that created section 10(j). In addition, 50 CFR 222.502(b) provides, before authorizing the release of an experimental population, "the Secretary must find by regulation that such release will further the conservation of the species."

1.2.4.4 Nonessential Experimental Population Designation and Regulatory Restrictions

Regulatory restrictions can be limited with a NEP designation. Under the ESA, species listed as endangered or threatened are afforded protection primarily through prohibitions of section 9 and the requirements of section 7. ESA section 9 prohibits take of endangered species and prohibits violation of any protective regulation established for a threatened species under ESA section

4(d). ESA section 10(j)(2)(C) requires that each member of an experimental population shall generally be treated as threatened. Therefore, and pursuant to NMFS' ESA section 10(j) implementing regulations at 50 CFR 222.503, NMFS proposes to issue tailored protective regulations under ESA section 4(d) for the proposed experimental populations of SR winter-run and CV spring-run Chinook salmon to identify take prohibitions to provide for the conservation of the species with exceptions for particular activities.

ESA section 10(j)(2)(C) also provides certain exceptions from the requirement that each member of an experimental population shall generally be treated as threatened, including, for purposes of ESA section 7 (other than subsection (a)(1)), a NEP shall be treated as if it were a species "proposed to be listed," rather than a species that is listed (unless it is located within a National Wildlife Refuge or National Park, in which case it is treated as listed). This means the ESA section 7(a)(2) consultation requirement would not apply to Federal agency actions affecting the NEPs in the NEP Area upstream of Shasta Dam. The NEPs would generally be treated as a proposed species for purposes of ESA section 7. In addition, no critical habitat can be designated for a NEP. Only two provisions of ESA section 7 would apply to the NEPs: (1) section 7(a)(1) (requiring Federal agencies to use their authorities to further the purposes of the ESA by carrying out programs for the conservation of listed species); and (2) section 7(a)(4) (requiring Federal agencies to confer with NMFS as applicable depending on the species before taking actions that are likely to jeopardize the continued existence of a species proposed to be listed).

1.2.4.5 ESA section 10(a)(1)(A) and Experimental Populations

ESA section 10(a)(1)(A) allows the Secretaries to grant exceptions to the prohibitions of ESA section 9 for scientific purposes and to enhance the propagation or survival of listed species. This includes acts necessary for the establishment and maintenance of experimental populations as specifically noted in ESA section 10(a)(1)(A). ESA section 10(d) requires the Secretaries to grant exemptions under ESA section 10(a)(1)(A) only after publishing a finding in the Federal Register documenting that such exceptions were: (1) applied for in good faith; (2) if granted would not operate to the disadvantage of such endangered species; and (3) will be consistent with the purposes and policies set forth in ESA section 2.

Individuals used to establish an experimental population may be collected from an existing donor population if donor populations can sustain the removal of fish without adverse population level effects and if appropriate permits are issued in accordance with ESA section 10(a)(1)(A), which would include analysis under NEPA and ESA section 7 for issuance of such permits. Under

section 10(a)(1)(A), Federal and non-Federal entities may apply for permits from NMFS to take ESA-listed species under the jurisdiction of NMFS, if such taking is for scientific purposes or to enhance the propagation or survival of the affected species.

Donor sources for reintroduction into the NEP Area are preliminarily identified as Livingston Stone NFH for SR winter-run Chinook Salmon and FRH for CV spring-run Chinook salmon. Identification of the source population(s) would depend upon the genetic diversity needs of the broodstock, the specific conditions of the proposed donor population at the time of reintroduction, and whether the collection would jeopardize the survival and recovery of the species. Any collection of Chinook salmon would likely be subject to a Hatchery and Genetic Management Plan (HGMP) and would require approval of a permit under ESA section 10(a)(l)(A), which includes associated analysis under NEPA and ESA section 7. If NMFS considers using SR winter-run Chinook salmon from naturally spawning populations, only small numbers of fish would be removed from natural populations, and collection would require approval of a permit under ESA section 10(a)(l)(A), which also includes associated analysis under NEPA and ESA section 7. Because authorization for the collection of SR winter-run Chinook salmon and issuance of ESA section 10(a)(1)(A) permits would be analyzed under the ESA and NEPA when NMFS receives the 10(a)(1)(A) permit applications, collection actions are therefore not analyzed in this EA.

In 2015, the USFWS submitted to NMFS two hatchery and genetic management plans (HGMPs) and one ESA section 10(a)(1)(A) permit application for two ongoing hatchery programs at the Livingston Stone NFH (described below under subsection 1.2.6.6, Livingston Stone National Fish Hatchery). In 2016, NMFS provided a letter advising the USFWS that the submitted HGMPs were determined to be sufficient for consideration under section 10(a)(1)(A) of the ESA. On September 29, 2017, section 10(a)(1)(A) permit 16477 was issued to the USFWS authorizing continued operation of the hatchery programs at Livingston Stone NFH (NMFS 2017). Section 10(a)(1)(A) permit 16477 is set to expire on December 31, 2027. These propagation programs would continue regardless of the section 10(j) designations described herein.

In authorizing the release of an experimental population of SR winter-run and CV spring-run Chinook salmon above Shasta Dam under ESA section 10(j), NMFS would issue permits under ESA section 10(a)(1)(A). A section 10(a)(1)(A) permit is required because winter-run Chinook salmon are listed as part of the endangered SR winter-run Chinook salmon ESU and because spring-run Chinook salmon are listed as part of the threatened CV spring-run Chinook salmon

ESU. Permits for SR winter-run and CV spring-run Chinook salmon would include: (1) all aspects involved in the capture, transport, reintroduction, and marking of SR winter-run and CV spring-run Chinook salmon; (2) all aspects of the reintroduction of SR winter-run and CV spring-run Chinook salmon, including the capture, transport, and outplanting of all life stages; and (3) all aspects of monitoring and evaluation associated with these activities.

1.2.5 ESA section 4(d) Regulations

In January of 2002, NMFS adopted a rule under ESA section 4(d) prohibiting the take of four groups of salmon and steelhead in California listed as threatened under the ESA, including CV spring-run Chinook salmon (67 Fed. Reg. 1116, January 9, 2002; codified at 50 CFR 223.203). In addition to applying the take prohibitions in ESA section 9(a)(1), the ESA section 4(d) rule sets forth specific circumstances when the prohibitions would not apply, known as section 4(d) limits (i.e., "conservation standards").

1.2.6 Relationship of the Proposed Experimental Populations to ESA Recovery Efforts

On July 22, 2014, NMFS adopted a final recovery plan for SR winter-run, CV spring-run Chinook salmon and CCV steelhead (79 Fed. Reg. 42504, July 22, 2014). The recovery plan (NMFS 2014) has the overarching aim of recovering the ESUs to warrant removal from the Federal List of Endangered and Threatened Wildlife (50 CFR 17.11). The objectives and criteria to accomplish this goal build upon technical input and guidance provided by the Technical Recovery Team (Lindley et al. 2004; 2006; 2007) that provided the technical framework for the recovery planning process. The conceptual recovery strategy for SR winter-run and CV Chinook salmon includes: (1) securing extant populations by implementing key habitat restoration actions; and (2) establishment of additional viable independent populations in the ESUs. Reintroduction would facilitate implementation of NMFS' recovery plan framework through expanding habitat and establishing additional populations of SR winter-run and CV spring-run Chinook salmon.

The recovery plan identifies reintroduction of SR winter-run and CV spring-run Chinook salmon upstream of Shasta Dam as a priority recovery recommendation. Re-establishing populations above Central Valley rim dams, including above Shasta Dam, would aid in the conservation and recovery of the SR winter-run and CV spring-run Chinook salmon ESU by increasing abundance and productivity, improving spatial structure and diversity, and reducing the risk of extinction.

ESA section 4(c)(2) requires that NMFS conduct a review every five years for all listed species under its responsibility to determine whether any such species should be removed from the list or

changed in status. This requirement would ensure that NMFS is tracking the status of the reintroduced SR winter-run Chinook salmon experimental population, would develop information to assess the effectiveness of this rulemaking, and, if necessary, would trigger revision to the regulation through the rulemaking process. This would ensure that the reintroduction of the SR winter-run and CV spring-run Chinook salmon proposed experimental populations above Shasta Dam is furthering the conservation of the species as expected and it would ensure that the nonessential classifications are reviewed.

1.2.7 Relationship to Other Plans and Policies

Federal, state, and local laws, regulations and policies affect SR winter-run and CV spring-run Chinook salmon in general. Some of these laws, regulations and policies also aid in meeting the goals of the Recovery Plan (NMFS 2014). Below is a summary of laws that provide additional context for the proposed NEP designations. Ongoing or future implementation of these laws is anticipated to provide protections to SR winter-run and CV spring-run Chinook salmon and their habitats.

1.2.7.1 The Federal Power Act

The Federal Energy Regulatory Commission (FERC), pursuant to the Federal Power Act (FPA) and the U.S. Department of Energy Organization Act, is authorized to issue licenses for up to 50 years for the construction and operation of non-Federal hydroelectric developments subject to its jurisdiction.

The McCloud, upper Sacramento, and Pit Rivers are regulated rivers because of the presence of large barrier dams and hydroelectric projects that modify the natural flows in these rivers within the NEP Area. Water flow from smaller tributaries within the NEP Area is largely unregulated by dams and diversions before entering the McCloud, upper Sacramento, and Pit Rivers or Shasta Lake. Descriptions of each major dam are found in the section 5.4.

The FPA authorizes NMFS to issue mandatory prescriptions for fish passage and recommend other measures to protect salmon, steelhead, and other anadromous fish. It is presently uncertain what license terms and conditions FERC will require as part of the ongoing relicensing processes occurring in the NEP Area. If NMFS issues mandatory prescriptions for fish passage under the FPA for a new FERC license, ESA section 10(j) designations and associated protective regulations under ESA section 4(d) would allow NMFS to provide exceptions to take prohibitions appropriate to the circumstances, including NMFS' exception for take of the

proposed experimental population in the NEP Area that is incidental to an otherwise lawful activity and unintentional, not due to negligent conduct, which would apply if passage is implemented pursuant to the FPA.

1.2.7.2 Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act)

The Magnuson-Stevens Act (MSA) (16 U.S.C. 1801 *et seq.*) is the principal law governing marine fisheries conservation and management in the United States. Chinook salmon Essential Fish Habitat (EFH) is identified and described to include "*all water bodies currently or historically occupied by… Chinook salmon… in California*," and Chinook salmon EFH was identified within specified United States Geological Survey (USGS) hydrologic units. Freshwater EFH for Pacific Coast salmon in the CV includes waters currently accessible to salmon within the CV, as well as historically accessible areas (Myers et al. 1998). Under the MSA, Federal agencies are required to determine whether a Federal action they authorize, fund, or undertake may adversely affect EFH (16 U.S.C. 1855(b)). EFH is not currently designated in the NEP Area.

1.2.7.3 Assembly Bill 1133 California Endangered Species Act - Experimental Populations

CESA prohibits the taking of an endangered or threatened species, unless authorized. CDFW may authorize take of listed species if the take is incidental to an otherwise lawful activity and impacts are minimized and fully mitigated.

On September 25, 2017, Governor Brown approved Assembly Bill No. 1133, which authorizes the incidental take of an endangered, threatened, or candidate species designated as an experimental population under the Federal ESA, without the need for further authorization or approval under CESA, if specified requirements are met. California Fish and Game Code sections 2080.5 and 2080.6 address the authorization of take associated with experimental populations. In addition, California Fish and Game Code section 2080.7 addresses public outreach efforts regarding the introduction of experimental populations.

1.2.7.4 The Clean Water Act

Section 404 of the Clean Water Act (CWA) (33 U.S.C. 1344) requires a permit before dredged or fill material may be discharged into waters of the United States, unless the activity is exempt. This permit program provides avoidance, minimization, and mitigation measures for the potential adverse effects of dredge and fill activities within the nation's waterways. CWA section 401 (33

U.S.C. 1341) requires an application for a federal license or permit to provide a certification for the relevant state(s) that any discharges from the facility will comply with applicable state water quality standards. In addition, CWA section 402 (33 U.S.C. 1342) establishes the National Pollutant Discharge Elimination System permit program to regulate point source discharges of pollutants into waters of the United States.

1.2.7.5 California Fish and Game Code and California Environmental Quality Act

California Fish and Game Code section 1600, *et seq*. and the California Environmental Quality Act (Pub. Resources Code sections 21000, *et seq*.) (CEQA) set forth criteria for the incorporation of avoidance, minimization, and feasible mitigation measures for on-going activities as well as for individual projects. Section 1600, *et seq*. was enacted to provide conservation for the state's fish and wildlife resources and includes requirements to protect riparian habitat resources on the bed, channel, or bank of streams and other waterways.

Section 1600, *et seq*. prohibits an entity from: (1) substantially diverting or obstructing the natural flow of any river, stream, or lake, (2) substantially changing or using any material from the bed, channel, or bank of, and river, stream or lake, or (3) depositing or disposing of debris, was, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake, without first notifying CDFW of the activity. CDFW then has the opportunity to determine whether the activity may substantially adversely affect an existing fish or wildlife resource and, if the activity may have such an effect, to issue a final agreement that includes reasonable measures necessary to protect the resources (California Fish and Game Code section 1602). Under CEQA, no public agency shall approve or carry out a project without identifying all feasible mitigation measures necessary to reduce impacts to a less than significant level, and shall incorporate such measures absent overriding considerations.

1.2.7.6 Livingston Stone National Fish Hatchery

In 1997, Reclamation completed the Livingston Stone NFH on the Sacramento River at the base of Shasta Dam as a substation of the Coleman NFH Complex for the purpose of establishing a conservation hatchery program for SR winter-run Chinook salmon. The Livingston Stone NFH operates two programs—the Winter Chinook Integrated-Recovery Supplementation Program and the Winter Chinook Captive Broodstock Program. The initial source of reintroduced SR winter-run Chinook salmon would be from the captive broodstock program. NMFS and the USFWS have coordinated on the Livingston Stone NFH programs since inception and are coordinating on

NMFS' issuance of an ESA section 10 permit for the two hatchery programs described in the 2015 Livingston Stone NFH Hatchery and Genetic Management Plans (USFWS 2015a, 2015b).

The Livingston Stone NFH Monitoring and Evaluation Program is discussed in USFWS' HGMP (USFWS 2015a, 2015b). Monitoring and evaluation is consistent with best management practices for artificial production. Monitoring and evaluation are conducted to evaluate potential negative effects resulting from the SR winter-run Chinook salmon propagation program at the Livingston Stone NFH. Knowledge gained through experimentation and research is used to modify fish culture practices, when appropriate, to maximize program benefits and reduce negative effects.

1.2.7.6.1 Integrated-Recovery Supplementation Program

The Livingston Stone NFH Integrated-Recovery Supplementation Program consists of the following: (1) propagation of SR winter-run Chinook salmon from adults collected at a trap at Keswick Dam, and (2) integrated management of the hatchery-origin fish with the natural-spawned population of SR winter-run Chinook salmon in the upper Sacramento River below Shasta and Keswick Dams.

Since 1997, the USFWS captured and retained, as broodstock, up to 120 SR winter-run Chinook salmon each year from the adult trap at Keswick Dam for the Integrated-Recovery Supplementation Program. SR winter-run Chinook salmon propagated at Livingston Stone NFH are intended to provide a demographic enhancement to aid in the rebuilding and recovery of the single extant population (subsection 1.2.2, Sacramento River Winter-run Chinook Salmon ESA Listing). Hatchery-origin SR winter-run Chinook salmon return as adults to the upper Sacramento River below Shasta and Keswick Dams, spawn in the wild within the Sacramento River system below the dams, and become reproductively and genetically assimilated into the natural spawning population. SR winter-run Chinook salmon from the Integrated-Recovery Supplementation Program are part of the listed ESU.

1.2.7.6.2 Winter Chinook Captive Broodstock Program

In 2015, the USFWS, NMFS, and the CDFW collectively decided to reinitiate the captive broodstock program at Livingston Stone NFH using juvenile hatchery fish from the Integrated-Recovery Supplementation Program (subsection 1.2.6.6, SR Winter-run Chinook Salmon HGMP) (USFWS 2015b). The goals of the captive broodstock program are to provide: (1) a genetic reserve of SR winter-run Chinook salmon in a safe and secure environment to be available for use as hatchery broodstock for the Integrated-Recovery Supplementation Program in the event of a

catastrophic decline in abundance, (2) a future source of SR winter-run Chinook salmon to contribute to multi-agency efforts to reintroduce winter-run Chinook salmon upstream of Shasta Dam and into restored habitats of Battle Creek, and (3) a future source of SR winter-run Chinook salmon to fulfill the needs of research projects. SR winter-run Chinook salmon from the captive broodstock program at the Livingston Stone NFH are a component of the Integrated-Recovery Supplementation Program and are considered as part of the listed SR winter-run Chinook salmon ESU (79 Fed. Reg. 20802, April 14, 2014; R. Jones, NMFS, letter to Chris Yates, NMFS, September 28, 2015, regarding inclusion of Livingston Stone NFH fish in the ESU; 81 Fed. Reg. 33468, May 26, 2016). SR winter-run Chinook salmon from Livingston Stone NFH's captive broodstock program would be used for the initial reintroduction efforts above Shasta Dam.

1.2.6.7 Hatchery and Genetic Management Plans

Fish hatchery programs that may affect listed salmon and steelhead require authorization under the ESA. A Hatchery and Genetic Management Plan (HGMP) provides detailed descriptions of hatchery programs that are submitted to NMFS for authorization under the ESA. HGMPs are the basis for NMFS' biological evaluations of hatchery programs under ESA sections 7 and 10, or Limit 5 of the current section 4(d) rule (subsection 1.2.5, ESA Section 4(d) Regulations). HGMPs describe each hatchery's operations and the actions taken to support recovery and minimize ecological or genetic impacts, such as straying and other forms of competition with naturally produced fish.

1.2.6.7.1 SR Winter-run Chinook Salmon HGMP

In 2015, the USFWS issued two HGMPs for the two Livingston Stone NFH programs: Integrated-Recovery Supplementation Program (USFWS 2015a), and the Winter Chinook Captive Broodstock Program (USFWS 2015b). The programs described in the HGMPs would occur regardless of NMFS' 10(j) designations described herein.

Captive broodstock are obtained by withholding a portion of the juveniles produced in the Integrated-Recovery Supplementation Program and rearing them to maturity in the hatchery. Beginning in the year 2015 (brood year 2014), 1,035 winter Chinook salmon juveniles were withheld from Livingston Stone NFH's Integrated-Recovery Supplementation Program release group for the Winter Chinook Captive Broodstock Program (USFWS 2015b). The USFWS expects that approximately 1,000 fish would be withheld from future brood years; however, the number of juveniles entered into the captive broodstock program would be reconsidered on an

annual basis by the USFWS, NMFS, and CDFW. Based on previous (1991-2007) performance of the Winter Chinook Captive Broodstock Program, USFWS anticipates that at least 50 percent of the fish retained as captive broodstock would survive to sexual maturity, thereby producing approximately 500 mature winter-run Chinook salmon adults per brood year (USFWS 2015b).

According to the 2015 Winter Chinook Captive Broodstock Program HGMP, one of the program purposes is to provide the source of SR winter-run Chinook salmon for the reintroduction of SR winter-run Chinook salmon upstream of Shasta Dam and into restored habitats of Battle Creek. The proportion of fish from Livingston Stone NFH used for the reintroduction program is expected to decrease over time and eventually cease as the number of returning adults originating from the NEP Area increases.

1.2.6.7.2 CV Spring-run Chinook Salmon HGMP Planning Process

FRH would likely be the donor stock source for the CV spring-run Chinook salmon reintroduction above Shasta Dam. An HGMP would be developed as part of the permitting process. Identification of the source population(s) would depend upon the genetic diversity needs of the broodstock, the specific conditions of the proposed donor population at the time of reintroduction, and whether the collection would jeopardize the survival and recovery of the species.

Future authorization for the collection of CV spring-run Chinook salmon for the conservation hatchery and issuance of a section 10(a)(1)(A) permit would be analyzed under the ESA and NEPA when NMFS receives a permit application. Over time, broodstock would produce juveniles for release to the NEP Area in sufficient numbers to enable the return of sufficient numbers of adults to complete their life cycle. Ultimately, the fish would establish a natural population of CV spring-run Chinook salmon and the hatchery contribution would be phased out. All collections of donor stock would require the application for and approval of section 10(a)(1)(A) permit(s), and associated NEPA and ESA section 7 reviews.

Collections of donor stock would occur, or eggs or young may be placed directly into the NEP Area. Conservation best management practices, as outlined in the HGMP, would be used to make the appropriate crosses of available individuals. The NEP designations of these fish and their propagation would increase the understanding of handling, transport, and broodstock culture methods for reintroductions and would have a beneficial impact on CV spring-run Chinook salmon by restoring an additional population to the Basalt and Porous Lava Diversity Group that

1 furthers the recovery plan objectives for the ESU. Operation of the hatchery in accordance with
2 an HGMP would ensure genetic diversity and would minimize domestication effects.

2.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

2.1 Purpose of the Action

The purpose of the proposed action is to support future reintroduction efforts leading to the re-establishment of populations of SR winter-run and CV spring-run Chinook salmon in the McCloud and Upper Sacramento Rivers upstream of Shasta Dam. NMFS rulemaking under ESA sections 10(j) and 4(d) would contribute to the conservation of SR winter-run and CV spring-run Chinook salmon and to the overall recovery goals provided in the recovery plan (NMFS 2014).

2.2 Need for the Action

The need for the action is to further the conservation of SR winter-run and CV spring-run Chinook salmon by increasing the abundance, productivity, spatial structure, and diversity of these species as the reintroduced populations becomes established and contributes to the recovery of the ESU.

Designation of the SR winter-run and CV spring-run Chinook salmon NEPs under ESA section 10(j) and establishment of a rule pursuant to ESA section 4(d) will advance recovery objectives of re-establishing populations. The proposed designations and ESA section 4(d) rule will also simultaneously protect individuals, private landowners, municipalities, tribes, and local, state, and Federal governments who may incidentally and unintentionally take (including harm) the fish while engaged in otherwise lawful activities.

NMFS is also interested in further developing a cooperative relationship with local entities and affected local landowners regarding the management of listed species for conservation and recovery. NMFS considers this action a means to facilitate partnerships in the NEP Area by reducing perceived regulatory constraints associated with reintroduction of an ESA listed species.

3.0 ACTION AREA

Under the ESA, the Action Area is defined as "*all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action*" (50 CFR 402.02). No such term exists under NEPA. However, under NEPA, the Affected Environment "… *should include a description of the environment in which the proposed action and alternatives are to take place... For project-specific analysis, the affected environment typically encompasses the proposed action's site and immediate vicinity. However, the analysis of cumulative impacts may broaden that range*." (NMFS 2009). The action area is described below, whereas the Affected Environment is described for each of the resource topics evaluated in this EA in Section 5.

3.1 Description of the Action Area

For this EA, the term "action area" is used synonymously with the NEP Area for the proposed experimental population designations under ESA section 10(j).

The NEP Area (Figure 3) extends from Shasta Dam up to Pit 7 Dam on the Pit River, McCloud Dam on the McCloud River, and Box Canyon Dam on the upper Sacramento River. All other tributaries flowing into Shasta Reservoir up to the ridge line, including tributaries below Pit 7 Dam, McCloud Dam, and Box Canyon Dam, up to the ridge line would be included in the NEP Area. All other areas above Pit 7 Dam on the Pit River, McCloud Dam on the McCloud River, and Box Canyon Dam on the upper Sacramento River would not be part of the NEP Area. The NEP Area extends up to the ridgelines to account for watershed processes and ends at the aforementioned dams because these dams lack fish passage facilities.

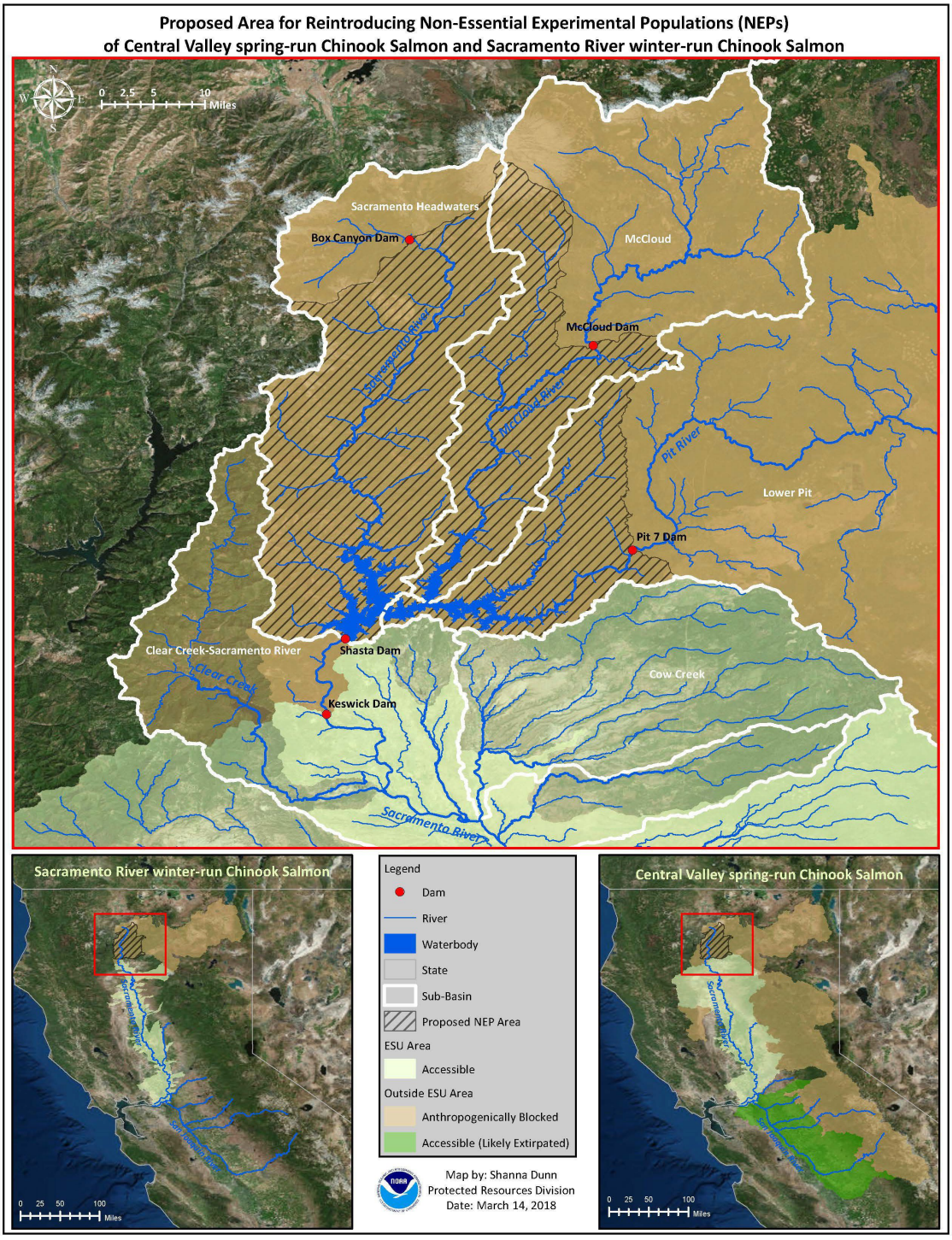

Figure 3. The NEP Area above Shasta Dam for SR winter-run and CV spring-run Chinook salmon.

4.0 ALTERNATIVES

This EA describes and evaluates three alternatives. NMFS considered but did not analyze two additional alternatives because they did not meet the purpose of and need for the action. These are discussed in subsection 4.4 (Alternatives Considered but Not Analyzed in Detail). Table 1 summarizes key components of each alternative.

4.1 Alternative 1 (No-action) –No Designation of Experimental Populations, No Authorization for Release, and no Adoption of Protective Regulations

Under the No-action Alternative, NMFS would:

(1) Not designate all SR winter-run and CV spring-run Chinook salmon in the NEP Area as NEPs under ESA section 10(j) or authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area; and

(2) Not establish take prohibitions for the NEPs of SR winter-run and spring-run Chinook salmon in the NEP Area and exceptions for particular activities under ESA section 4(d).

Long-term reintroduction of SR winter-run and spring-run Chinook salmon could occur above Shasta Dam without a NEP designation. In 2022, as an ad-hoc, "urgent action" action addressing impacts to SR winter-run Chinook salmon from multiple years of drought, NMFS, DFW, USFWS, and the Winnemem Wintu Tribe transported winter-run Chinook salmon eggs from LSNFH to incubators at a location on the McCloud River over 25 miles upstream of Shasta Reservoir. Here, the eggs incubated and fry reared until outmigration. This was intended to provide guaranteed cold water to the eggs and therefore increase their likelihood of survival. Approximately 40,000 eggs from the hatchery were incubated at the site on the McCloud River. Approximately 1600 juvenile fish from those incubators were captured in the McCloud River downstream of the incubators and translocated around Shasta Reservoir to a release site in the upper Sacramento River to continue rearing and migrating to the ocean. This action could continue until a long-term reintroduction program is in place. However, a program for full scale and permanent reintroduction will require separate authorization, under the ESA, for any take of SR winter-run and CV spring-run Chinook salmon associated with handling, transport, etc.

However, a full-scale and permanent fish passage program without a NEP designation and associated protective regulations is anticipated to result in opposition from landowners and other concerned groups whose otherwise lawful activities could be impacted by the presence of listed species.

Opposition would likely result in significant delays and/or permanently stall reintroduction efforts. Without a reintroduction program, recovery of the SR winter-run and CV spring-run Chinook salmon ESU under the No-action Alternative would continue to depend on contributions from the below-dam independent and dependent extant populations of SR winter-run and CV spring-run Chinook salmon in the Sacramento River and tributaries.

Under the No-action Alternative, the endangered status of SR winter-run Chinook salmon and the threatened status of CV spring-run Chinook salmon would remain in effect throughout the ESUs. Existing ESA section 9 take prohibitions would remain in effect. The current take prohibitions and exceptions under ESA section 4(d) protective regulations that apply to the CV spring-run Chinook salmon ESU (50 CFR 223.203) would remain in effect. ESA regulations would apply to any SR winter-run or CV spring-run reintroduced to the NEP Area. Existing section 7 requirements for Federal agencies to consult with NMFS to ensure their actions are not likely to jeopardize the continued existence of SR winter-run and CV spring-run Chinook salmon or result in destruction or adverse modification of their critical habitat throughout the ESUs would continue to apply.

4.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Limited Protective Regulations

4.2.1 Introduction

Alternative 2 is the NMFS' preferred alternative because it would contribute to the conservation and recovery of SR winter-run and CV spring-run Chinook salmon by advancing NMFS' recovery objectives for re-establishing populations, while simultaneously protecting individuals, private landowners, municipalities, tribes, and local, state, and Federal governments who may incidentally and unintentionally take (including harm) the fish while engaged in otherwise lawful activities. Under Alternative 2, NMFS would:

(1) Designate all SR winter-run and CV spring-run Chinook salmon in the NEP Area as NEPs under ESA section 10(j) and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area; and

(2) Establish take prohibitions for the NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and exceptions for particular activities under ESA section 4(d).

Under Alternative 2, NMFS would designate NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area, which would generally be treated as threatened species, and NMFS would be able to establish limited protective regulations under ESA section 4(d) appropriate to the circumstances. Under Alternative 2, ESA section 4(d) protective regulations would provide exceptions for take of NEP fish in the NEP Area appropriate to the circumstances, including take that is incidental to an otherwise lawful activity and unintentional, not due to negligent conduct. Downstream of the NEP Area (downstream of Shasta and Keswick Dams) the current ESA take prohibitions and exceptions that apply to SR winter-run and CV spring-run Chinook salmon would remain in effect (see 50 CFR 223.203). Activities that could incidentally take NEPs in the NEP Area include recreation, forestry, water management, agriculture, power production, mining, transportation management, rural development, livestock grazing, and other similar activities that are carried out in accordance with Federal, state, and local laws and regulations. In addition, with the NEP designations, ESA section 7 requirements for Federal agencies to consult with NMFS to ensure their actions are not likely to jeopardize the continued existence of SR winter-run and CV spring-run Chinook salmon would not apply to any Federal actions that may affect the NEPs in the NEP Area (unless it occurs in a National Wildlife Refuge or National Park). The NEPs would generally be treated as proposed species for purposes of ESA section 7, and Federal agencies would only need to confer with NMFS as applicable depending on the species before taking actions that are likely to jeopardize the continued existence of a species proposed to be listed. The designation of all SR winter-run and CV spring-run Chinook salmon in the NEP Area as NEPs and limited protective regulations under ESA section 4(d) would remain in effect until recovery goals for the SR winter-run and CV spring-run Chinook salmon ESUs have been achieved and the species are removed from the list of endangered and threatened species under the ESA, or if barriers geographically separating the proposed experimental populations in the NEP Area from nonexperimental populations of SR winter-run and CV spring-run Chinook salmon are removed (i.e., a barrier dam is removed or modified to allow fish passage).

4.2.2 Regulatory Process

Under Alternative 2, the ESA section 4(d) regulations would prohibit take of SR winter-run and CV spring-run Chinook salmon in the NEP Area and provide exceptions for particular activities, which are described below.

4.2.2.1 Take

ESA section 3(19) defines "take" as "*to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct*." Under 50 CFR 222.102, "harm" "may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering." The ESA does not specifically prohibit the take of species listed as threatened, but instead authorizes NMFS to adopt regulations under section 4(d) it deems necessary and advisable for species conservation, including prohibiting take. Under ESA section 10(j)(2)(C), experimental populations are generally treated the same as species listed as threatened, and NMFS may issue an ESA section 4(d) rule applying the take prohibitions broadly or more narrowly as appropriate to the circumstances.

4.2.2.2 ESA Section 4(d) Regulations

Concurrent with the ESA section 10(j) experimental population designations, NMFS' rulemaking adopts limited protective regulations under ESA section 4(d) for SR winter-run and CV spring-run Chinook salmon in the NEP Area. These limited protective regulations prohibit take of the NEPs of SR winter-run and CV spring-run Chinook salmon located within the geographic range of the proposed experimental population designations, except in the following circumstances

1. Any take by authorized governmental personnel acting in compliance with 50 CFR 223.203(b)(3)[1] to aid a sick, injured or stranded fish; dispose of a dead fish; or salvage a dead fish which may be useful for scientific study;

2. Any take that is incidental to an otherwise lawful activity and is unintentional, not due to negligent conduct. Otherwise lawful activities include, but are not limited to, recreation, forestry, water management, agriculture, power production, mining, transportation

[1] According to 50 CFR 223.203(b)(3), the prohibitions relating to the threatened West Coast salmon ESUs and steelhead DPSs do not apply to any employee or designee of NMFS, the United States Fish and Wildlife Service, any Federal land management agency (e.g., USFS), CDFW, or any other governmental entity that has co-management authority for the listed salmonids, when the employee or designee, acting in the course of his or her official duties, takes a threatened salmonid without a permit if such action is necessary to: (1) aid sick, injured, or stranded salmonids; (2) dispose of dead salmonids; or (3) salvage dead salmonids that may be useful for scientific study. Each agency acting under this limit on the take prohibitions is to report to NMFS the numbers of fish handled and their status, on an annual basis. A designee of the listed entities is any individual the Federal or state fishery agency or other co-manager has authorized in writing to perform the listed functions.

management, rural development, or livestock grazing, when such activities are in full compliance with all applicable laws and regulations; and

3. Any take that is pursuant to a permit issued by NMFS under section 10 of the ESA (16 U.S.C. 1539) and regulations in 50 CFR part 222 applicable to such a permit.

Outside of the NEP Area (Figure 3), take of SR winter-run and CV spring-run Chinook salmon originating from the NEP Area would be prohibited in the same manner as other SR winter-run Chinook salmon under ESA section 9. Take of CV spring-run Chinook salmon would be prohibited in the same manner as under the current ESA section 4(d) regulations (67 Fed. Reg. 1116) for threatened species.

4.2.2.3 ESA Section 7

In accordance with ESA section 10(j)(2)(C), the ESA section 7(a)(2) consultation requirement would not apply to Federal actions that may affect the proposed experimental populations in the NEP Area. For purposes of ESA section 7, NEPs are treated as species proposed for ESA listing, and only two provisions of ESA section 7 would apply: (1) section 7(a)(1) (requiring Federal agencies to use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of listed species); and (2) section 7(a)(4) (triggered by Federal actions that are likely to jeopardize the continued existence of a species proposed to be listed). In addition, no critical habitat could be designated for the NEPs.

4.2.2.4 ESA Section 10

Collection and transport of SR winter-run and CV spring-run Chinook salmon as part of a future reintroduction effort would be subject to approval of a permit under ESA section 10(a)(l)(A), which would be subject to an HGMP in relation to a hatchery source and additional analysis under NEPA and ESA section 7. Individuals used to establish experimental populations could be collected from an existing donor population, if fish can be removed without adverse population effects and provided that appropriate permits are issued in accordance with ESA section 10(a)(1)(A), and subject to additional analysis under NEPA and ESA section 7.

Monitoring and evaluation specific to the proposed experimental populations would be approved as part of the permitting process under ESA section 10(a)(1)(A). Monitoring and evaluation activities could also be authorized under a section 4(d) approval process. Specifically, biological and technical

information would be collected as necessary to evaluate the reintroduced Chinook salmon colonization, pre-spawn (adult) survival and movement, and adult spawning.

4.2.2.5 Federal Power Act

Under the provisions of the FPA, FERC must decide whether to issue licenses, and what conditions should be placed on any license issued.

The FPA authorizes NMFS to issue mandatory prescriptions for fish passage and to recommend other measures to protect salmon, steelhead, and other fish under NMFS' jurisdiction. During the relicensing process for the McCloud-Pitt Hydroelectric Project, NMFS reserved its authority to require the licensee to construct and operate fish passage facilities. Although it is presently uncertain what terms and conditions FERC will place in the new license, if NMFS issues mandatory prescriptions for fish passage under the FPA in the NEP Area, the ESA section 4(d) rule in NMFS' rulemaking would provide exceptions to take prohibitions appropriate to the circumstances, including NMFS' exception for take of experimental population fish in the NEP Area that is incidental to an otherwise lawful activity and unintentional, not due to negligent conduct.

4.3 Alternative 3 – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Current Protective Regulations

4.3.1 Introduction

Under Alternative 3, NMFS would:

(1) Designate all SR winter-run and CV spring-run Chinook salmon in the NEP Area as NEPs under ESA section 10(j) and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area; and

(2) Establish take prohibitions for the NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and exceptions that are the same as the current ESA section 4(d) rule protective regulations (50 CFR 223.203).

In contrast to the No-action Alternative, but similar to Alternative 2, Alternative 3 proposes that NMFS would designate and authorize the release of NEPs of SR winter-run and CV spring-run Chinook in the NEP Area under ESA section 10(j). However, unlike Alternative 2, NMFS would apply the current ESA section 4(d) rule protective regulations (50 CFR 223.203) for the reintroduced

fish when they are in the NEP Area, rather than establishing a separate ESA section 4(d) rule for the NEP Area.

Under the current ESA section 4(d) rule protective regulations (50 CFR 223.203), the take prohibitions of ESA section 9(a)(1) that apply to endangered species apply to threatened species with limits or exceptions for 10 categories of activities when they meet specified criteria. As an alternative to using the 10 limits on the take prohibitions, affected non-Federal entities may choose to seek an ESA section 10 permit from NMFS.

Alternative 3 would contribute to the conservation and recovery of SR winter-run and CV spring-run Chinook salmon by advancing NMFS's recovery objectives for re-establishing populations, but would not provide an exception for take of NEP fish in the NEP Area that is incidental to an otherwise lawful activity and unintentional, not due to negligent conduct. Under Alternative 3, an entity proposing to undertake otherwise lawful activities (e.g., recreation, forestry, water management, agriculture, power production, mining, transportation management, rural development, or livestock grazing) that could incidentally take SR winter-run or CV spring-run Chinook salmon in the NEP Area would be required to meet one of the limits or exceptions under the current ESA section 4(d) rule protective regulations (50 CFR 223.203) or obtain a permit from NMFS under ESA section 10(a)(1)(B). The current ESA section 4(d) rule protective regulations would remain in effect until recovery goals for the SR winter-run and CV spring-run Chinook salmon ESU are achieved and the species is removed from the list of endangered and threatened species under the ESA.

4.3.2 Regulatory Process

Under Alternative 3, the ESA section 4(d) regulations under Alternative 3 would prohibit the take of SR winter-run and CV spring-run Chinook salmon in the NEP Area unless: (1) one of the limits or exceptions in the current ESA section 4(d) protective regulations applies; or (2) the project proponent obtains an ESA section 10 permit from NMFS.

4.3.2.1 Take

Similar to Alternative 2, under Alternative 3, NMFS would generally establish take prohibitions for the NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area. ESA section 3(19) defines "take" as "*to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct*." Under 50 CFR 222.102, "harm" "may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly

impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering."

4.3.2.2 ESA Section 4(d) Regulations

In contrast to Alternative 2, under Alternative 3, the current ESA section 4(d) rule protective regulations would apply to the take of SR winter-run and CV spring-run Chinook salmon in the NEP Area with limits or exceptions for 10 categories of activities when they meet specified criteria (50 CFR 223.203). NMFS would not issue an ESA section 4(d) rule applying the take prohibitions more narrowly as appropriate to the circumstances concurrent with the proposed ESA section 10(j) experimental population designations, including the exception for take of NEP fish in the NEP Area that is incidental to an otherwise lawful activity and unintentional, not due to negligent conduct. NMFS' experience under the current ESA section 4(d) rule protective regulations shows that NMFS does authorize take associated with some otherwise lawful activities, but some activities may not meet one of the 10 categories of activities and some activities may be modified during the authorization process to meet the applicable criteria under the current protective regulations.

Outside of the NEP Area, take of SR winter-run Chinook salmon originating from the proposed experimental populations would be prohibited in the same manner as other SR winter-run Chinook salmon under current ESA section 9 prohibitions. Take of CV spring-run Chinook salmon originating from the NEP Area would be prohibited in the same manner as other CV spring-run Chinook salmon under the current 4(d) rule protective regulations for threatened anadromous species (50 CFR 223.203).

4.3.2.3 ESA Section 7

Similar to Alternative 2, under Alternative 3, in accordance with ESA section 10(j)(2)(C), the ESA section 7(a)(2) consultation requirement would not apply to Federal actions that may affect the NEPs in the NEP Area. For purposes of ESA section 7, the NEPs would be treated as a species proposed for ESA listing, and only two provisions of ESA section 7 would apply: (1) section 7(a)(1) (requiring Federal agencies to use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of listed species); and (2) section 7(a)(4) (triggered by Federal actions

that are likely to jeopardize the continued existence of a species proposed to be listed). In addition, no critical habitat could be designated for the NEPs.

4.3.2.4 ESA Section 10

Similar to Alternative 2, under Alternative 3, collection and transport of SR winter-run and CV spring-run Chinook salmon as part of a future reintroduction effort would be subject to approval of a permit under ESA section 10(a)(l)(A), which would potentially be subject to an HGMP in relation to a hatchery source and would be subject to additional analysis under NEPA and ESA section 7. Individuals used to establish experimental populations could be collected from an existing donor population, provided that appropriate permits are issued in accordance with ESA section 10(a)(1)(A), and subject to additional analysis under NEPA and ESA section 7.

It is anticipated that a monitoring plan will be implemented specific to the proposed experimental populations upstream of Shasta Dam. Specifically, biological and technical information would be collected as necessary to evaluate the reintroduced juvenile Chinook salmon colonization, pre-spawn (adult) survival and movement, and adult spawning. NMFS would need to issue an ESA section 10(a)(1)(A) permit(s), subject to review under NEPA, for monitoring and evaluation of the proposed experimental populations.

4.3.2.5 Federal Power Act

Under the provisions of the FPA, FERC must decide whether to issue licenses, and what conditions should be placed on any license issued.

The FPA authorizes NMFS to issue mandatory prescriptions for fish passage and to recommend other measures to protect salmon, steelhead, and other fish under NMFS' jurisdiction. Although it is presently uncertain what terms and conditions FERC will place in the new license for the McCloud-Pitt Hydroelectric Project, if NMFS issues mandatory prescriptions for fish passage under the FPA, the ESA section 4(d) rule in NMFS' rulemaking would provide exceptions to take prohibitions appropriate to the circumstances, including NMFS' exception for take of the proposed experimental population fish in the NEP Area that is incidental to an otherwise lawful activity and unintentional, not due to negligent conduct. Under Alternative 3, NMFS expects restrictions placed on water resource management in the NEP Area would be similar to those that are currently in place outside of the NEP Area.

4.4 Alternatives Considered but Not Analyzed in Detail

4.4.1 Designation as *Essential* Experimental Populations

Under this scenario, the proposed experimental populations of SR winter-run and CV spring-run Chinook salmon would be designated as essential experimental populations rather than NEPs. Under ESA section 10(j)(2)(B), the Secretary must determine, on the basis of the best available information, whether or not an experimental population is essential to the continued existence of an endangered or threatened species. NMFS regulations define an essential experimental population to be an experimental population whose loss would be likely to appreciably reduce the likelihood of the survival of the species in the wild (50 CFR 222.501(b)).

The NMFS (2014) recovery plan identifies that re-establishment of populations of SR winter-run and CV spring-run Chinook salmon would aid in recovery of the ESU by increasing abundance and productivity, by improving spatial structure and diversity, and by reducing the risk of extinction to the ESU as a whole. Although NMFS must ultimately make this determination through rulemaking, we did not analyze this alternative in detail because of our preliminary determination that the proposed experimental populations, if lost, would not be likely to appreciably reduce the likelihood of the survival of the species in the wild. We considered the geographic location of the proposed experimental populations in relation to other populations of SR winter-run and CV spring-run Chinook salmon, and the likelihood of the survival of these populations without the existence of the proposed experimental populations.

Table 1. Comparison of key components among alternatives.

Alternative	SR Winter-run and CV spring-run Chinook Salmon Release	ESA Take Prohibitions on SR Winter-run and CV spring-run Chinook Salmon	Experimental Population Designations for SR Winter-run and CV spring-run Chinook Salmon
Alternative 1 – No-action alternative.	No authorization for release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area under ESA section 10(j).	The current ESA section 4(d) rule protective regulations that apply to the threatened Chinook salmon (50 CFR 223.203) outside of the NEP Area would apply to any SR winter-run and CV spring-run Chinook salmon reintroduced to the NEP Area.	No NEP designations.
Alternative 2 –Designation and authorization for release of NEPS in the NEP Area under ESA section 10(j) with adoption of limited protective regulations under ESA section 4(d).	Authorization for release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area under ESA section 10(j).	Adoption of limited protective regulations under ESA section 4(d) that would prohibit take of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area except in the following circumstances: Any take by authorized governmental personnel acting in compliance with 50 CFR 223.203(b)(3) to aid a sick, injured or stranded fish; dispose of a dead fish; or salvage a dead fish which may be useful for scientific study; Any take that is incidental to an otherwise lawful activity and is unintentional, not due to negligent conduct; and Any take that is pursuant to a permit issued by NMFS under section 10 of the ESA (16 U.S.C. 1539) and regulations in 50 CFR part 222 applicable to such a permit.	NEP designations in the NEP Area.
Alternative 3 – Designation and authorization for release of NEPs in the NEP Area under ESA section 10(j) with adoption of the current ESA section 4(d) rule protective regulations for the NEP Area.	Authorization for release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area under ESA section 10(j).	Adoption of the current ESA section 4(d) rule protective regulations that apply to the SR winter-run and CV spring-run Chinook salmon ESUs (50 CFR 223.203) for the NEPs in the NEP Area.	Same as Alternative 2 – NEP designations in the NEP Area.

5.0 AFFECTED ENVIRONMENT

5.1 Description of the Analysis Area

The potentially affected environment is the same as the NEP Area for Aquatic Habitat, Fisheries Resources in the NEP Area, Cultural Resources, Wildlife Species (except for Southern Resident killer whale (*Orcinus orca*)), and Land Use and Ownership.

The analysis area for ESA-listed salmon is outside of the NEP Area because ESA-listed salmon are downstream of Shasta and Keswick Dams and straying and disease were identified as potential effects.

The analysis area for Socioeconomics, Tourism and Recreation, and Environmental Justice comprises all of Shasta and Siskiyou Counties because local residents within these areas would most likely be affected by the alternatives considered in this EA.

The analysis area for Southern Resident killer whale includes the Pacific Ocean off the California coast where this species forages on Chinook salmon.

5.2 Overview and Approach

The NEP Area (Figure 3) includes portions of the upper Sacramento River above Shasta Dam including the upper Sacramento River and McCloud River. This area intersects two counties in northern California and contains large areas of sparsely populated private and public lands that provide habitat for native and non-native fish and wildlife. The majority of public lands within the NEP Area are administered by the USFS – Shasta Trinity Nation Forest (STNF).

The alternatives considered in this EA have the potential to affect the physical, biological, sociological, and economic resources within the affected environment. A description of the current baseline condition of environmental resources that may be affected by these alternatives is provided below. NMFS conducted an internal scoping process to identify resources within the affected environment that could potentially be affected by the alternatives. During the scoping process, NMFS discussed possible effects to all resources from activities associated with issuing a proposed rule to designate and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area.

NMFS weighed a number of environmental parameters against the Proposed Action and concluded the following environmental resources did not warrant further analysis because they would not be impacted: (1) Geology and Soils, (2) Wetlands, (3) ESA-listed Plants, (3) Noise, (4) Aesthetics, (5) Light and Glare, (6) Transportation, (7) Public Services, and (8) Safety and Human Health.

5.3 Fisheries Resources

5.3.1 ESA-listed Fish Species

Due to Shasta and Keswick Dams, there are no ESA-listed anadromous fish species currently in the NEP Area. Alternative 2 and Alternative 3 authorize the release of SR winter-run and CV spring-run Chinook salmon to the NEP Area.

The analysis area for ESA-listed salmon extends outside of the NEP Area because ESA-listed salmon are downstream of Shasta and Keswick Dams and straying and disease were identified as potential effects. Life history information for these species is included in this section to inform the analysis of effects in Section x, Environmental Consequences, regarding disease and straying.

Although listed under the ESA and present below Keswick Dam, effects to the Southern DPS of the North American green sturgeon are not discussed because no impacts to this species from the Proposed Action were identified.

5.3.1.1 Sacramento River Winter-run Chinook Salmon

Adult SR winter-run Chinook salmon migrate from a marine environment into their natal freshwater streams and rivers to mate; they spawn once and then die. In the Sacramento River, SR winter-run Chinook salmon spawning occurs from late April through mid-August. SR winter-run Chinook salmon spawn during the summer months when air temperatures approach the yearly maximum and are thus restricted to stream reaches with sufficient cold water to support their summer freshwater life stages. Their life history is summarized in Yoshiyama et al. (1998), Poytress and Carillo (2010; 2011; 2012), Moyle (2002), Snider and Titus (2000a, 2000b), Quinn (2005), Healey (1991), California Department of Fish and Game (1998), Sommer et al. (2001), Montgomery et al. (1999), USFWS and Reclamation (1997), and NMFS (2014).

Yoshiyama et al. (1998, 2001) reported that winter-run Chinook salmon originally spawned in the upper Sacramento River system above the location of Shasta Dam (Little Sacramento, Pit, McCloud, and Fall Rivers) and in Battle Creek. The range of SR winter-run Chinook salmon has been greatly reduced by Keswick and Shasta Dams on the Sacramento River and by hydroelectric development and operation on Battle Creek. Currently, SR winter-run Chinook salmon spawning is limited to the mainstem Sacramento River downstream of Shasta and Keswick Dams that block access to historical cold water summer spawning and rearing habitats. The naturally spawning population persists

primarily because water released from Shasta Reservoir during the summer has been, for the most part, sufficiently cold.

In 2016, NMFS completed a periodic review as required by the ESA section 4(c)(2)(A) and on May 26, 2016 (81 Fed. Reg. 33468) announced the SR winter-run Chinook salmon ESU would remain listed as endangered. In 2023, NMFS completed the 2022 review of SR winter-run Chinook salmon that indates the biological status of the SR winter-run Chinook salmon ESU has declined since the 2016 viability assessment (Williams et al. 2016), with the single spawning population on the mainstem Sacramento River now at a high risk of extinction (SWFSC 2022). Updated information indicates an increased extinction risk due to the larger influence of the hatchery broodstock and low numbers of natural-origin returns in two consecutive years (SWFSC 2022). Analysis identified that the viability of the ESU would be improved by re- establishing this species in their historical spawning and rearing habitats through reintroduction efforts in Battle Creek and upstream from Shasta Reservoir.

5.3.1.2 Central Valley Spring-run Chinook Salmon

Adult CV spring-run Chinook salmon migrate from a marine environment into their natal freshwater streams and rivers to mate; they spawn once and then die. In the Sacramento River, CV spring-run Chinook salmon spawning occurs between late August and early October (Fisher 1994) depending on water temperatures (NMFS 2002). Their basic life history is summarized in Yoshiyama et al. (1998), Fisher (1994), Healey (1991), Moyle (2002), USFWS (1995), California Department of Fish and Game (CDFG) (1998; 2000a; 2004), Department of Water Resources (DWR) (2009), Myers et al. (1998), Quinn (2005), and NMFS (2014). Information on straying can be found in Lindley et al. (2007) and Johnson and Lindley (2016).

Listed CV spring-run Chinook salmon from this ESU spawn in accessible reaches of the Sacramento River below Keswick Dam, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and the lower Yuba River (CDFG 1998). Fifteen of the independent 18 to 19 historical populations of the CV spring-run Chinook salmon ESU are extirpated as a result of the construction of dams throughout the Central Valley (Yoshiyama et al. 2001; Lindley et al. 2004; Schick and Lindley 2007) (Figure 2). These dams, including Shasta and Keswick Dams, prevent CV spring-run Chinook salmon from accessing historical spawning and rearing habitats in higher elevation stream reaches, leading to their extirpation and/or hybridization with CV fall-run Chinook salmon (Lindley et al. 2004; Lindley et al. 2006).

In 2016, NMFS completed a periodic review as required by ESA section 4(c)(2)(A) and on May 26, 2016 (81 Fed. Reg. 33468) recommended the CV spring-run Chinook salmon ESU remain listed as threatened. As part of the periodic review, NMFS' Southwest Fisheries Science Center conducted an analysis (Johnson and Lindley 2016) that indicated the extant independent populations of the CV spring-run Chinook salmon ESU remained at a moderate to low extinction risk. NMFS' Southwest Fisheries Science Center (2022) recent viability analysis noted some improvements in the viability of the ESU, particularly with the increased spatial diversity of the dependent Battle Creek and Clear Creek populations. However, the analysis also identified recent catastrophic declines of many of the extant populations, high pre-spawn mortality during the 2012- 2015 drought in California, uncertain juvenile survival as a result of drought and ocean conditions, as well as straying of CV spring-run Chinook salmon from the Feather River Fish Hatchery as key threats.

5.3.2 Non-ESA-listed Native Fish Species

Various natural-origin and introduced fish species occur within the NEP Area (Table 2). Natural-origin fish include salmonids and non-salmonid fish species. Native non-ESA/non-CESA-listed fish species are listed in Table 2 and include McCloud River redband and resident rainbow trout. The analysis area for non-ESA-listed native fish species is the same as the NEP Area.

Table 2. Native non-listed (non-ESA/non-CESA listed) fish species within the NEP Area and their status under CDFW's California Fish Species of Special Concern list.

Common Name	Scientific Name	Shasta Lake and other tributaries[2]	Upper Sacramento River and tributaries[3]	McCloud River and tributaries	California Fish Species of Special Concern
Rainbow trout	*Oncorhynchus mykiss*	X	X	X	
McCloud redband	*Oncorhynchus mykiss stonei*			X	X
White sturgeon	*Acipenser transmontanus*	X			X
California roach	*Lavinia symmetricus*		X		
Riffle sculpin	*Cottus gulosus*	X	X	X	X
Pit sculpin	*Cottus pitensis*	X			
Sacramento sucker	*Catostomus occidentalis*	X	X	X	
Hardhead	*Mylopharodon conocephalus*	X	X	X	X
Sacramento pikeminnow	*Ptychocheilus grandis*	X	X	X	
Tule perch	*Hysterocarpus traski traski*	X			
Tui chub	*Siphateles bicolor*	X			

Source: FERC 2011; Reclamation 2017; Moyle 2002; Moyle et al. 2015; California Fish Website 2017a.

The McCloud River historically had the southernmost and only bull trout (*Salvelinus confluentus*) population in the State of California until it was extirpated circa 1975 (FERC 2011). Attempts to reintroduce bull trout have failed and the success of future reintroductions will likely be problematic as long as the conditions that caused their extirpation persist (Moyle 2002). As a result of their extirpation from the NEP Area and State of California, bull trout will not be discussed further.

Resident rainbow trout were originally present in nearly all permanent coastal streams from San Diego in southern California north to the Smith River and were also found in most rivers in the Central Valley, from the Kern River north to the Pit River. The McCloud River is known as a premier trout stream with an abundance of large resident rainbow trout. Resident rainbow trout are not a threatened

[3] From Box Canyon Dam down to Shasta Dam via Shasta Lake.

or endangered species. CDFW currently stocks Shasta Lake and the upper Sacramento River with fertile rainbow trout. Resident rainbow trout prefer clear, clean, and cold waters with habitat complexity (Moyle 2002; USDA 2000). Adult resident rainbow trout feed on aquatic and terrestrial insects as well as frogs and small fish. In lakes and reservoirs, they frequently feed on open-water fish, such as threadfin shad (Moyle et al. 2008). The California Fish and Game Commission has designated Wild Trout Waters in California that are managed exclusively for wild trout (including resident rainbow trout) in the NEP Area. Wild Trout Waters within the NEP Area include the McCloud River from McCloud Dam downstream to the southern boundary of Section 36, T38N, R3W, M.D.B. & M. (Shasta County), the upper Sacramento River and its tributaries from Box Canyon Dam downstream to Scarlett Way in Dunsmuir (Siskiyou County), and from the county bridge at Sweetbriar downstream to Shasta Lake (Shasta County) (CDFW 2016a).

McCloud River redband trout (McCloud redband, henceforth) are a form of rainbow trout that were isolated from coastal rainbow trout populations over many centuries. McCloud redband inhabit lake and riverine systems and are known for the brilliant red/crimson stripe along their sides. McCloud redband occur in the upper McCloud River above Middle Falls, which is believed to be the historical natural barrier to anadromous fishes (USFS 1998a). Total permanent habitat for the McCloud redband is estimated at 15 to 16 stream miles, or less in dry years (Moyle et al. 2008). Based on survey work from 1978 through 1995, Trout, Swamp, Edson, Sheepheaven, Blue Heron, Tate, Bull, Moosehead, Dry, and Raccoon Creeks and the mainstem McCloud River above Middle Falls (USFS 1998a) are believed to still support populations of McCloud redband. Much of the mainstem McCloud River and southern tributaries have populations of brook and brown trout, which appear to have displaced McCloud redband. Edson, Moosehead, Sheepheaven, and Swamp Creeks represent the Core Conservation Area for focused restoration and protection activities within a broader McCloud Redband Refugium (Redband Core Group 2016). Past stocking of nonindigenous coastal rainbow trout, brown trout, and brook trout in the upper McCloud River has altered species composition throughout much of the drainage and may have contributed to the decline of McCloud redband as a result of hybridization, predation, competition, and possible introduction of diseases. Stocking over the last century has possibly altered species composition from exclusively McCloud redband (above Middle Falls) to a system mostly dominated with introgressed (when a species' gene pool contains a gene from the gene pool of another species) and non-native fishes. These non-native trout compete for food and space with McCloud redband.

Historically, McCloud redband likely were the only salmonid species that occupied the upper portions of the McCloud River Watershed (above Middle Falls) (M. Dege, CDFW, email to Jon Ambrose, NMFS, regarding conservation issues pertaining to McCloud redband, November 29, 2016). Although the CDFW has stocked the McCloud River system with non-native trout for the past 100 years, this practice stopped in the upper McCloud Watershed, first with rainbow trout (last stocking 1994) and then with other trout species (last stocking 2013). Introgressed McCloud redband x rainbow trout are not present in some of the isolated headwater streams (Edson, Moosehead, Sheepheaven, Swamp, and possibly a few others). However, downstream from these headwaters the level of introgression increases (Simmons et al. 2010; M. Dege, CDFW, email to Jon Ambrose, NMFS, regarding conservation issues pertaining to McCloud redband, November 29, 2016).

White sturgeon are a long-lived anadromous fish and only spawn in large river systems from the Sacramento-San Joaquin system northward (Moyle 2002). White sturgeon spend most of their lives in estuaries of large rivers and migrate into fresh water to spawn. White sturgeon were blocked from access to the upper Sacramento River following the completion of Shasta Dam, but a small resident population still persists in Shasta Lake (Reclamation 2017). These sturgeon were likely trapped in the reservoir following completion of Shasta Dam, but they have been unable to spawn since the 1960s when powerhouses on the Pit River obstructed access to their spawning grounds.

California roach are widely distributed throughout California and are found in a wide variety of habitats (Moyle 2002). California roach are generally found in small, warm, mid-elevation streams and were observed in the upper Sacramento River (Reclamation 2017). Roach are tolerant of relatively high temperatures (86° F to 95° F [30° C to 35° C]) and low oxygen levels (1 to 2 parts per million) (Moyle 2002).

Riffle sculpin are found in the upper Sacramento River and typically live in headwater streams with cold water and rocky or gravelly substrate. They prefer permanent streams where the water does not exceed 77° F to 79° F (25° C to 26° C), and where ample flow keeps the dissolved oxygen level near saturation. Riffle sculpins may occupy riffles or pools, though they tend to favor areas that have adequate cover in the form of rocks, logs, or overhanging banks.

Pit sculpin are a recently described species that are closely related to the riffle sculpin (Moyle 2002). Pit sculpin are widely distributed through the Pit River Watershed and are most abundant in rocky riffles in smaller, well shaded streams (Moyle 2002 citing Robins and Miller 1957 and Bond 1973). Pit sculpin were detected in the lower Pit River in 2007 (FERC 2011).

Sacramento sucker are likely rare in the McCloud River, but are capable of thriving in diverse conditions within streams, lakes, and mild estuarine environments. Most suckers are found in clear, cool streams and in lakes at moderate elevations. Sacramento suckers often share waters with Sacramento pikeminnow, roach, and hardhead. Their diet consists mostly of diatoms and detritus, with invertebrates playing a smaller role. At age 4 to 6, Sacramento suckers become sexually mature and begin a spawning ritual that may involve a migration to a warmer and smaller stream. Spawning is triggered by the onset of warmer water temperatures and usually occurs between February and June (California Fish Website 2016a).

Hardhead are a large, native minnow generally found in undisturbed areas of larger low- to middle-elevation streams (elevation between 30 and 4,760 feet in the Sacramento and San Joaquin Watersheds). Its range extends from the Kern River in the south to the Pit River in the north. Hardhead inhabit areas that have clear, deep pools with sandy, gravel/boulder substrates and slow water velocities (less than 0.05 feet per second). Hardhead co-occur with Sacramento pikeminnow and usually with Sacramento suckers, and tend to be absent from streams where introduced species, especially centrarchids, predominate. Hardhead were detected in the lower Pit River in 2007 (FERC 2011).

Sacramento pikeminnow are widely distributed in California but are rare in the McCloud River (USFS 1998b). Sacramento pikeminnow are typically found in clear, low- to mid-elevation streams and rivers. Sacramento pikeminnow favor streams with deep pools and slow runs that have cover in the form of undercut banks or aquatic vegetation. Fish in larger, warmer waters tend to grow faster and bigger than fish found in smaller, cooler waters. In addition to fish, prey items may include frogs, lamprey ammocoetes (larvae), large stoneflies, and even small rodents. At age 3 to 4, Sacramento pikeminnow become sexually mature and begin spawning in April through May. Ideal spawning grounds are riffles and pool tails with gravel substrate (California Fish Website 2016b).

Sacramento tule perch are found in low-elevation waters of the Sacramento-San Joaquin River drainage, and are apparently extirpated from the Pajaro, Salinas, and San Joaquin Rivers in California (Moyle 2002). Tule perch give birth to fully formed young and occur in a wide variety of habitats, including lakes, estuarine sloughs, and clear streams and rivers, but rarely enter brackish water (Moyle 2002). Tule perch school when foraging and feed on small invertebrates associated with aquatic vegetation (Moyle 2002). Their diet may include shrimp, crabs, clams, chironomid midges, and aquatic insects, depending on the type of water body (California Fish Website 2016b).

Tui chub occur in the Columbia River drainage of Washington, Oregon, and Idaho; in the Klamath and upper Pit Rivers (Sacramento River drainage); and interior drainages of Nevada and California down to the Mohave River in southern California (USGS 2017; Page and Burr 1991). Tui chub occur in many habitats, such as isolated springs, large desert lakes, sloughs, slow flowing rivers, and backwaters, and are considered opportunistic omnivores (Moyle 2002). Tui chub habitat is characterized by slow water and abundant aquatic vegetation. Tui chub in one location may focus on detritus and supplement with invertebrates or plants, whereas in a different water body they might focus on benthic macroinvertebrates and supplement with fish and fish eggs (California Fish Website 2016b).

5.3.3 Non-native Fish Species

Species discussed in this subsection are organized first by background information, followed by general descriptions of each species. The analysis area for non-native fish species is the same as the NEP Area.

There are approximately 16 introduced fish species in the NEP Area. These species are listed in Table 3 that also shows where they are found within the NEP Area (California Fish Website 2016a; Reclamation 2015a; Reclamation 2017). Limiting factors and threats are similar to those for native fish species: populations of non-native species are affected by inter- and intra-specific competition, water and habitat quality and quantity, and climatic conditions. Brief descriptions of non-native species are given below.

Table 3. Non-native fish species in the NEP Area.

Common Name	Scientific Name	Shasta Lake and other tributaries	Upper Sacramento River and tributaries[4]	McCloud River and tributaries
Brook trout	*Salvelinus fontinalis*	X	X	X
Brown trout	*Salmo trutta*	X	X	X
Upper Klamath - Trinity Rivers Chinook salmon ESU	*O. tshawytscha*	X		
Bluegill sunfish	*Lepomis macrochirus*	X		
Brown bullhead	*Ameiurus nebulosus*	X		
Black bullhead	*A. melas*	X		
Largemouth bass	*Micropterus salmoides*	X	X	X
Smallmouth bass	*M. dolomieui*	X	X	X
Spotted bass	*M. punctulatus*	X		
White crappie	*Pomoxis annulauris*	X		
Golden shiner	*Notemigonus crysoleucas*	X		
Carp	*Cyprinus carpio*	X		
Channel catfish	*Ictalurus punctatus*	X		
White catfish	*A. catus*	X		
Green sunfish	*L. cyanellus*	X		
Threadfin shad	*Dorosoma petenense*	X		

Brook trout were planted in waters throughout the United States beginning in 1871 and are now a popular sportfishing species in California. Brook trout are found in cold, clear lakes and streams, and in California they have become well established in small, spring-fed, headwater streams and isolated mountain lakes. Brook trout growth is reduced in waters warmer than 66° F (19° C) (California Fish Website 2016b). Brook trout primarily eat terrestrial insects, aquatic insect larvae, and zooplankton as they drift at or near the surface, but are also known to feed on benthic organisms and will occasionally feed on fish (CDFW 2017).

[4] From Box Canyon Dam down to Shasta Lake.

Brown trout were introduced and widely planted in waters of California in 1893 and are a popular sportfishing species (CDFW 2016b). Shasta Lake is stocked with brown trout and although a majority of recent fish plants were triploid, not all fish were sterile (M. Currier, CDFW, email to Jon Ambrose regarding CDFW stocking practices, November 28, 2016). Water temperature is an important factor limiting brown trout distribution (preferred temperatures are 54° F to 68° F [12° C to 20º C]) (CDFW 2016b). Smaller brown trout will feed on drift organisms, in particular terrestrial insects, and shift to more bottom dwelling invertebrates as they get larger. Large adult brown trout feed almost exclusively on other fish, but will eat terrestrial insects during late summer when there are massive hatching events (California Fish Website 2017b).

Chinook salmon from the Upper Klamath-Trinity Rivers (UKTR) ESU have been planted in Shasta Lake for recreational fishery purposes as part of CDFW's Inland Chinook Program. CDFW temporarily suspended stocking of UKTR Chinook salmon for the recreational fishery in Shasta Lake in 2010 during a state-wide evaluation of fish stocking programs. Following the evaluation, CDFW resumed stocking sterile (triploid) UKTR Chinook salmon in Shasta Lake in the fall of 2014 using fish from Iron Gate Hatchery. Triploid fish are reproductively sterile, thereby eliminating the potential for hybridization with other Chinook salmon. For many salmonids, sterility also means that fish will live longer, resulting in some trophy individuals (Lincoln and Scott 1984; Donaldson et al. 1993).

Bluegill sunfish are most common in warm, shallow lakes, reservoirs, ponds, streams, and sloughs at low elevations. They can also be found in streams if there are deep, well covered and vegetated pools, and warm summer temperatures. Bluegill prefer aquatic insect larvae, but will also eat planktonic crustaceans, flying insects, and snails as well as small fish, fish eggs, and crayfish when available. This variety of feeding options leads to a diversity in diets between populations that can vary dramatically depending on location (California Fish Website 2016b).

Brown bullhead are an adaptable species and find niche habitats within warm turbid sloughs to clear mountain lakes. In California, they are found mostly in larger bodies of water where they stay toward the deep end of the nearshore (littoral) zone, near aquatic plant beds and muddy substrate. When found in rivers, bullhead prefer slow moving, low gradient, turbid streams with deep pools, aquatic plant beds, and soft bottoms. Young bullhead feed mostly on midge larvae and small crustaceans, but their diet will expand to larger prey such as insect larvae and small fish as they get older. Bullhead are opportunistic and will eat nearly anything that can fit in their mouths (California Fish Website 2016b).

Black bullhead are very hardy, but are not well studied in California. In their native ranges their preferred habitats include ponds, small lakes, river backwaters, sloughs, and pools in slow, low gradient streams with muddy bottoms and warm turbid water. The areas similar to this in California are mostly farm ponds, sloughs, reservoirs, and highly altered, lower reaches of rivers. Black bullhead are an omnivorous species that will eat nearly anything they can find, including aquatic insects, crustaceans, and mollusks (California Fish Website 2016b).

Largemouth bass are most common in warm shallow waters with moderate clarity and beds of aquatic plants (e.g., farm ponds, lakes, reservoirs, sloughs, and river backwaters). Largemouth bass may change prey preference numerous times throughout their lifetime. In general, fry feed on crustaceans and rotifers, change to insects and fish fry at 2 to 2.4 inches (50 to 60 mm) in length, and become primarily fish eating at 3.9 to 4.9 inches (10 to 12.5 cm) in length. Crayfish, tadpoles, or frogs may also be preferred once a largemouth bass has grown large enough to digest them (California Fish Website 2016b).

Smallmouth bass are most common in large, clear lakes and cool, clear streams with large amounts of cover. In streams, complex habitat with a variety of pools, riffles, runs, rocky bottoms, and overhanging trees is preferred, while lake populations prefer narrow bays along shore with underwater rocky shelves. Small-sized smallmouth bass commonly feed on crustaceans and aquatic insects, while larger fish will feed on crayfish and fish. By the time an individual reaches 3.9 to 5.9 inches (10 to 15 cm), larger food items will dominate their diet, which may include insects, amphibians, and small mammals because of the opportunistic nature of their feeding habits (California Fish Website 2016b).

Spotted bass are most common in moderately sized, clear, low gradient rivers and reservoirs. In streams they spend most of their time hiding in pools, avoiding riffles, or backwaters with heavy plant growth. Reservoir populations are found along steep rocky banks toward the upstream end of the reservoir. Fry feed mostly on zooplankton and small insects, while juveniles feed on crustaceans and larger aquatic insects. Individuals between 3 to 6 inches (7.5 to 15 cm) feed on aquatic insects, fish, crayfish, and terrestrial insects (California Fish Website 2016b).

White crappie are most common in warm, turbid lakes, reservoirs, and river backwaters, and in streams with areas where high flows can be avoided. Their feeding strategy mostly involves floating in midwater, using their flat shape as camouflage, and quickly grabbing everything they can using their protruding jaw and short gill rakers. This feeding adaptation allows a diversity of prey items, most

commonly planktonic crustaceans and small fish, but also aquatic insects when available (California Fish Website 2016b).

Golden shiners are commonly found around aquatic vegetation in warm, shallow ponds and lakes and are especially common in low-elevation reservoirs and sloughs. Golden shiners are adapted to both feeding on large zooplankton individually and filter feeding for smaller zooplankton species. While this allows for a variety in food choices, *Daphnia* and small flying insects plucked from the surface make up the bulk of an individual's diet. Larger golden shiners may also eat small fish, mollusks, aquatic insect larvae, and even algae when food is scarce (California Fish Website 2016b).

Carp are most often found in the warm, turbid waters of eutrophic lakes, reservoirs, and sloughs with silty bottoms and high vegetation growth or in turbid, alkaline streams with deep permanent pools and soft bottoms. However, carp can be found in a wide range of habitats with harsh conditions. Carp stay in shallow areas where they forage for most of the year, but will overwinter in the deeper areas of their range. In spring, carp leave these deeper areas to root through the soil for aquatic insect larvae, small mollusks, crustaceans, and annelid worms. Newly hatched larvae feed only on algae and zooplankton, but can eat most available invertebrates by the time they are a year old. Adults will also feed on plants and algae (California Fish Website 2016b).

Channel catfish are found mostly in the main channels of large, warm-water streams with sand, gravel, or rubble bottoms, but can also be found in farm ponds, reservoirs, and turbid, muddy bottomed rivers. Channel catfish juveniles feed on crustaceans and insect larvae and will begin hunting fish and crayfish as they grow older. Individuals larger than 12 to 15 inches (30 to 38 cm) mainly feed on fish, but will eat anything from insects to small mammals if it fits in their mouths (California Fish Website 2016b).

White catfish can be found in deep lakes and reservoirs and the sluggish sections of rivers and streams. They can be found in salinities up to 14.5 parts per thousand and prefer temperatures over 68° F (20° C), surviving in water up to 88° F (31° C). White catfish are mostly carnivorous bottom feeders, and the focus of a population's diet depends mainly on prey availability. Juveniles feed on amphipods, shrimp, and insect larvae and shift their diet toward fish and large invertebrates as they get larger. It is also not uncommon for catfish to scavenge carrion or swim to the surface to feed on planktivorous fish (California Fish Website 2016b).

Green sunfish are most common in small, warm streams with turbid, mud-bottom pools and aquatic vegetation, and are especially prevalent in streams that are intermittent in summer. They can also be

found in ponds and large lakes in shallow weedy areas that are ill-suited to larger predators. Green sunfish are opportunistic predators, feeding primarily on invertebrates and small fish. Young-of-the- year feed mainly on zooplankton, small benthic invertebrates, and the larvae of other fish, but the focus of their diet switches to large aquatic and terrestrial insects, crayfish, and other fish as they grow (California Fish Website 2016b).

Threadfin shad are found in the open waters of sluggish backwaters, large ponds, and reservoirs where they stay close to the inlets of small streams or along the surfaces of dams. They are dependent on light for foraging and generally stay high in the water column. They are warm-water fish that are very tolerant of salinity, and prefer summer temperatures between 72° F and 75° F (22° C and 24° C) and will die if the water drops below 43° F (6° C). Shad feed exclusively on plankton and use two methods to catch it. Small zooplankton, phytoplankton, and detritus are filtered through their gill rakers, while large zooplankton, especially copepods, are chased down and caught as individual prey (California Fish Website 2016b).

5.3.4 Fish Diseases

The analysis area for fish diseases includes the NEP Area and downstream of Shasta and Keswick Dams to the Livingston Stone NFH located near the base of Shasta Dam. Past fish stocking practices in the NEP Area may have introduced diseases and parasites to the analysis area. Pathology studies by CDFW conducted in 2012 and 2013 in the upper McCloud River basin found sporadic and minor external parasites, including *Gyrodactylus, Trichodina,* and *Apiosoma*-like ectocommensal ciliates (Redband Core Group 2016). Low to moderate levels of external parasite detection is considered normal. Because information on the pathogen distribution aids risk management decisions, CDFW and the CA-NV Fish Health Center coordinated a survey in the upper Sacramento and McCloud Rivers (USFWS 2015c). The survey focused on native resident rainbow trout and brown trout during the period of warmest water temperatures. No viral pathogens or *Renibacterium salmoninarum* (bacterial kidney disease agent) were detected in either sample group. Similarly, there were no detections of the following myxosporeans: *Myxobolus cerebralis, Ceratonova shasta,* or *Parvicapsula minibicornis*.

One rainbow trout from the upper Sacramento River had an asymptomatic *Yersinia ruckeri* bacterial infection (causative agent of enteric (intestinal) redmouth disease). Several parasites were observed in histological sections of gill, intestine, and kidney; however, no significant tissue lesion was associated with the infections.

The Livingston Stone NFH is located below Shasta Dam and currently lacks water treatment facilities capable of treating pathogens that may be introduced by wild Chinook salmon reintroduced into the NEP Area.

5.4 Aquatic Habitat

For this subsection the analysis area is the same as the NEP Area and describes the current quality and quantity of salmonid aquatic habitat in the NEP Area (subsection 3.1, Description of the Action Area). Discussions in this subsection address the aquatic habitat conditions important for viability of SR winter-run Chinook salmon and CV spring-run Chinook salmon, including water quality, water quantity and fish passage, and habitat availability.

5.4.1 Water Resources

The upper Sacramento River, McCloud River, and Pit River Watersheds are subject to compliance with the Water Quality Control Plan for the Sacramento and San Joaquin River Basin (Basin Plan) (Central Valley Regional Water Quality Control Board [CVRWQCB] 2016). The Basin Plan applies to the entire geographic extent of the Sacramento and San Joaquin River Watersheds, covers 27,210 square miles, and includes the entire area drained by the Sacramento River. The Basin Plan identifies both numeric and narrative water quality objectives applicable to the waters of the upper Sacramento River, McCloud River, Pit River, and Shasta Lake. State law defines beneficial uses of California's waters that may be protected against quality degradation (California Water Code Section 13050(f)). The upper Sacramento River, McCloud River, Pit River, and Shasta Lake share a number of designated beneficial uses, including Agricultural Supply, Recreation, Non-contact Water Recreation, Freshwater Habitat, and Wildlife Habitat (see CVRWQCB 2016 for a full list of shared and unique beneficial uses). Two subcategories, warm and cold, are included to further describe spawning habitat type, but cold-water spawning habitat use is designated only for the upper Sacramento River, McCloud River, and Pit River, while Shasta Lake is also designated for warm-water spawning habitat use.

The McCloud, upper Sacramento, and Pit Rivers are regulated rivers because of the presence of large barrier dams and hydroelectric projects that modify the natural flows in these rivers within the NEP Area. Water flow from smaller tributaries within the NEP Area is largely unregulated by dams and diversions before entering the McCloud, upper Sacramento, and Pit Rivers or Shasta Lake. Descriptions of each major dam are found in the subsections below that correspond to the rivers on which they are located.

5.4.1.1 Shasta Lake

Water quality in Shasta Lake generally meets the standards for beneficial uses identified in the Basin Plan (CVRWQCB 2016). A favorable inflow-outflow relationship of 1.4 to 1 results in good water quality throughout the reservoir (USFS 1996 as cited by Reclamation 2013). Seasonal and annual variations in water surface elevation are functions of reservoir releases for water demand and water quality requirements, tributary inflow, and carryover storage from year to year. Shasta Lake is classified as a cool-water, mesotrophic, monomictic reservoir (Reclamation 2017).

Shasta Lake is listed as impaired by mercury throughout the lake under the Clean Water Act (CWA) section 303(d) (CVRWQCB 2016). Within Shasta Lake, some areas exist where the water quality does not meet Basin Plan objectives during periods of storm runoff because of past management activities or as a result of drainage from historical mining and mine processing operations.

5.4.1.2 Upper Sacramento River

This subsection focuses on the segment of the upper Sacramento River from Box Canyon Dam to Shasta Lake. The water quality of the upper Sacramento River and its major tributaries supports nearly all beneficial uses, most of the time (Domagalski et al. 2000). Most of the water in the upper Sacramento River and its tributaries is derived from snowmelt and runoff from typically abundant winter rainfall at lower elevations; as a result, the water in the system is relatively pure and low in dissolved minerals (Domagalski et al. 2000). Box Canyon Dam on the upper Sacramento River, completed in 1970, is owned and operated by Siskiyou County's Flood Control and Water Conservation District and Siskiyou Power Authority.

The upper Sacramento River above Shasta Lake has no listed water quality impairments of beneficial uses as defined under section 303(d) of the CWA (CVRWQCB 2016). Surface water of the upper Sacramento River upstream from Shasta Lake does not exceed any of the Basin Plan thresholds for important metal pollutants, including dissolved cadmium, copper, or zinc (NSR 2010). The turbidity data available for the upper Sacramento River at the United States Geological Survey (USGS) gage at Delta (above Shasta Lake) and for Hazel Creek, a tributary midway between Box Canyon Dam and Shasta Lake, suggest that since 1998, during low-flow conditions, water clarity has met the Basin Plan objective for turbidity (Reclamation 2017).

Water temperature in the upper Sacramento River fluctuates seasonally and spatially between Box Canyon Dam and Shasta Lake. Beginning in 2011, Reclamation installed and operated thermographs at

nine locations along the Sacramento River between Box Canyon Dam (RM 36) and Gibson (RM 9). These thermographs indicate that maximum water temperature objectives in Water Year 2012 were met in each season upstream from Gibson Road, where water temperatures approached, but did not exceed, 70° F (21° C) during the May through October time period (Reclamation 2014b). The thermal regime along much of the upper Sacramento River (upstream from Shasta Lake), except in the immediate vicinity of the Delta gage and the head of Shasta Lake, appears to be highly suitable for cold-water fishes and generally meets Basin Plan objectives for cold-water fishery beneficial uses (Reclamation 2014b).

The available thermographic record (Reclamation 2014b) indicates thermal conditions remain within the suitable range for juvenile Chinook salmon growth and survival throughout the summer, not exceeding a Monthly Maximum Weekly Average Temperature (MMWAT) of 66.0° F (19.0° C),[5] for 28 miles of the upper Sacramento River from Box Canyon Dam downstream to Gibson Road (RM 9).

Mount Shasta's sizable snowpack and glacial meltwater percolate through its porous volcanic geologic structure, eventually emerging as hundreds of springs that input cold, clear water into the upper Sacramento River. These inflows occur mostly as springs and provide an abundance of high quality (clean, cool) water into the upper Sacramento River. These springs are located mostly upstream from Soda Creek along the upper Sacramento River. The USGS has monitored surface flow in the upper Sacramento River at a station near Lake Shasta since 1945. Average daily flow is approximately 1,000 cubic feet per second (cfs), with a peak daily flow of 70,000 cfs (1974) and extreme low of 117 cfs (1977) (Sacramento River Watershed Program 2016a).

5.4.1.3 McCloud River

This subsection focuses on the segment of the McCloud River from McCloud Dam to Shasta Lake. The water quality of the McCloud River supports all of its designated beneficial uses most of the time. In general, water quality is exceptional in the watershed. The McCloud River has no listed water quality impairments to its designated beneficial uses under CWA section 303(d).

Under base-flow conditions, suspended sediment values typically range from less than 2.0 to 4.0 milligrams per liter of total suspended solids (0.5 to 3.6 Nephelometric Turbidity Units (NTU)) in the

[5] The basis and rationale for this temperature criterion is described in the habitat assessment accompanying the Shasta Dam Fish Passage Evaluation Program (Reclamation 2014b).

McCloud River (Reclamation 2017). Continuous monitoring of turbidity over five events in August-October 2007, and August-September 2008, showed downstream turbidity levels in the McCloud River ranging from 65 to 300 NTU below McCloud Dam, 12 to 155 NTU above Claiborne Creek, and 5 to 72 NTU above Shasta Lake (FERC 2011). Water quality contaminants (e.g., metals, bacterial, biostimulatory, chemical) have not been reported to occur in the McCloud River.

McCloud Dam on the McCloud River, completed in 1965, is owned and operated by PG&E as part of the McCloud-Pit Hydropower Project. The dam is 235 feet high, 630 feet long at its crest, and impounds a maximum capacity of 35,200 acre-feet (FERC 2011). PG&E's McCloud-Pit Hydroelectric Project (FERC Project No. 2106) diverts water at McCloud Reservoir through a tunnel complex into the Pit River drainage at Iron Canyon Reservoir. Required minimum base flows from McCloud Dam are 50 to 60 cfs. Required minimum flows[6] downstream (as measured by USGS gage 11367800/MC-1 located at the Ah-Di-Na site on the McCloud River) range from 160 cfs to 210 cfs depending on water- year-type and time of year (FERC 2011). A synthesis of mean estimated unimpaired flows from 1974 through 2006 (as measured at the Ah-Di-Na gage) ranged between a high of 1,614 cfs and a low of 589 cfs (FERC 2011). Under regulated flow conditions, mean estimated flows during the same period at the Ah-Di-Na gage ranged between a high of 484 cfs and a low of 204 cfs. These data indicate current flow conditions are substantially less than unimpaired conditions.

Temperatures in McCloud Reservoir and the McCloud River downstream from McCloud Dam reflect the large volume of cold water entering the reservoir from the spring-fed upper McCloud River and the relatively short residence time of water in the reservoir. Groundwater springs provide a large and relatively stable source of cold water to the upper McCloud River. Flow in the McCloud River is regulated by releases from McCloud Dam, but the river receives significant inflow in the form of groundwater discharge from springs and runoff from tributaries; both contribute to a water temperature regime that supports year-round cold-water fish habitat throughout much of the length of the lower river (Reclamation 2014b). This cold water supports a viable trout fishery throughout the entire 24- mile-long reach of the McCloud River (FERC 2011).

Temperatures vary seasonally in the McCloud River, increasing from June to mid-July, remaining warmest in mid-summer, and declining from mid- to late-August through September. Typically, daily

[6] When FERC issues a new hydropower license for the McCloud–Pit Hydroelectric Project, minimum baseflow releases from McCloud Dam are anticipated to increase above current minimum base flows.

average water temperature in the McCloud River remains below 68° F (20° C).[7] Seasonally, water temperature in the lower reaches of the McCloud River can rise to around 68° F (20° C), especially in hot, critically dry water years, under both the previous and new hydropower operating licenses (FERC 2011).

Similar to the upper Sacramento River, the thermal regime along much of the McCloud River (upstream from Shasta Lake), except in the immediate vicinity of the head of Shasta Lake, appears to be highly suitable for cold-water fishes and generally meets Basin Plan objectives for cold-water fishery beneficial uses (Reclamation 2017). Based on a limited set of long-term thermographic records and PG&E's (2009) temperature modeling for the McCloud River below McCloud Dam, optimal temperatures for Chinook salmon egg incubation through the summer months is limited to approximately 11.6 miles of the upper reaches of the river below McCloud Dam under both the previous and proposed hydropower licenses (FERC 2011; Reclamation 2014b). Thermal conditions remain within the suitable range for juvenile Chinook salmon growth and survival throughout the summer, not exceeding an MMWAT of 66° F (19° C), for the entire distance of the McCloud River from McCloud Dam to Shasta Lake (Reclamation 2014b). Upstream from McCloud Reservoir, considerable cold-water spring inflows maintain relatively cold and consistent water temperatures.

The USGS has monitored surface flows on the lower McCloud River since 1945 (USGS gage 11368000), and the average daily flow in the McCloud River ranges from less than 1,000 cfs to 20,000 cfs, with a peak daily flow recorded in 1996 of 45,000 cfs (Reclamation 2014b).

5.4.1.4 Pit River

The Pit River, from the confluence of the North and South Forks to Shasta Lake, is designated under CWA section 303(d) as impaired by excess nutrients, organic enrichment/low-dissolved oxygen, and high water temperatures (Cal EPA 2010). No Chinook salmon would be released into the Pit River portion of the NEP Area (below Pit 7 Dam). The Pit River is discussed because SR winter-run and/or CV spring-run Chinook salmon may stray into the lower Pit River below Pit 7 Dam. Agriculture and livestock grazing are cited as the probable sources for water quality impairment (CVRWQCB 2016)

[7] A 68° F (20° C) criterion for cold-water fishes is based on the thermal requirements and tolerances of rainbow trout and is considered a conservative threshold for water temperatures, above which adverse effects to trout growth and survival may occur.

and originate upstream of the NEP Area. Water quality concerns that do exist are influenced largely by the quality of water entering from the upper watershed.

Pit 7 Dam on the Pit River, completed in 1965, is owned and operated by PG&E as part of the McCloud-Pit Hydropower Project. The dam is 228 feet high, 770 feet long at its crest, and impounds a maximum capacity of 34,142 acre-feet (FERC 2011). Required minimum base flows from Pit 7 Dam during all water year types is 150 cfs. An estimate of mean unimpaired flows from 1974 through 2006 (as measured at USGS gage 11365000/PH-47) ranged between a high of 6,844 cfs to a low of 2,415 cfs (FERC 2011). Under regulated flow conditions, mean estimated flows during the same period at the same gage ranged between a high of 7,765 cfs and a low of 3,024 cfs (FERC 2011). These data indicate current flow conditions are greater than unimpaired conditions, in large part due to the additional water diverted from the McCloud River.

Below Pit 7 Dam (in the NEP Area), the river water temperature reaches a maximum of 64° F to 68° F (18° C to 20º C) during the middle to late summer with a 24-hour variation. There is a steady decline in water temperatures in the fall and winter, with minimum water temperatures at all sites near 39° F (4º C) (FERC 2011).

The USGS has monitored surface flows in the Pit River and the daily historical mean and median daily discharges are 4,231 and 3,760 cfs, respectively (USGS gage 11364800/PH-64) (FERC 2011). Summer flows rarely fall below 2,000 cfs (Sacramento River Watershed Program 2016b). The lower reach of the Pit River supports warm-water species (e.g., bass, catfish, crappie, and bullhead) (subsection 5.3.3, Non-native Fish Species) as well as resident rainbow trout.

5.4.2 Fish Passage

Dams and water diversion projects are located on the upper Sacramento River, McCloud River, and Pit River and their associated tributaries, most of which fall on the outer limits or outside of the NEP Area. The boundaries of the NEP Area are partly determined by the upstream location of a dam on all three of the main tributaries in the NEP Area: Box Canyon Dam on the Sacramento River, McCloud Dam on the McCloud River, and Pit 7 Dam on the Pit River.

The only significant impediment to salmonid upstream migration in the areas targeted for salmonid reintroduction occurs between Shasta Lake and the Box Canyon Dam on the upper Mears Falls (located immediately upstream of the Mears Creek confluence with the Sacramento River). Mears Falls forms

an incomplete, seasonally temporary impediment to upstream migration during late-summer and fall flows, but would be passable during the higher river flows of the winter through early summer months (Reclamation 2014b). The only potential fish passage impediment on the McCloud River between Shasta Lake and McCloud Dam is a simple cascade known as Tuna Falls, located immediately upstream of the Tuna Creek confluence upstream of Shasta Lake. This boulder cascade does not pose a significant passage barrier or impediment to salmonid fish migration (Reclamation 2014b).

5.4.3 Habitat Availability and Quality

5.4.3.1 Upper Sacramento River Habitat Availability and Quality

The upper Sacramento River is a highly productive, cold-water, mountain stream for most of its length. This quality is due in part to the cold, nutrient-rich, and well-oxygenated water emanating from Lake Siskiyou and numerous tributary streams and springs downstream from Box Canyon Dam (CDFG 2000). Riverine habitat types are variable and representative for a stream of this type, and include pools, runs, riffles, cascades, and pocket water. The relative abundance of habitat types, habitat dimensions, and environmental conditions vary along the length of the river (Thomas R. Payne and Associates 2005; NSR 2010; Reclamation 2014b). The upper river is generally swifter and of steeper gradient, with longer riffles and shorter, shallower pools than the lower river. These differences in river characteristics result in variation in relative species abundance, productivity, and biomass along the length of the river (CDFG 2000). The flow regime of the upper Sacramento River is lowest and relatively stable during the summer and fall, and exhibits more flow variability and peak flows in response to precipitation events and snowmelt runoff from the winter through the spring (Reclamation 2014b).

According to Reclamation's habitat assessment study (2014c), spawning habitat conditions in all study reaches throughout the upper Sacramento River ranges from fair to good (Reclamation 2014b). Substrate attribute scores were the highest of the three evaluated spawning habitat attributes. The lowest spawning habitat component scores were for structural habitat metrics (e.g., proportion of pool habitat, maximum pool depth, and spawning substrate area), suggesting that two of the limiting factors of overall salmon spawning habitat condition in the Sacramento River may be the frequency of large, deep pools and the amount of suitable-sized spawning gravel, especially in the reach upstream of Dunsmuir. However, pool depths and spawning gravel areas may be more limiting under low baseflow conditions of late summer and fall when CV spring-run Chinook salmon spawn, but not so limiting during the higher flows of spring and early summer when SR winter-run Chinook salmon spawning

peaks. The later-spawning fraction of the SR winter-run Chinook salmon would be affected however, because they have been observed to spawn into the month of August (Vogel and Marine 1991; Yoshiyama et al. 1998).

The quality of physical spawning and rearing habitat attributes generally improves downstream of Dunsmuir to Shasta Lake (Reclamation 2014b). Overall, suitable physical spawning habitat for anadromous salmonids occurs throughout the upper Sacramento River under suitable water temperature conditions. However, Reclamation's study (Reclamation 2014b) found optimal water temperature conditions for SR winter-run Chinook salmon egg incubation (less than or equal to 53.5° F (12.0° C) daily average) are exceeded in most years from June through August, which coincides with most of the SR winter-run Chinook salmon egg incubation season. Furthermore, the study found that, based on the only available longitudinal thermograph record (Water Year 2012, a below normal water year), this optimal thermal threshold appears limiting for SR winter-run Chinook salmon that spawn downstream from about Dunsmuir to Shasta Lake. With regard to rearing habitat, the study indicated that overall the upper Sacramento River provides fair rearing habitat conditions for Chinook salmon from at least Dunsmuir downstream to Shasta Lake, including suitable thermal conditions (Reclamation 2014b).

Because anadromous salmonids do not return to the NEP Area under existing conditions, there is no delivery of marine-derived nutrients to the NEP Area. The NEP Area is lacking a primary source of marine-derived nutrients that were available to help drive stream productivity historically, such as nitrogen, phosphorous, calcium, and potassium.

5.4.3.2 McCloud River Habitat Availability and Quality

The McCloud River is a mixed bedrock-alluvial channel, with high transport capacity relative to sediment supply and generally low volumes of active sediment storage. Channel reach morphology in the McCloud River broadly transitions from one that is predominantly step-pool upstream from Ah-Di-Na Campground to an alternating plane-bed and pool-riffle channel downstream from Ah-Di-Na, reflecting an overall decrease in channel slope and confinement and an increase in mobile sediment supply (FERC 2011).

Reclamation's habitat assessment study (2014b) indicated that habitat composition in the McCloud River is dominated by pools and flatwater habitats (consisting of runs, glides, and pocket water) in all three study reaches, with the frequency of pool habitats tending to increase downstream from McCloud Dam and becoming the dominant habitat in the lower study reach. Higher gradient, fast water habitats

(i.e., riffles and cascades) made up a greater proportion of the available habitat in the upper study reach. The flow regime of the McCloud River is lowest and relatively stable during the summer and fall and exhibits more flow variability and peak flows in response to precipitation events and snowmelt runoff from the winter through the spring (Reclamation 2014b).

According to Reclamation's study data, rearing conditions were fair to good, with little spatial variation in the upper and middle study reaches (no scores were given for the lower reach because no field surveys had been conducted) (Reclamation 2014b). Cover attribute scores were the lowest rated component, which influenced the overall rearing habitat condition scores for each study reach.
Substrate and habitat attribute scores were fair to good. Rearing habitat conditions improved with distance downstream from McCloud Dam, a function of increasing frequencies of flatwater habitats preferred by juvenile Chinook salmon. Physical rearing habitat conditions, including water temperatures through the summer months, are fair to good for Chinook salmon in the McCloud River from McCloud Dam downstream to at least Squaw Valley Creek. Thermal conditions throughout the summer remain within the suitable range for juvenile Chinook salmon growth and survival all the way downstream to Shasta Lake (Reclamation 2014b).

Because anadromous salmonids do not return to the NEP Area under existing conditions, there is no delivery of marine-derived nutrients to the NEP Area. The NEP Area is lacking a primary source of marine-derived nutrients that were available to help drive stream productivity historically, such as nitrogen, phosphorous, calcium, and potassium.

5.5 Wildlife Species

The analysis area for wildlife is the same as the NEP Area except for killer whale (*Orcinus orca*). The NEP Area represents the area of potential effects; for example, where wildlife species could reasonably be expected to modify their behavior in response to changes in the availability of food resources in the NEP Area under the alternatives.

The NEP Area (Figure 3) is home to a variety of wildlife species, many of which rely to varying extents on fish, including salmonids. Of the approximately 311 wildlife species (amphibians, reptiles, birds, and mammals) that may occur in the NEP Area (CDFW 2016c), 33 (11 percent) have a strong- consistent or recurrent relationship with salmon as a food resource (Cederholm et al. 2000) and therefore, these are the species most likely affected under the range of alternatives. Salmonids provide direct or indirect foraging opportunities for these species, in some cases to the extent of influencing the distribution or population status of a particular species (Cederholm et al. 2000; Hilderbrand et al. 2004;

Ward et al. 2013). For example, common mergansers (*Mergus merganser*) may congregate to feed on salmon fry when they are available (Cederholm et al. 2000). Turkey vultures (*Cathartes aura*), in contrast, opportunistically feed on salmon carcasses as well as many other items, and are unlikely to respond to changes in the availability of salmonids as a food source (Cederholm et al. 2000). Black bear (*Ursus americanus*) are found in the NEP Area, are generalists in terms of their diet, and would include salmon carcasses when available (Jameson and Peeters 1988). An example of a species with an indirect link to salmonids is the American dipper, which feeds on aquatic insects that are beneficially affected by nutrients derived from salmon carcasses (Cederholm et al. 2000).

A number of native species prey on salmon or their carcasses directly (Table 4) (Cederholm et al. 2000; Hilderbrand et al. 2004). These species vary in their response to changes in the availability of salmonids as a food source. Because the availability of salmon varies seasonally, most species that directly consume salmon likely have flexible foraging strategies, eating salmon when they are available and alternate food sources at other times (Cederholm et al. 2000). The life history of these species are described briefly below.

Table 4. Native wildlife species and their status in the NEP Area with a strong-consistent, or recurrent, relationship with salmon as defined by Cederholm et al. (2000). All birds in this table are on the list of protected species pursuant to the Migratory Bird Treaty Act of 1918, as amended.

Classification / Species / Scientific Name	Federal Status	California Status
Amphibians		
Pacific giant salamander (*Dicamptodon tenebrosus*)		
Reptiles		
Aquatic garter snake (*Thamnophis atratus*)		
Birds		
Common loon (*Gavia immer*)		Species of Special Concern
Osprey (*Pandion haliaetus*)		
Caspian tern (*Hydroprogne caspia*)		
Turkey vulture (*Cathartes aura*)		
Pied-billed grebe (*Podilymbus podiceps*)		
Western grebe (*Aechmophorus occidentalis*)		
Clark's grebe (*Aechmophorus clarkii*)		
Double-crested cormorant (*Phalacrocorax auritus*)		
Black-crowned night heron (*Nycticorax nycticorax*)		
American dipper (*Cinclus mexicanus*)		
Common merganser (*Mergus merganser*)		
Hooded merganser (*Lophodytes cucullatus*)		
Red-breasted merganser (*Mergus serrator*)		
Great blue heron (*Ardea herodias*)		
Snowy egret (*Egretta thula*)		
Bald eagle (*Haliaeetus leucocephalus*)	Delisted, USFS – Sensitive	Endangered, Fully Protected
Golden eagle (*Aquila chrysaetos*)		Fully Protected
Herring gull (*Larus argentatus*)		
Ring-billed gull (*Larus delawarensis*)		
California gull (*Larus californicus*)		
Belted kingfisher (*Megaceryle alcyon*)		
American crow (*Corvus brachyrhynchos*)		
Common raven (*Corvus corax*)		
Mammals		
Virginia opossum (*Didelphis virginiana*)		
Water shrew (*Sorex palustris*)		
Coyote (*Canis latrans*)		
Gray wolf (*Canis lupus*)	Endangered	Endangered
Black bear (*Ursus americanus*)		
Raccoon (*Procyon lotor*)		
American mink (*Mustela vison*)		
Northern river otter (*Lutra canadensis*)		Species of Special Concern
Bobcat (*Lynx rufus*)		

Sources: CDFW 2016e; Cederholm et al. 2000; Benjamin Nelson, Reclamation, forwarded email of U.S. Fish and Wildlife Service Species Lists to Alice Berg, NMFS, March 3, 2016.

The association of aquatic mollusks (Table 5) to salmon, including those with a special listing status and known to occur in the NEP Area, is not well documented. While portions of their habitat requirements are often similar (cold and clean water), whether these species have a strong and consistent, or recurrent relationship in unknown.

Table 5. Special-status species in the NEP Area with unknown relationships with salmon.

Classification / Species	Federal Status	California Status
Aquatic Mollusks		
Nugget pebblesnail (*Fluminicola seminalis*)	USFS – Sensitive	

Sources: Furnish 2007; PG&E 2008; Bill Brock, USFS, November 7, 2016, email communication to Jon Ambrose, NMFS, providing an attached list of U.S. Forest Service Sensitive Animal Species dated June 30, 2013.

5.5.1 ESA-listed and Special Status Wildlife Species

Wildlife species that may feed on salmonids are designated under state or Federal law as being at risk are listed in Table 6 and Table 7. Except for killer whales, the analysis area is the same as the NEP Area. Killer whales are discussed below under Mammals. Northern spotted owl critical habitat is located within the NEP Area (Table 7). However, this species does not feed on salmon and would not be expected to be affected by the Proposed Action; therefore, this species and its designated critical habitat will not be analyzed in this EA.

Table 6. Special-status species outside the NEP Area but with strong-consistent relationships with salmon.

Mammals	Federal Status
Killer whale (*Orcinus orca*)	Endangered (Southern Resident DPS)

Table 7. Critical habitat within the NEP Area.

Birds and Amphibians	Critical Habitat Type
Northern spotted owl (*Strix occidentalis caurina*)	Final designated

Source: Benjamin Nelson, Reclamation, March 3, 2016, email to Alice Berg, NMFS, of USFWS Species Lists.

Birds

The common loon is only present in the NEP Area during their migration periods and does not use the area for nesting or breeding (CDFW 2016d). Common loons are found in wooded lakes, tundra ponds, and coastal waters of the United States and Canada (National Audubon Society 2016a). The diet of the common loon mainly consists of small fish up to about 10 inches long (e.g., minnows, suckers, perch,

gizzard shad, etc.). Common loons will also eat crustaceans, mollusks, aquatic insects, leeches, and frogs (National Audubon Society 2016a).

Bald eagles are found throughout the United States, and their abundance varies depending on their habitat usage patterns through the seasons and whether they are resident or migratory. In the NEP Area, bald eagles are found year-round, and in the Shasta-Trinity National Forest often remain in their nesting territory year-round and year after year return to and maintain the same nesting site (USFS 2012; National Audubon Society 2016b). One of the state's most important bald eagle populations is located in the Lower Pit River Watershed (Sacramento River Watershed Program 2016b). The diet of bald eagles is varied and they will hunt for prey, mainly fish, waterfowl, and small mammals, as well as feed on carrion. In the Shasta, Trinity, and Lewiston Lakes area, the bald eagle diet consists primarily of fish, either live or carrion (USFS 2012).

Golden eagles are found mainly in the western half of the United States in all seasons (Johnsgard 1990). In the NEP Area, golden eagles are seen in all seasons. The diet of the golden eagle consists mainly of small mammals, ranging in size from ground squirrels to marmots and jackrabbits. They are also known to take larger prey (such as foxes or young deer) or smaller prey (such as voles and mice), and also eat carrion, including fish (National Audubon Society 2016c).

Mammals

The gray wolf is found in many states within the lower contiguous United States, including Minnesota, Montana, Wyoming, Idaho, Washington, Oregon, and recently in California. The California population may be located in the NEP Area and is currently listed as endangered under the ESA. CDFW also listed the gray wolf as endangered under the CESA. In 2015, photographs of two adults and their pups, named the Shasta pack, confirmed the presence of the gray wolf in northern California (CDFW 2016e). The gray wolf can thrive in a diversity of habitats ranging from the tundra to forests to deserts. Habitat in the NEP Area is mountainous and forested. The diet of the gray wolf consists mainly of large hoofed animals, such as deer and elk, but they will also hunt and eat smaller mammals such as rodents and hares (National Wildlife Federation 2016). The gray wolf would likely consume salmon carcasses opportunistically.

The northern river otter is an uncommon, year-long resident of a variety of aquatic habitats in the northern portions of California and patchily distributed through the Sierra Nevada mountain range. The northern river otter is present in the NEP Area where they feed primarily on fish, crayfish, carrion,

mammals, birds, and occasionally fruits (Toweill 1974 as cited in Verts and Carraway 1998). According to the CDFW (2016f), northern river otters generally do not affect population numbers of game fish and may improve sport fishing because they eat mostly slower, nongame fish (CDFW 2016f).

The killer whale is found in all parts of the oceans and are most abundant in colder waters, including Antarctica and the North Atlantic and Pacific Oceans. Killer whales off the coast of California include a number of pods that range along the eastern Pacific Ocean and are present in offshore and coastal waters depending on the season (NOAA Fisheries 2017). Resident killer whale populations (Table 6) in the eastern North Pacific mainly feed on salmonids, showing a strong preference for Chinook salmon (Olesiuk et al. 1990 as cited on NOAA Fisheries 2017). While killer whales are located in the ocean outside of the NEP Area, they are discussed in this EA because a main component of their diet is adult salmonids, which could be indirectly affected by the successful introduction of additional Chinook salmon runs considered in the Proposed Action.

Aquatic Mollusks

The nugget pebblesnail was detected in the lower McCloud River during an aquatic mollusk survey as part of the FERC relicensing process for the McCloud-Pit Hydroelectric Project (FERC 2011). Nugget pebblesnail prefers gravel-cobble substrate with clear and cold flowing water in large streams and rivers (Taylor 1981). This species has declined precipitously from its historical distribution (Furnish 2007) when it was formerly found from the mouth of the mainstem Sacramento River to the Pit River (Taylor, 1981), and is now likely limited to the Pit and McCloud Rivers (Hershler and Frest 1996; Furnish 2007). The nugget pebblesnail population that occurred in the upper Sacramento River may have been extirpated following the Cantara spill in 1991 (C. Jordan, USFS, email sent to J. Ambrose, NMFS, regarding status of USFS surveys for nugget pebblesnail, November 8, 2016). The nugget pebblesnail is believed to be declining, but there is insufficient information regarding the distribution and population trends to accurately assess the current status of this species (IUCN 2016).

5.5.2 Non-ESA-listed Wildlife Species

Several non-listed wildlife species that may be a food source for salmonids or that may feed on salmonids are found in the analysis area (Table 2). The analysis area for non-ESA-listed wildlife is the same as the NEP Area. The following paragraphs briefly summarize these species' diets and general life history.

Amphibians

Pacific giant salamander adults are found in cool, damp, dense coniferous forests, usually in the vicinity of streams, seepages, or lakes. As larvae they are found in small to medium sized creeks and streams in habitat similar to adult habitat. They prey on insects, slugs, snails, and worms, as well as other amphibians, snakes, shrews, and mice (Leonard et al. 1993).

Reptiles

The aquatic garter snake is found spring through fall in creeks, streams, rivers, small lakes, and ponds, and in woodland, brush, and forest, preferring shallow rocky creeks and streams. This species of garter snake is highly aquatic (but also found away from water) and is able to remain underwater. The aquatic garter snake feeds mainly on amphibians and their larvae, including frogs, tadpoles, and aquatic salamander larvae, but small fish are also eaten (Lind and Welsh 1994).

Birds

Osprey are found near fresh or salt water (rivers, lakes, coastal areas). They feed almost entirely on fish and catch them by first hovering over their prey and plunging to the water surface and grasping the fish with their talons. Their population was once severely reduced because of pesticide use; however, the osprey has made a comeback in many parts of North America (National Audubon Society 2016d).

The Caspian tern is found on both fresh and salt water, including large lakes, coastal waters, beaches, and bays, and favors protected waters such as bays, lagoons, rivers, and lakes, favoring large lakes rather than small ponds in inland areas. Caspian terns feed primarily on fish and concentrate on locally abundant species (National Audubon Society 2016e).

The turkey vulture is widespread and found over open country, woods, deserts, and foothills, and are most common over open or semi-open country that is within a few miles of rocky or wooded areas that provide secure nesting sites. Turkey vultures eat carrion located by soaring high and watching the ground and the actions of other scavengers; they also may locate carrion using their well-developed sense of smell (National Audubon Society 2016f).

The pied-billed grebe is found in ponds, lakes, and marshes, and in winter may also be found in salt bays. Pied-billed grebes forage by diving beneath the water surface and swimming in search of prey. Their diet is highly variable depending on location and season. Pied-billed grebes feed primarily on

aquatic insects, crustaceans, small fish, and leeches; they may also eat mollusks, frogs, tadpoles, salamanders, spiders, and small amounts of aquatic plants (National Audubon Society 2016g).

The western grebe summers mainly on freshwater lakes with large areas of both open water and marsh vegetation (rushes), and winters mainly on sheltered bays or estuaries on the coast, but also on large freshwater lakes. The western grebe mainly eats small fish at all seasons and in all habitats. Western grebes are also known to eat crustaceans, insects, polychaete worms, and salamanders (National Audubon Society 2016h).

Clark's grebe is considered identical to the western grebe in almost all aspects of behavior that have been studied, including foraging and prey selection (see western grebe, above). Clark's grebes may tend to feed farther from shore and in deeper water (National Audubon Society 2016i).

The double-crested cormorant is very adaptable and may be found in almost any aquatic habitat, including coasts, bays, lakes, and rivers. The double-crested cormorant diet varies with season and location, feeding mainly on a very wide variety of fish, but also crabs, shrimp, crayfish, frogs, salamanders, and eels, and sometimes snakes, mollusks, and plant material (National Audubon Society 2016j).

The black-crowned night heron is found in a wide variety of aquatic habitats, both fresh and salt water, including marshes, rivers, ponds, mangrove swamps, tidal flats, canals, and rice fields. The black-crowned-night heron diet is variable, feeding mainly on fish, but also crustaceans, aquatic insects, frogs, snakes, clams, mussels, rodents, and carrion (National Audubon Society 2016k).

The American dipper is mainly found in fast-flowing streams in mountainous areas, but sometimes may be found along streams through level country, even near sea level. The American dipper mainly catches prey under water, but will also swim on the surface to pick up floating insects and occasionally takes insects from streamside rocks (National Audubon Society 2016l).

The common merganser is found mainly around fresh water in all seasons. In summer they are found on shallow but clear rivers and lakes in forested areas, and in winter are found on lakes and large rivers, and occasionally on bays along the coast. The common merganser feeds mainly on a wide variety of fish, but will also eat mussels, shrimp, salamanders, and rarely plant material (National Audubon Society 2016m).

The hooded merganser is found in forested areas along creeks, narrow rivers, and edges of ponds in summer, and in winter is found on woodland ponds, wooded swamps, and fresh and brackish coastal estuaries. The hooded merganser feeds mainly on small fish, crayfish and other crustaceans, aquatic insects, and also will eat tadpoles, mollusks, and small amounts of plant material (National Audubon Society 2016n).

The red-breasted merganser is found during nesting season around lakes and rivers within the northern forest and northward into tundra regions, and in winter is found mostly on coastal waters, including bays, estuaries, and open ocean. The red-breasted merganser feeds mainly on small fish, but also crustaceans, aquatic insects, and sometimes frogs, tadpoles, or worms (National Audubon Society 2016o).

The great blue heron is found in marshes, swamps, shores, and tide flats. They typically forage in calm fresh waters, slow-moving rivers, and in shallow coastal bays. They eat mostly fish, but will also eat frogs, salamanders, turtles, snakes, insects, rodents, and birds (National Audubon Society 2016p).

The snowy egret is found in many types of fresh- or salt-water habitats (inland and coastal), including marshes, swamps, ponds, and shores. The snowy egret diet is varied and includes fish, crabs, crayfish, frogs, snakes, insects, snails, worms, lizards, and rodents (National Audubon Society 2016q).

The herring gull is found in a wide variety of habitats typically associated with water. They are most numerous along coasts and major rivers, and around large lakes. They forage at sea, on beaches, mudflats, plowed fields, marshes, or where human activity provides food (garbage dumps, picnic grounds, docks, fishing operations). Their diet varies with season and location, and includes fish, crustaceans, mollusks, sea urchins, marine worms, birds, eggs, and insects, and they also scavenge refuse and carrion (National Audubon Society 2016r).

The ring-billed gull is found around lakes, bays, coasts, piers, dumps, and plowed fields. They are associated with both fresh and salt water in all seasons, but are common along coasts, especially at harbors and estuaries. Ring-billed gulls are common around cities, docks, farm fields, landfills, and other human-altered habitats. They are opportunistic feeders and their diet varies with season and location, but major food items include insects, fish, earthworms, grain, rodents, and refuse (National Audubon Society 2016s).

The California gull is found along seacoasts, lakes, farms, and urban centers. During the breeding season they are found at interior lakes and marshes, often foraging for insects around farms and plowed fields. In winter, California gulls are found mainly on the coasts (frequenting beaches, docks, garbage dumps, and fields), and some are found inland around major lakes and rivers. Their diet is varied and includes insects, fish, eggs, and refuse (National Audubon Society 2016t).

The belted kingfisher is found along streams, lakes, bays, and coasts. During winter and migration, they may be found in almost any waterside habitat, including the edges of small streams and ponds, large rivers and lakes, marshes, estuaries, and rocky coastlines. Their diet consists mainly of small fish less than 4 to 5 inches long (National Audubon Society 2016u).

The American crow is found in a wide variety of semi-open habitats, including woodlands, farms, fields, river groves, and shores, and is adapting to towns and cities. They are opportunistic and quickly take advantage of new food sources. They will feed on practically anything, including insects, spiders, snails, earthworms, frogs, small snakes, shellfish, carrion, garbage, eggs and young of other birds, seeds, grain, berries, and fruit (National Audubon Society 2016v).

The common raven can be found in a wide variety of habitats, including boreal and mountain forests, coastal cliffs, tundra, and desert. They are opportunistic and eat practically anything. The majority of their diet is animal matter, feeding on a wide variety of insects (including beetles, caterpillars, etc.), rodents, lizards, frogs, eggs and young of other birds, and carrion (National Audubon Society 2016w).

Mammals

The Virginia opossum obtains much of its food and shelter from agricultural areas, where it has readily adapted. This species will eat most anything edible, either plant or animal, but mainly feeds on soil-dwelling insects, and will also eat small mice, birds' eggs, nuts, and berries (Jameson and Peeters 1988).

The water shrew is common to abundant in montane riparian habitats of the Cascades and Sierra Nevada. It is primarily restricted to cold mountain streams and adjacent riparian areas. Water shrews feed mainly on invertebrates as well as small salmonids, amphibians, and sculpins (Maser 1998).

The coyote is considered one of the most adaptable of North American mammals and occupy almost every conceivable habitat including urban areas (Maser 1998). Their diet is highly variable and includes small mammals, domestic livestock, birds, carrion, insects, and even fruit (Maser 1998).

The black bear is a wide-spread species found in forested areas in both coastal and mountain regions. The black bear diet is varied and includes berries, nuts, other vegetable foods, insects, mice, ground squirrels, and occasionally ground-nesting birds (Jameson and Peeters 1988).

The raccoon is widely distributed, highly adaptable, and found almost everywhere in California. Raccoons commonly forage along watercourses to catch crayfish and frogs. They will also eat fruits, nuts, berries, mice, small birds, and contents of birds' nests (Jameson and Peeters 1988).

American mink are found in streamside habitats (e.g., watercourses, marshes, tidal margins, mud flats) to elevations of 2,187 yards (2,000 meters) or higher. Mink feed on invertebrates such as crayfish; vertebrates such as frogs, mice, and muskrats; carrion; and sometimes ducks and coots (Jameson and Peeters 1988).

The bobcat is found in a wide range of habitats, including brushland, foothill chaparral, sagebrush, and forests. Bobcats are opportunistic and feed by availability rather than preference, with a diet that consists of rabbits, small squirrels, small reptiles, and birds (Jameson and Peeters 1988).

5.6 Land Use and Ownership

The analysis area for land use and ownership is the same as the NEP Area and encompasses the upper Sacramento River Watershed, the McCloud River Watershed, the lowermost portion of the Pit River below Pit 7 Dam, and numerous other smaller tributaries to Shasta Lake (Figure 3). The potential for lands outside these areas to be affected by the alternatives is negligible because restrictions on land use in response to ESA take prohibitions are typically applied within the basins that support ESA-listed fish species.

The NEP Area encompasses portions of Shasta County (513,118 acres) and Siskiyou County (88,875 acres), for a total of 601,993 acres, as shown in Figures 3 and 4. The land use patterns within the NEP Area are similar to the counties' land use patterns overall in that a large proportion is under Federal or state management. A significant proportion is also in timber production by private owners. The NEP Area includes 383,144 acres of the Shasta-Trinity National Forest (59 percent of the NEP Area). Castle Crags Wilderness Area is also within the NEP Area boundaries and encompasses 3,811 acres split between Shasta and Siskiyou Counties (3,797 and 14 acres, respectively, or approximately 0.7 percent of the NEP Area).

In the portion of the NEP Area that falls within Shasta County, private entities own 35 percent of the land area, with the remainder divided between Federal (64 percent) and state (2 percent) ownership (Figure 4). In the portion of the NEP Area that falls within Siskiyou County, private entities own 67 percent of the land area, with the remainder divided between Federal (33 percent) and state (less than 1 percent) ownership (Figure 4). Subsection 5.8, Tourism and Recreation, describes some of these land uses in more detail.

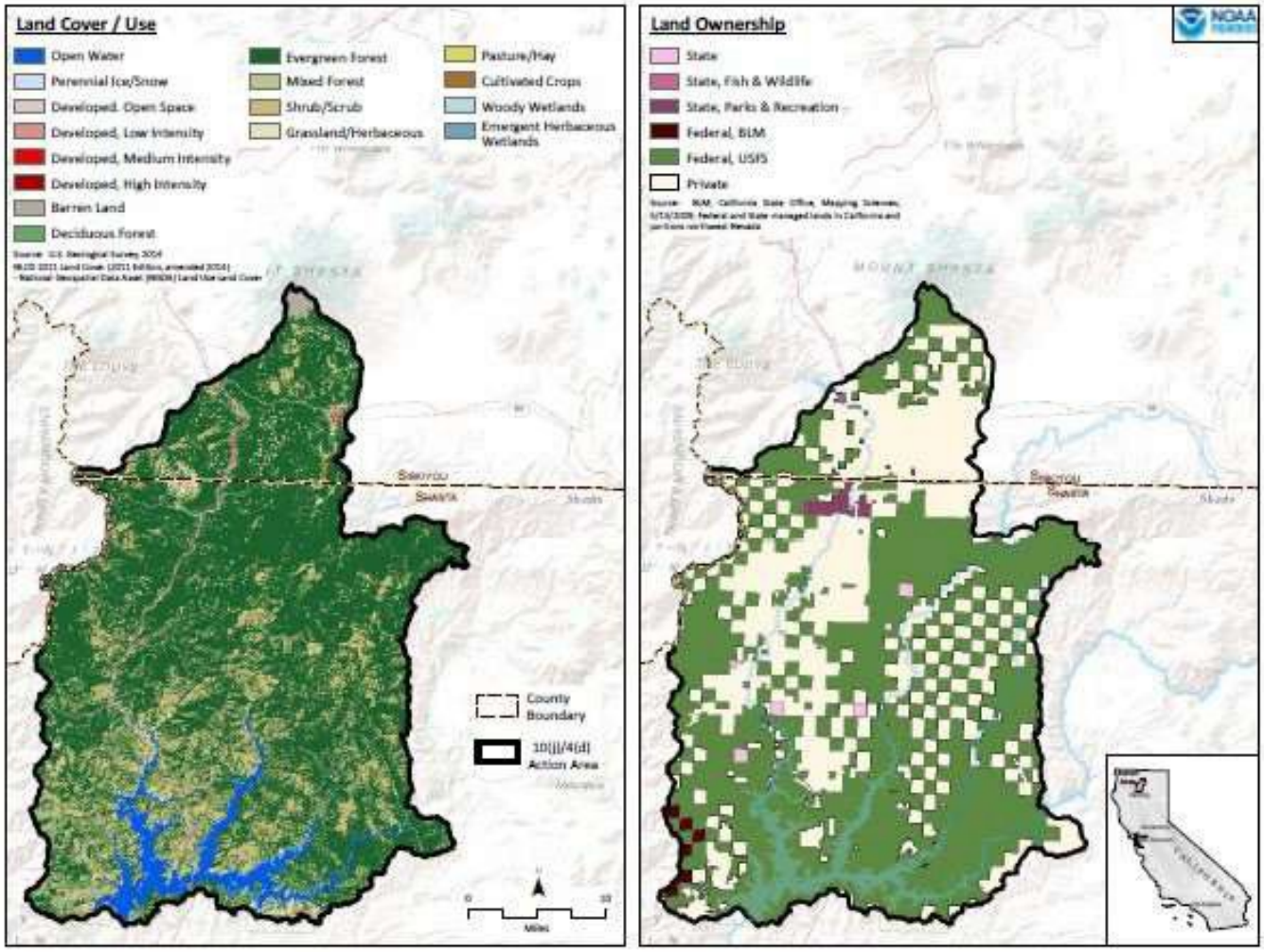

Figure 4. (a) Land cover/use types and (b) land ownership within the action area.

5.7 Hatchery Facilities

The analysis area for hatchery facilities extends outside the NEP Area and includes the Sacramento River watershed. The U.S. Fish and Wildlife Service's Livingston Stone NFH is located at the base of Shasta Dam and would be the source of SR winter-run Chinook salmon reintroduced to the NEP Area.

In 1997, USFWS and Reclamation published a final EA (USFWS and Reclamation 1997) analyzing the construction, operation, and maintenance of the Livingston Stone NFH. Subsection 1.2.6.6, SR Winter-run Chinook Salmon HGMP, describes the propagation programs at Livingston Stone NFH, the associated HGMPs, and use of this facility as a source of SR winter-run Chinook salmon. The SR winter-run conservation hatchery consists of two programs, the Winter Chinook Integrated-Recovery Supplementation Program and the Winter Chinook Captive Broodstock Program. Hatchery programs that may affect listed salmon and steelhead require authorization under the ESA. NMFS and USFWS have coordinated on the Livingston Stone NFH programs since inception and are coordinating on NMFS' issuance of an ESA section 10 permit for the two hatchery programs described in the 2015 Livingston Stone NFH Hatchery and Genetic Management Plans (subsection 1.2.6.6, SR Winter-run Chinook Salmon HGMP):

Future authorization for the collection of CV spring-run Chinook salmon and issuance of a section 10(a)(1)(A) permit for the broodstock program would be analyzed under the ESA and NEPA when NMFS receives a permit application.

5.8 Tourism and Recreation

The analysis area for tourism and recreation extends beyond the NEP Area and includes Shasta and Siskiyou Counties. Local residents within these two counties would most likely be affected by the alternatives because they live close to Shasta Lake and the upper Sacramento and McCloud Rivers.

Tourism and recreation are important components of Shasta and Siskiyou Counties' economies (Sacramento River Watershed Program 2016a, 2016b, 2016c). A large proportion of Shasta County and Siskiyou County lands are managed by Federal and state natural resource agencies, as described in subsection 5.6, Land Use and Ownership.

Recreational fishing is an important component of the recreational opportunities in these two counties. The upper Sacramento River Watershed and the McCloud River Watershed both support high quality recreational trout fisheries, with the McCloud River considered a premier trout stream that supports rainbow and brown trout. The Lower McCloud River is a CDFW-designated Wild Trout Stream from McCloud Reservoir Dam downstream to Lake Shasta (Sacramento River Watershed Program 2016a, 2016c).

Shasta Lake is a highly visited recreation destination (USFS 2014a) and is located fully within the NEP Area. Shasta Lake (within the Shasta Unit) is part of the Whiskeytown-Shasta-Trinity National

Recreation Area that was established by Congress in 1965 because of the "unique and varied recreation potential" of these areas. Shasta Lake has 370 miles of shoreline, 30,000 acres of surface area, and a maximum depth of 517 feet. Outdoor recreation opportunities in the Shasta Unit include boating, wildlife viewing, water-skiing, swimming, fishing, camping, picnicking, hiking, hunting, and mountain biking (USFS 2014a). CDFW operates a popular recreational salmon fishery in Shasta Lake as part of their Inland Fishing Program where up to 90,000 juvenile non-listed Chinook salmon (typically UKTR Chinook salmon) are planted annually. Only a small number of these fish are marked and monitoring occurs opportunistically (e.g., during fishing tournaments).

Redding (population 91,110), Shasta Lake (population 10,164), and Anderson (population 9,932) are three of the largest cities in Shasta County (City of Redding California 2016; SuburbanStats 2016a, 2016b). In the County of Siskiyou, Yreka (population 7,775), Mount Shasta (population 3,402), and Weed (population 2,983) are the largest communities in the county (County of Siskiyou 2016a). Redding has more than 300 sunny days a year and provides amenities and accommodations for visitors to the area, as do the other cities and towns in or near the NEP Area (Visit Redding California 2016; City of Redding 2016; City of Mount Shasta 2016; City of Shasta Lake 2016; City of Weed 2016; City of Yreka 2016).

Other tourism and recreation opportunities in Shasta and Siskiyou Counties include sightseeing, camping, hiking, climbing, hunting, back country skiing, and horseback riding in the many Federal- and state-managed public lands within these counties (Shasta County 2016a; County of Siskiyou 2016b).

5.9 Socioeconomics

The analysis area for socioeconomics extends outside of the NEP Area and comprises Shasta and Siskiyou Counties, because local residents within these areas would most likely be affected by the alternatives. The northern portion of the NEP Area is within Siskiyou County and the southern portion is within Shasta County (Figure 3 and subsection3.1, Description of the Action Area). The current conditions described in this subsection are combined with current conditions described in subsection 5.8, Tourism and Recreation, to create a comprehensive framework for the socioeconomic effects analyzed in subsection 6.7, Effects on Socioeconomics.

Shasta and Siskiyou Counties are relatively sparsely populated (Table 8) compared to other areas in the state. The unincorporated portion of Shasta County contains approximately 37 percent of the county's

population (Shasta County 2020). The unincorporated portion of Siskiyou County contains approximately 62 percent of the county's population (U.S. Census Bureau 2020a; County of Siskiyou 2020a). The alternatives would have no direct or indirect effect on human population trends, and population trends will not be discussed further.

A substantial portion of both Shasta and Siskiyou Counties are under the management of Federal or state resource management agencies. The economy of Shasta County is based on agriculture, tourism, timber, medical services, and retail businesses (Shasta County 2021b), while important employment sectors in Siskiyou County are agriculture, wood products, retail, tourism, manufacturing, education and health services, local government, and professional and business services (Siskiyou County 2021). Average monthly employment in 2020 was 51,288 in Shasta County and 8,310 in Siskiyou County (Table 9). In Shasta County, the unemployment rate as of October 2022 was 3.9 percent and in Siskiyou County was 4.4 percent (State of California 2021). Per capita personal income percent change for 2019 and 2020 in Shasta County was 4.1 and 10.1 percent, and Siskiyou County was 2.9 to 11.0 percent (Bureau of Economic Analysis 2020). The employment sectors with the highest average monthly number of employees for Shasta and Siskiyou Counties are healthcare and social assistance, retail trade, and accommodation and food services. Trends in economic bases, wages, employment, and unemployment in the two counties would be expected to continue as under existing conditions under all alternatives and will not be discussed further.

Commercial fishing of salmon occurs off the coasts of Washington, Oregon, and California in accordance with the Salmon Fishery Management Plans developed under the jurisdiction of the Pacific Fisheries Management Council (PFMC). The PFMC's plans have two central parts: (1) conservation objectives, which are annual goals for the number of spawners of the major salmon stocks, and (2) allocation provisions of the harvest among different groups of fishers (commercial, recreational, tribal, various ports, ocean, and inland). These Plans must comply with the ESA. The contribution of additional fish from the alternatives is considered speculative at this point and would be addressed in future Plans and ESA consultations.

Table 8. Population levels in Shasta and Siskiyou Counties, communities, and the State of California.

County/Community	2000	2010	2020
Shasta County	163,256	177,223	182,155
Shasta Lake	9,008	10,164	10,378
Redding	80,865	89,861	93,559
Anderson	9,022	9,932	11.327
Siskiyou County	44,301	44,900	44,076
Mount Shasta	3,621	3,394	3,215
Weed	2,978	2,967	2,858
Yreka	7,290	7,765	7,809
State of California	33,871,648	37,253,956	39,538.223

U.S. Census Bureau 2016a.

Table 9. Average monthly employment, per capita income, land area, and population of Shasta and Siskiyou Counties, and the State of California.

Parameter	Shasta County	Siskiyou County	State of California
Average Monthly Employment (2020)[1]	51,288	8,310	1625,067,233
Household Income ($)[2]	61,937	49,857	84,097
Land Area (square miles)[3]	3,775.40	6,277.89	155,779.22
Persons per Square Mile (2020)[3]	48.2	7.0	253.7

[1]Bureau of Labor Statistics 2016
[2]Bureau of Economic Analysis 2017 (2016 data for counties and California)
[3]U.S. Census Bureau 2016a, Quick Facts for California and Siskiyou and Shasta Counties 2010

5.10 Cultural and Historical Resources

Cultural resources include prehistoric and historical archaeological sites, historic structures, and traditional cultural properties (places that may or may not have human alterations but are important to the cultural identity of a community or Native American tribe). The analysis area for cultural resources is the same as the NEP Area (subsection 3.1, Description of the Action Area). However, many federally recognized tribes were also contacted below Shasta Dam to the confluence with the San Joaquin River because they may have historically benefited from the presence of SR winter-run Chinook salmon and CV spring-run Chinook salmon along the mainstem of the Sacramento River and some tributaries during the upstream migration of these species.

The lands along the McCloud River were occupied by Native Americans for at least 6,000 years, and a number of prehistoric sites are located on the terraces along the river and along the major ridges

(Sacramento River Watershed Program 2016c; Winnemum Wintu 2016c). For several thousand years, native tribes lived near the Upper Falls of the McCloud River in the late spring, summer, and fall.

Tribes came from their valley homes to hunt and fish. Present day Winnemem Wintu people are still deeply connected to the river and the salmon that once populated this river in abundance (Sacramento River Watershed Program 2016c).

The Winnemem Wintu are an indigenous people whose historical lands are located within the analysis area. The Winnemem Wintu are formally recognized by the California Native American Heritage Commission (Winnemem Wintu 2016c), but are not federally recognized to receive services from the Bureau of Indian Affairs (83 Fed. Reg. 4235, January 30, 2018). The Winnemem Wintu people were displaced from their historical lands on the McCloud River by the construction of the Shasta Dam and impoundment of waters in the reservoir (Winnemem Wintu 2016c). Once the dam was closed, the rivers filled Shasta Lake and inundated village areas and many sacred sites on the lower McCloud River. Currently, there are approximately 150 people who identify as Winnemem Wintu, some of whom live at the base of Bear Mountain, north of Redding (Winnemem Wintu 2016d). The Winnemem Wintu have identified 33 sacred sites on the McCloud River, and the McCloud River Watershed was listed on the Sacred Sites International Foundation's website in 2008 (Sacred Sites International Foundation 2016). Chinook salmon play an important role in the lives of the Winnemem Wintu, who are advocates for the restoration of Chinook salmon runs to their historical habitat (Winnemem Wintu 2016c), including Chinook salmon translocated from California to New Zealand more than 100 years ago.

The federally recognized Native American tribes outside and downstream of the NEP Area include:

- Redding Rancheria
- Paskenta Band of Nomlaki Indians
- Mechoopda Indian Tribe of Chico Rancheria
- Berry Creek Rancheria of Maidu Indians
- Mooretown Rancheria of Maidu Indians of California
- Enterprise Rancheria, Estom Yumeka Maidu Tribe
- Cachil Dehe Band of Wintun Indians of the Colusa Indian Community of the Colusa Rancheria
- Cortina Indian Rancheria of Wintun Indians of California
- United Auburn Indian Community of the Auburn Rancheria of California

As stated above, these federally recognized tribes occur outside of the NEP Area and were contacted because they may have historically benefited from the presence of SR winter-run Chinook salmon and CV spring-run Chinook salmon along the mainstem of the Sacramento River and some tributaries during the upstream migration of these species.

In early 2018, the federally recognized Pit River Tribe was contacted as part of the planning effort for the Shasta Fish Passage Program to include evaluation of the Pit River as a program component. Similar to the Winnemem Wintu, salmon were an important dietary and cultural component to the Pit River Tribe prior to the construction of Shasta Dam and a series of hydroelectric dams on the lower Pit River.

The presence of historical Native American artifacts along the upper Sacramento and McCloud Rivers is documented (Du Bois 1935) and archeological evidence confirms the presence of Native Americans in portions of Shasta County for over 12,500 years. These groups typically built their villages near or next to streams and rivers. Prior to the arrival of white settlers, these groups were hunter-gatherers, and one of their main foods was salmon caught with hooks, seine nets, traps, or spears and dried or smoked for later consumption (Smith 2016).

In addition to Native American cultural resources, the NEP Area, in particular Shasta Lake and tributaries, also contains artifacts from the settlement of California. These include remnants of the Oregon Trail and the Central Pacific Railroad, as well as the copper mining town of Kennett, founded during the gold rush, all of which are submerged beneath Shasta Lake. On the Pit River Arm of Shasta Lake are the remains of the Sacramento Valley and Eastern Railroad that linked the Bully Hill Mines (the remains of which are located north of the confluence) to the Southern Pacific railroad lines on the Sacramento River (USFS 2014b).

On November 2, 2017, the State of California's Office of Historic Preservation (OHP) received a letter from NMFS initiating consultation under section 106 of the National Historic Preservation Act of 1966 (as amended) (Maria Rea, NMFS, letter sent to Julianne Polanco, OHP, October 31, 2017). The consultation was in regard to NMFS' Proposed Action for the authorization of the release, designation of ESA section 10(j) populations, and promulgation of regulations pursuant to ESA section 4(d) for SR winter-run and CV spring-run Chinook salmon above Shasta Dam. NMFS determined that the NEP Area was coterminous to the Area of Potential Effects (APE). Pursuant to 26 CFR 800.5(a)(1), NMFS determined that its Proposed Action would not, directly or indirectly, alter any of the features or characteristics that convey significance to Traditional Cultural Properties within the APE. On

December 1, 2017, NMFS received a letter from California OHP (Julianne Polanco, OHP, letter sent to Maria Rea, NMFS, December 1, 2017) and provided the following comments:

- OHP did not object to the APE as defined.
- NMFS documented a reasonable and good faith effort to identify historic properties within the APE.
- The OHP did not object to NMFS' determination that the Proposed Action would not result in adverse effects to historic properties.

5.11 Environmental Justice

The analysis area for Environmental Justice extends beyond the NEP Area and includes Shasta and Siskiyou Counties. This subsection was prepared in compliance with Presidential Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations (EO 12898), dated February 11, 1994, and Title VI of the Civil Rights Act of 1964. Both EO 12898 and Title VI address persons belonging to the following target populations:

- Minority – all people of the following origins: Black, Asian, American Indian and Alaskan Native, Native Hawaiian or Other Pacific Islander, and Hispanic.
- Low income – persons whose household income is at or below the U.S. Department of Health and Human Services poverty guidelines.

Through the NEPA process, NMFS will ensure that the requirements of Executive Order 12898 regarding environmental justice are implemented, including all appropriate tribal consultation activities.

Environmental justice impacts refer to disproportionately high and adverse human health or environmental effects of a proposed action on low-income populations, minority populations, or Indian tribes (Table 10). The current Health and Human Services poverty guidelines set the poverty line for a family of four at $27,750 for 2022 ($26,500 for 2021, and $26,200 for 2020). In 2020, the estimated poverty level in Shasta County was down from the 2010 census at 14 percent, in Siskiyou County at 17 percent, and the State of California at 12 percent (U.S. Census Bureau 2020).

Table 10. Minority and Hispanic populations in Shasta and Siskiyou Counties from 2020 U.S. Census.

Description	Shasta County	Siskiyou County	California
Total	182,155	44,076	39,538,223
White	158,292	37,592	28,111,677
Black or African American	2,368	661	2,569,985
American Indian or Alaska native	5,829	2,292	672,150
Asian	6,011	749	6,286,577
Native Hawaiian and Other Pacific Islander	364	176	197,691
Two or more races	9,107	2,556	1,660,605
Hispanic or Latino (or any race)	20,766	6,127	15,894,366
Percent Hispanic (%)	11.4	13.9	40.2
Percent minority (%)	13.1	14.7	18.9

U.S. Census Bureau 2010

As listed above in subsection 5.10, Cultural Resources, there are nine federally recognized tribes located along or near the Sacramento River to the confluence of the San Joaquin River. These federally recognized tribes occur outside of the NEP Area and were contacted via letters in July and August of 2017 because they may have historically benefited from the presence of SR winter-run Chinook salmon and CV spring-run Chinook salmon along the mainstem of the Sacramento River and some tributaries during the upstream migration of these species. NMFS' letters to the tribes described the Proposed Action and invited the tribes to request a meeting to provide their input. No tribal responses were received.

General directive in Executive Order 12898 requires that each Federal agency identify and address, as appropriate, "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations…." There are also several provisions of the Executive Order and a number of supporting documents agencies should refer to when identifying and addressing environmental justice concerns in the NEPA process (CEQ 1997). Executive Order 12898 provides for agencies to collect, maintain, and analyze information on patterns of subsistence consumption of fish, vegetation, or wildlife. Where an agency action may affect fish, vegetation, or wildlife, that agency action may also affect subsistence patterns of consumption and indicate the potential for disproportionately high and adverse human health or environmental effects on

low-income populations, minority populations, and Indian tribes (CEQ 1997). The following two issues related to consumption patterns were considered.

- ***Subsistence consumption of fish and wildlife*** - Dependence by a minority population, low-income population, Indian tribe or subgroup of such populations on indigenous fish, vegetation and/or wildlife, as the principal portion of their diet.
- ***Differential patterns of subsistence consumption*** - Differences in rates and/or patterns of subsistence consumption by minority populations, low-income populations, and Indian tribes as compared to rates and patterns of consumption of the general population.

6.0 ENVIRONMENTAL CONSEQUENCES

6.1 Analysis Approach and Alternative Description Summaries

This section evaluates the potential effects of the alternatives on the biological, physical, and human environments described in Section 5, Affected Environment. The affected environment resource information establishes baseline conditions used in the analysis under each alternative in Section 4, Environmental Consequences. For this analysis, baseline conditions reflect expected conditions under the No-action Alternative (subsection 4.1, Alternative 1 (No-action)). Subsequently, each resource under each action alternative is compared to the No-action Alternative to assess changes in conditions relative to the affected environment. A summary of resource effects under each alternative is provided at the end of this section.

The NEP Area includes *all* tributaries draining into Shasta Lake up to the ridge line including the lower Pit River and tributaries (below Pit 7 Dam), the McCloud River and tributaries below McCloud Dam, and the upper Sacramento River and tributaries below Box Canyon Dam (subsection 3.1). The potentially affected environment is broader in scope than the NEP Area for some of the resources analyzed. Therefore, the analysis area encompasses the geographic area in which the effects of the action alternatives would be experienced and areas outside of the NEP Area.

Under the No-action Alternative (subsection 4.1), NMFS would (1) not designate SR winter-run and CV spring-run Chinook salmon in the NEP Area as NEPs under ESA section 10(j); (2) not authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area; and (3) not establish take new prohibitions for the NEPs in the NEP Area and exceptions for particular activities under ESA section 4(d). SR winter-run and CV spring-run Chinook salmon could be released upstream of Shasta Dam with or without a NEP designation under ESA 10(j). If SR winter-run and CV spring- run Chinook salmon were released in the NEP Area without a NEP designation under ESA section 10(j), the current take prohibitions to nonexperimental populations of the SR winter-run and CV spring-run Chinook salmon ESUs would apply to any SR winter-run and CV spring-run Chinook salmon reintroduced to the NEP Area. A fish passage program without a NEP designation and associated protective regulations described under Alternative 2 is anticipated to result in opposition from landowners and others whose otherwise lawful activities could be impacted by the presence of listed SR winter-run and CV spring-run Chinook salmon. Opposition would likely result in significant delays and/or permanently stall reintroduction efforts. Therefore, under Alternative 1, we assume that there would be no changes from present circumstances regarding the range of the SR winter-run and CV spring-run Chinook salmon ESUs being limited to areas downstream of Shasta and Keswick Dams,

and recovery of the SR winter-run and CV spring-run Chinook salmon ESUs would largely depend upon the extant populations and recovery actions downstream of dams in the CV.

Under Alternative 2 (subsection 4.2), NMFS would: (1) designate all SR winter-run and CV spring-run Chinook salmon in the NEP Area as a NEPs under ESA section 10(j); (2) authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area; and (3) establish take prohibitions for the NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and exceptions for particular activities under ESA section 4(d). Under Alternative 2, ESA section 4(d) protective regulations would provide exceptions for take of NEP fish in the NEP Area appropriate to the circumstances, including take that is incidental to an otherwise lawful activity and unintentional, not due to negligent conduct. Downstream of the NEP Area (downstream of Shasta and Keswick Dams), the current take prohibitions and exceptions that apply to the extant ESUs of SR winter-run and CV spring-run Chinook salmon would remain in effect (see 50 CFR 223.203) and apply to Chinook salmon originating from the NEP Area. Under Alternative 2, if the reintroduced populations became established, the proposed experimental populations would contribute to the recovery of the ESUs.

Under Alternative 3 (subsection 4.3), NMFS would (1) designate all SR winter-run and CV spring-run Chinook salmon in the NEP Area as NEPs under ESA section 10(j); (2) authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area; and (3) establish take prohibitions for the NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and exceptions that are the same as the current ESA section 4(d) rule protective regulations (50 CFR 223.203). NMFS would apply the current ESA section 4(d) rule protective regulations (50 CFR 223.203) for the reintroduced fish when they are in the NEP Area, rather than establishing a separate ESA section 4(d) rule for the NEP Area. Within the NEP Area (Figure 3), take would be prohibited unless authorized under section 10 of the ESA or a take limit (exception) specified in 50 CFR 223.203 applies. Under Alternative 3, if the reintroduced populations became established, the proposed experimental populations would contribute to recovery of the ESUs.

Comparing the level of protection afforded to the NEPs under Alternative 2 and Alternative 3 to the No-action Alternative is not possible because designation and authorization for release of NEPs in the NEP Area would not occur under the No-action Alternative.

6.1.1 Determination of Whether Effects of an Alternative are Significant

NEPA requires Federal agencies to examine the impacts of major federal actions significantly affecting the quality of the human environment (NMFS 2009). According to the CEQ regulations (40 CFR

1508.27), the determination of a significant impact is a function of both context[8] and intensity[9]. The following factors should be considered in evaluating intensity (40 CFR 1508.27):

- Impacts may be both beneficial and adverse – a significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial.
- Degree to which public health or safety is affected.
- Unique characteristics of the geographic area.
- Degree to which effects on the human environment are likely to be highly controversial.
- Degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.
- Degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
- Whether the action is related to other actions with individually insignificant but cumulatively significant impacts.
- Degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places, or may cause loss or destruction of significant scientific, cultural, or historic resources.
- Degree to which the action may adversely affect an endangered or threatened species or its critical habitat as defined under the ESA.
- Whether the action threatens a violation of Federal, state, or local law or requirements imposed for environmental protection.

Significance is a function of the short-term, long-term, and cumulative impacts, both positive and negative, of the action on that environment. To determine significance, impact severity must be examined in terms of: (1) the type, quality, and sensitivity of the resource involved; (2) the location of the proposed project; (3) the duration of the effect (short- or long-term); and (4) other considerations of context (NMFS 2009).

6.2 Effects on Fisheries Resources

6.2.1 ESA-listed Fish Species

For ESA-listed fish species, the analysis area is the same as the NEP Area. Alternatives analyses presented in this subsection evaluate potential effects of the varying degree and extent the Proposed Action and alternatives would affect ESA-listed fish species.

[8] The significance of an action is analyzed in several contexts such as society as a whole, the affected region, the affected interests, and the locality.

[9] Refers to the severity of an impact.

Redband trout, a former USFWS candidate species, occur in the NEP Area and are discussed below.

Effects on ESA-listed fish below Shasta and Dams are discussed here relative to the primary mechanisms of effect: (1) disease transmission to Livingston Stone NFH from adult Chinook salmon reintroduced to the NEP Area, and (2) straying of adult Chinook salmon originating from the NEP Area into tributaries of the Sacramento River.

6.2.1.1 Alternative 1 (No-action) –No Designation of Nonessential Experimental Populations, No Authorization for Release, and No Adoption of Protective Regulations

Under the No-action Alternative, NMFS would not designate NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, or adopt protective regulations. Because these actions would not occur, there would be no effect on ESA-listed fish species or their habitat. Under the No-action Alternative, there would be no changes from existing conditions and, therefore, no effects on ESA- listed fish species.

6.2.1.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Limited Protective Regulations

In contrast to the No-action Alternative, under Alternative 2, NMFS would designate NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area under ESA section 10(j), and adopt limited protective regulations under ESA section 4(d). The proposed action associated with Alternative 2 would have no direct or indirect effect on other ESA-listed fish species in the NEP Area. Alternative 2 does have the potential to indirectly, beneficially affect SR winter-run and CV spring-run Chinook salmon in the future because it would increase the amount of habitat available to the ESUs. Under Alternative 2, the quantity of habitat available for SR winter-run and CV spring-run Chinook salmon would increase over current conditions (see subsection 5.4.3. for information on habitat availability and suitability).

As part of a future reintroduction program,[10] it is anticipated juvenile SR winter-run and CV spring-run Chinook salmon would be collected and transported downstream of Keswick Dam. The juvenile fish would migrate downstream to the Pacific Ocean. Under Alternative 2, the status and associated

[10] Subject to separate NEPA and ESA compliance requirements.

regulatory protections provided to those juvenile SR winter-run and CV spring-run Chinook salmon outside of the NEP Area would change from being considered part of the non-essential experimental populations of SR winter-run and CV spring-run Chinook salmon in the NEP Area to being considered part of the extant SR winter-run and CV spring-run Chinook salmon ESUs. Outside of the NEP Area, juvenile and adult winter-run Chinook salmon would be afforded the same ESA regulatory protections as the existing extant populations of SR winter-run and CV spring-run Chinook salmon ESUs.

Consequently, Alternative 2 would not result in adverse effects to ESA-listed species.

6.2.1.3 Alternative 3 – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Current Protective Regulations

Regulatory protections for non-essential experimental populations in the NEP Area would be more stringent under Alternative 3 compared to Alternative 2. However, the anticipated physical and biological effects of Alternative 3 on ESA-listed fish species would be the same as Alternative 2. Alternative 3 would have no direct or indirect effect on other ESA-listed fish species in the NEP Area. As discussed under Alternative 2, the quantity of habitat available for SR winter-run and CV spring-run Chinook salmon under Alternative 3 would increase over current conditions.

6.2.2 Effects on Other Non-listed Native Fish Species

For other non-listed native species, the analysis area is the same as the NEP Area. Alternative analyses presented in this subsection depend on how the alternatives vary in their potential effects to native fish species in the NEP Area (subsection 5.3.2).

Limiting factors and threats for native fish species include inter- and intra-specific competition, water quality and quantity, and climatic conditions[11].

6.2.2.1 Alternative 1 (No-action) –No Designation of Nonessential Experimental Populations, No Authorization for Release, and No Adoption of Protective Regulations

Under the No-action Alternative, NMFS would not designate NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, or adopt protective regulations. Because these actions would not occur, there would be no effect on other non-listed native fish species. Because there would be no designation and authorization for release of NEPs in the NEP Area, there would be no potential for interaction between native fish and the proposed experimental populations in that area as a result of the

[11] Climate change considerations are addressed in Section 7 (Cumulative Effects).

No-Action Alternative. Baseline conditions generally would reflect the expected conditions under the No-action Alternative. Limiting factors and threats for native fish species would not change (e.g., inter- and intra-specific competition) or would be expected to improve (e.g., water quality and quantity[12]), relative to existing conditions.

6.2.2.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Limited Protective Regulations

In contrast to the No-action Alternative, under Alternative 2, NMFS would designate NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and authorize release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area under ESA section 10(j), and adopt limited protective regulations under ESA section 4(d). Competition among or between species (interspecific competition) occurs when resources are limited (such as food availability and/or when the area needed to accommodate spawning or rearing life stages exceed supply). In general, interspecific interactions with pre-existing native fauna in reintroduction areas are unlikely to suppress the establishment of a population (NMFS 2018). Species that naturally occur in sympatry are more likely to have evolved niche separation in resource usage (Fausch 1988). This sympatry tends to minimize ecological interactions such as competition and predation. Additional information on inter- and intra-specific competition can be found in Young (2001), Reeves et al. (1993), Fausch and White (1986), Allee (1982), NMFS (2018), Beamesderfer and Rieman (1991), Rieman et al. (1991), Harvey and Nakamoto (1996) and Ostberg et al. (2004).

Anadromous salmonids supply marine nutrients to terrestrial and aquatic ecosystems (Cederholm et al. 1999). Marine-derived nutrients are released to freshwater systems by anadromous fish through excretion, gametes, and after dying. Although differences can occur from locality to locality, the pathways for use of nutrients by stream biota occur through uptake by: (1) primary producers; (2) transfer of nutrients up the food chain; (3) uptake of dissolved organic matter from decomposing carcasses by microfauna in the streambed substrate; and (4) direct consumption of salmon eggs, fry, and carcasses. Collins et al. (2016) found the addition of salmon carcasses in nine tributaries of the North Fork Boise River, Idaho, increased annual trout production (growth) by 2 to 3-fold. Alternative 2 would benefit the ecosystem with the return of marine-derived nutrients, long absent from the NEP Area. Over the long term, this would improve ecosystem function and diversity by increasing primary

[12] See previous discussions about water quality and quantity in subsection 5.4.1 of this EA.

productivity, increased aquatic insect production and thereby increasing prey availability for fish species in the NEP Area. As a result of Alternative 2, release of SR winter-run and CV spring-run Chinook salmon also may lead to an increase in annual trout production over time. Adverse effects to productivity are not expected from inputs of marine derived nutrients.

Reintroduction of SR winter-run and CV spring-run Chinook salmon could result in introduction of pathogens and diseases into the NEP Area. However, native fish species co-evolved with Chinook salmon and the diseases and pathogens carried by SR winter-run and CV spring-run Chinook salmon were likely endemic to the NEP Area prior to the construction of Shasta Dam. Transmission of a novel disease is more likely to carry risk than transmission of an endemic disease (Ewen et al. 2012).

Changes to the status, trends, and life history strategies of native fish species in the NEP Area are not expected under Alternative 2 and, therefore, no adverse effects are expected to occur. Additional information on disease transmission can be found in Walker et al. (2008), Naish et al. (2008), McMichael and Pearsons (1998), and NMFS (2008).

The presence of generally healthy resident rainbow trout populations in the NEP Area and the complex life history strategies of these fish would not change (subsection 5.3.2, Non-ESA-listed Native Fish Species). Fluvial rainbow trout would continue to spend their lives in cool headwater tributaries, and adfluvial rainbow trout would continue to spend most of their lives in reservoirs in the NEP Area. McMichael and Pearsons (1998) investigated some of the ecological interactions between rainbow trout and introduced spring-run Chinook salmon in the upper Yakima River basin in Washington and reported that rainbow trout and spring-run Chinook salmon partitioned available resources and impacts were not detected. Large populations of Chinook salmon and rainbow trout in the Umpqua River in Oregon (Ratti 1979) suggest abundance of either species is not affected during periods of co- occurrence. Prior to construction of Shasta Dam, Chinook salmon and rainbow trout shared habitat in the NEP Area. Because these species coexisted in the NEP Area prior to dam construction and because of the short residence time and relatively rapid migration of Chinook salmon through the freshwater environment, competitive interactions between Chinook salmon and resident rainbow trout would be limited in magnitude and duration and adverse impacts are not expected. Alternative 2 would not change the current status and trends of resident rainbow trout (subsection 5.3.2, Non-ESA-listed Native Fish Species) and therefore no significant adverse impacts are expected.

Under Alternative 2, in contrast to the No-action Alternative, evaluations would be conducted of juvenile Chinook salmon survival and potential impacts from native fish, including (a) investigations of timing and size distribution of juvenile/smolt migrants, (b) growth rates and conditions, (c) survival

rates from planted fry to juvenile emigration, (d) juvenile distribution over the rearing and emigration seasons, (e) differences in the number or quality of juveniles leaving the upper Sacramento and McCloud Rivers, (f) juvenile behavior in response to hydrologic conditions, and (g) potential level of competition and predation between juvenile Chinook salmon and resident fish. This information would be used to inform the adaptive management approach for reintroduction and infer potential interactions and impacts with non-native trout in the NEP Area.

6.2.2.3 Alternative 3 – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Current Protective Regulations

Although the protections for non-essential experimental populations in the NEP Area would be more stringent under Alternative 3, the anticipated potential physical and biological effects of this alternative to native fish species are the same as Alternative 2.

6.2.3 Effects on Non-native Fish Species

For non-native fish species, the analysis area is the same as the NEP Area. Limiting factors and threats for non-native fish species include inter- and intra-specific competition, predation, water quality and quantity, and climatic conditions[13]. There are approximately 17 introduced fish species in the NEP Area (Table 3); however, many of these species do not occur in the upper Sacramento or McCloud Rivers but are present in Shasta Reservoir where conditions are more favorable for warm water non- native species.

6.2.3.1 Alternative 1 (No-action) –No Designation of Nonessential Experimental Populations, No Authorization for Release, and No Adoption of Protective Regulations

Under the No-action Alternative, NMFS would not designate NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, or adopt protective regulations. Because there would be no authorization for release of Chinook salmon in the NEP Area and the No-Action Alternative there would be no potential for interaction between non-native fish species and experimental populations in that area as a result of the No-action Alternative. Under the No-action Alternative, there would be no change to limiting factors and threats currently affecting non-native fish species in the NEP Area.

[13] Climate change considerations are addressed in Section 7 (Cumulative Effects).

6.2.3.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Limited Protective Regulations

Non-native species can be a significant threat to the viability of salmon populations, both through predation and competition (Sanderson et al. 2009). According to NMFS (2018), it is conceivable, and in some cases even likely, predation by non-native fish could reduce the likelihood of population establishment. Depensatory processes could magnify predation effects at the low densities typical of recolonization (Liermann and Hilborn 2001). Similar to native species, effects of non-native species will be most significant in highly modified habitats (NMFS 2018). Non-native fish (e.g., channel catfish and smallmouth bass) have thrived in the warm, clear, lentic reservoirs created by dams (Sanderson et al. 2009). Collect-and-transport reintroduction programs may offset high rates of juvenile mortality that would likely occur during migration through a reservoir (such as Shasta Reservoir) with abundant non-native populations.

Under Alternative 2, as under the No-action Alternative, potential effects to non-native fish species would likely remain the same as current conditions. Alternative 2 would have no direct effect on non-native fish species. Alternative 2 may potentially, indirectly affect non-native fish through positive and negative ecological effects on non-native fish species and their habitats. For example, there could be an increase in competition between non-native trout and juvenile Chinook salmon.

The potential for interspecific competition between Chinook salmon and brown and brook trout (Glova and Field-Dodgson (1995); Krueger et al. (2011)) exist in the NEP Area. Compared to the No-action Alternative, release of proposed experimental populations of SR winter-run and CV spring-run Chinook salmon into the NEP Area, and the resultant production of juvenile salmon would likely result in beneficial effects through increased food resources available to non-native fish species. Brook trout could potentially prey on young Chinook salmon, as larger brook trout would tend to occupy similar habitats. However, brook trout abundance is likely low in the NEP Area; thus, neither competition nor predation is likely to be a factor in juvenile Chinook salmon survival. Therefore, brook trout are not likely to measurably benefit from reintroduction of Chinook salmon as an increased prey base.

Various bass species occur in Shasta Reservoir (subsection 5.3.3). Increased foraging opportunities for bass would depend, in part, on the outmigration timing of juvenile SR winter-run and CV spring-run Chinook salmon from the NEP Area, and location of juvenile collection facilities. NMFS expects the location and design of juvenile collector facilities would account for predation to minimize interactions between bass and juvenile Chinook salmon. Alternative 2, despite measures to minimize potential

effects from predation, would likely have a beneficial effect on bass by providing increased foraging opportunities compared to the No-action Alternative. Pilot studies and other monitoring and evaluation efforts are expected to provide more information on these interactions.

Under Alternative 2, release of SR winter-run and CV spring-run Chinook salmon could result in the introduction of pathogens and diseases into the NEP Area. The resistance of non-native fish species in the NEP Area is unknown, and potential effects to the status, trends, and life history strategies of non-native fish species is unknown. However, downstream of Shasta Dam, anadromous salmonids (including SR winter-run and CV spring-run Chinook salmon), co-occur with most if not all of the non- native species present in the NEP Area, and it is expected that conditions allowing co-occurrence below the dam will also occur in the NEP Area. Changes to the status, trends, and life history strategies of brown and brook trout and other non-native fish species in the NEP Area are not expected to occur under Alternative 2 and, therefore, no adverse effects are expected to occur.

The potential for behavioral interactions between Chinook salmon and brown and brook trout exist in the NEP Area. Simulated stream studies (Glova and Field-Dodgson 1995) indicate juvenile Chinook salmon and brown trout are highly territorial and actively defend preferred drift-feeding sites and resting areas in pools. Species dominance differed with season and prior residence. Interspecific competition between brown trout and Chinook salmon would likely occur in the NEP Area. After reintroduction, it is likely brown trout would be the dominant species in preferred habitats (feeding sites and pools) because of prior residence. It is also likely adult brown trout would feed on Chinook salmon juveniles where distribution overlaps. In the near term, NMFS expects large brown trout would benefit energetically from the increased prey base. Krueger et al. (2011) reported that predation mortality among Chinook salmon juveniles can act at small spatiotemporal scales and cause variability in juvenile survival and potential recruitment. Brown trout were a major predator of Chinook salmon juveniles, consuming from 15 to 34 percent of the total number available. Vulnerability of Chinook salmon juveniles to predation appeared to be controlled by parr growth rates, brown trout stocking dates, and the number of brown trout stocked. Stocking of non-native trout was discontinued in the McCloud River in 2013 and any remaining brown trout have been naturalized in the NEP Area.

Compared to the No-action Alternative, release of the proposed experimental populations would likely result in beneficial effects through increased food resources available to non-native fish species (e.g., brown trout).

Under Alternative 2, in contrast to the No-action Alternative, evaluations of juvenile Chinook salmon survival and potential impacts from non-native trout, including (a) investigations of timing and size

distribution of juvenile/smolt migrants, (b) growth rates and conditions, (c) survival rates from planted fry to juvenile emigration, (d) juvenile distribution over the rearing and emigration seasons, (e) differences in the number or quality of juveniles leaving the upper Sacramento and McCloud Rivers, (f) juvenile behavior in response to hydrologic conditions, and (g) potential level of competition and predation between juvenile Chinook salmon and resident fish. This information would be used to inform the adaptive management approach for reintroduction and infer potential interactions and impacts with non-native trout in the NEP Area.

6.2.3.3 Alternative 3 – Designation of a Nonessential Experimental Populations, Authorization for Release, and Adoption of Current Protective Regulations

Similar to Alternative 2, under Alternative 3, NMFS would designate NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and authorize release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area under ESA section 10(j), and adopt protective regulations under ESA section 4(d). Unlike Alternative 2, under Alternative 3, NMFS would adopt the more restrictive current ESA section 4(d) rule protective regulations that apply downstream of Shasta and Keswick Dams for the NEP Area. The anticipated potential physical and biological effects to non- native fish species under Alternative 3 could result in slightly less suitable conditions for some of these species. Application of the current ESA section 4(d) rule could create additional opportunities to ensure the protection of water quality. Enhanced protection of water quality could result in marginally cooler water temperatures which are less suitable for some non-natives fish species, particularly those that prefer warmer water temperatures.

6.3 Effects on Aquatic Habitat

For aquatic habitat, the analysis area is the same as the NEP Area described in subsection 3.1. The following discussion focuses on different effects to aquatic habitat in the NEP Area, including water resources, fish passage, and habitat availability and quality.

The alternatives vary in extent to which authorization for release of SR winter-run and CV spring-run Chinook salmon would have potential to impact aquatic habitat in the NEP Area. Under all alternatives, the NEP Area would continue to have variable flows and water temperatures as described in subsections 5.4.1 and 5.4.3. Under all alternatives, environmental laws would continue to regulate, and habitat restoration actions would continue to mitigate human impacts from agriculture, timber harvesting, mining, and commercial and residential development. These human induced impacts can directly influence water quality parameters limiting salmon productivity, such as sediment levels (fine

and coarse), chemical contamination (e.g., pesticide and herbicide use in agriculture), and municipal waste (e.g., high nitrogen levels).

6.3.1 Water Resources

6.3.1.1 Alternative 1 (No-action) – No Designation of a Nonessential Experimental Population, No Authorization for Release, and No Adoption of Protective Regulations

Under the No-action Alternative, NMFS would not designate NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, or adopt protective regulations. Under the No-action Alternative, there would be no efforts to reintroduce SR winter-run and CV spring-run Chinook salmon. There would be no changes from the current conditions and no significant adverse impacts would occur.

Shasta Lake would remain listed as impaired by mercury and poor water quality. Additionally, water temperatures would continue to exceed lethal tolerance levels for salmonids in the mid- to late summer months in some areas of Shasta Lake. These conditions would continue under the No-action Alternative (subsection 5.4, Aquatic Habitat). Under the No-action Alternative, the upper Sacramento and McCloud Rivers would continue to have no listed water quality impairments of beneficial uses as defined under section 303(d) of the CWA (CVRWQCB 2016).

Under the No-action Alternative, existing dams and water diversion projects located on the upper Sacramento River, McCloud River, and lower Pit River tributaries (most of which fall outside the NEP Area for the Pit River), would continue to affect streamflow in the NEP Area (subsection 3.1, Description of the Action Area; subsection 5.4.1, Water Resources). Existing dams would continue to modify and regulate downstream flows in the NEP Area, including Shasta Lake. Existing stream flow conditions in the NEP Area above Shasta Dam are anticipated to continue or somewhat improve following FERC's issuance of a new license for the McCloud-Pit Hydroelectric Project (FERC Project No. 2016, California). Flow regimes in the upper Sacramento, Pit, and McCloud Rivers would continue to be lowest and relatively stable during the summer and fall, and exhibit more flow variability and peak flows in response to precipitation events and snowmelt runoff from the winter through the spring (subsection 5.4.1, Water Resources) (Reclamation 2014b). There would be no changes from the current conditions and therefore no additional adverse effects are anticipated.

6.3.1.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Limited Protective Regulations

In contrast to the No-action Alternative, under Alternative 2, NMFS would designate NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and authorize release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area under ESA section 10(j), and adopt limited protective regulations under ESA section 4(d).

Alternative 2 (Proposed Action/Preferred Alternative)) would affect water quality primarily through a minor increase in marine-derived nutrients from the input of salmon carcasses to the NEP Area. However, as under the No-action Alternative, authorization for reintroduction and designation of experimental populations in the NEP Area would have no effect on the 2008 CWA 303(d) listing of Shasta Lake or associated tributaries (i.e., West Squaw Creek below the Balakala Mine, lower Little Backbone Creek, lower Horse Creek, and Town Creek) listed by the EPA as impaired for heavy metal accumulations and low pH. Additionally, authorization for reintroduction and designation of experimental populations would not cause any effects on other baseline aquatic habitat water quality components such as sedimentation levels because, for example, there would be no streambed disturbance other than spawning under Alternative 2. Increased disturbance of streambeds by spawning salmon under Alternative 2 would be expected to result in local improvements in spawning gravel quality because the spawning process loosens the gravel and decreases the amount of fine sediments (Kondolf and Wolman 1993).

As under the No-action Alternative, water temperatures under Alternative 2 would be expected to remain the same as under existing conditions (subsection 5.4, Aquatic Habitat). However, unlike the No-action Alternative, Alternative 2 would have a small effect on water quality through input of adult Chinook salmon carcasses to the NEP Area. Although a high input of decomposing salmon carcasses could lead to an increase in biological oxygen demand and reduce dissolved oxygen levels that negatively affect water quality (subsection 5.4, Aquatic Habitat), it is unlikely that a large enough concentration of carcasses would be present in any given location within the NEP Area to cause measurable changes or adverse effects on water quality.

Unlike the No-action Alternative, an increase in adult salmon carcasses under Alternative 2 would likely have a beneficial effect on availability of food for rearing fishes, growth of riparian forests, and salmonid productivity through the addition of marine-derived nutrients from salmon carcasses. The increased transport of marine-derived nutrients and trace elements from returning wild Chinook salmon

adults associated with reintroduction is expected to enhance stream productivity (Scheuerell et al. 2005). Bilby et al. (2002) found a positive linear relationship between the biomass of juvenile anadromous salmonids and the abundance of carcass material at sites in the Salmon (Idaho) and John Day Rivers (Oregon), suggesting that spawning salmon may influence and benefit aquatic productivity and the availability of food for rearing fishes.

Salmon carcasses also appear to promote the growth of riparian forests, a source of large woody debris and stream shading (Bilby et al. 1998; Cederholm et al. 2000; Gresh et al. 2000). Helfield and Naiman (2001) hypothesized several pathways for the transfer of marine-derived nutrients from streams to riparian vegetation, including transfer of dissolved nutrients and trace elements from decomposing carcasses into shallow subsurface flow paths, and the dissemination in feces, urine, and partially eaten carcasses by bears and other salmon-eating fauna (Gende et al. 2002). Studies suggest that the biomass of carcasses beneficially affects the productivity of salmonids and their rearing habitat, but functional and quantitative relationships are poorly understood and difficult to generalize from the specific conditions studied (Bilby et al. 1998; Cederholm et al. 2000; Gresh et al. 2000).

For purposes of ESA section 7, the NEPs would be treated as a species proposed for ESA listing, and only two provisions of ESA section 7 would apply: (1) section 7(a)(1) (requiring Federal agencies to use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of listed species); and (2) section 7(a)(4) (triggered by Federal actions that are likely to jeopardize the continued existence of a species proposed to be listed). Under Alternative 2, there would be no ESA section 7(a)(2) consultation requirement for Federal actions that may affect the NEPs in the NEP Area.

As under the No-action Alternative, under Alternative 2, existing stream flow conditions in the NEP Area above Shasta Dam are anticipated to continue. Streamflow conditions may improve following FERC's upcoming relicensing of the McCloud-Pit Hydroelectric Project (FERC Project No. 2016, California) (subsection 5.4.1.3 McCloud-Pit Hydroelectric Project).

Alternative 2, similar to the No-action alternative, would not have a significant adverse impact on water quantity in the NEP Area and may result in beneficial effects to the aquatic ecosystem.

6.3.1.3 Alternative 3 – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Current Protective Regulations

Similar to Alternative 2, under Alternative 3, NMFS would designate NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and authorize release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area under ESA section 10(j), and adopt current protective regulations under ESA section 4(d). Unlike Alternative 2, under Alternative 3, NMFS would adopt the more restrictive current ESA section 4(d) rule protective regulations for the NEP Area. Adoption of more restrictive regulations would likely result in increased resistance from landowners and other user groups to a SR winter-run and CV spring-run Chinook salmon reintroduction.

In contrast to the No-action Alternative and Alternative 2, under Alternative 3, NMFS would apply the current January 9, 2002 (67 Fed. Reg. 1116) section 4(d) rule (subsection 1.2.4, ESA Section 4(d) Regulations). Application of these restrictions on take of Chinook salmon could result in additional restrictions on existing lawful activities. NMFS expects that any restrictions placed on water resource management in the NEP Area would be similar to those that are in place outside the NEP Area below Keswick Dam. Alternative 3, in contrast to Alternative 2 and the No-action alternative, could have a beneficial impact to water quantity and quality in the NEP Area as a result of increased regulatory oversight that may result in beneficial effects to water resources.

Similar to Alternative 2, and in contrast to the No-action Alternative, Alternative 3 would have a small effect on water quality resulting from an input of adult Chinook salmon carcasses to the NEP Area.

6.3.2 Effects on Fish Passage

6.3.2.1 Alternative 1 (No-action) – No Designation of a Nonessential Experimental Population, No Authorization for Release, and No Adoption of Protective Regulations

Under the No-action Alternative, NMFS would not designate NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, or adopt new protective regulations. Under the No-action Alternative, there would be no efforts to reintroduce SR winter-run and CV spring-run Chinook salmon and there would be no resistance from landowners and other user groups in the NEP Area.

Under the No-action Alternative, absence of authorization for reintroduction and designation of experimental populations would preclude any effects on fish access to habitat in the NEP Area. Baseline conditions discussed in subsection 5.4, Aquatic Habitat, reflect expected conditions under the No-action Alternative. Ongoing programs described in subsection 5.4.3, Habitat Availability and

Quality, would continue to be implemented under the No-action Alternative, providing potentially improved aquatic habitat benefits in the NEP Area.

Under the No-action Alternative, no increased transport of marine-derived nutrients and trace elements from returning Chinook salmon adults associated with reintroduction and concomitant enhancement of stream productivity in the NEP Area (subsection 5.4, Aquatic Habitat) would occur. In addition, decomposing Chinook salmon carcasses would not be available under the No-action Alternative to increase the biological oxygen demand and reduce the amount of dissolved oxygen in the NEP Area (Ssbsection 5.4, Aquatic Habitat). Under the No-action Alternative, the lower portions of the upper Sacramento River and Shasta Lake would continue to have impaired water temperatures for salmonids in the mid- to late summer months. There would be no changes from the current conditions and therefore no additional adverse effects are anticipated.

6.3.2.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Limited Protective Regulations

In contrast to the No-action Alternative, under Alternative 2, NMFS would authorize the release of SR winter-run and CV spring-run Chinook salmon in the NEP Area, designate the reintroduced SR winter-run and CV spring-run Chinook salmon as experimental populations under ESA section 10(j), and adopt limited protective regulations under ESA section 4(d). Critical habitat could not be designated in the NEP Area. Alternative 2, efforts to reintroduce SR winter-run and CV spring-run Chinook salmon may meet some resistance from landowners and other user groups in the NEP Area but would be reduced with adoption of a new ESA section 4(d) rule.

As under the No-action Alternative, under Alternative 2, conditions for fish passage in the NEP Area above Shasta Dam would be expected to continue as under existing conditions (subsection 5.4, Aquatic Habitat). A number of dams and water diversion projects are located on the upper Sacramento River, McCloud River, and Pit River and their associated tributaries, most of which fall on the outer limits or outside of the NEP Area. These dams and barriers would continue to be in place. Even with the existing fish passage barriers in place, there would be approximately 23 miles of habitat accessible to reintroduced Chinook salmon on the McCloud River and 37 miles on the upper Sacramento River.

Alternative 2, similar to the No-action Alternative, would not have a significant adverse effect on fish passage in the NEP Area.

6.3.2.3 Alternative 3 – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Current Protective Regulations

Similar to Alternative 2, under Alternative 3, NMFS would designate NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and authorize release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area under ESA section 10(j), and adopt current protective regulations under ESA section 4(d). Unlike Alternative 2, under Alternative 3, NMFS would adopt the more restrictive current ESA section 4(d) rule protective regulations for the NEP Area. Adoption of more restrictive regulations would likely result in increased resistance from landowners and other user groups to a SR winter-run and CV spring-run Chinook salmon reintroduction.

6.3.3 Effects on Habitat Availability and Quality

6.3.3.1 Alternative 1 (No-action) –No Designation of Nonessential Experimental Populations, No Authorization for Release, and No Adoption of Protective Regulations

Under the No-action Alternative, NMFS would not designate NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run Chinook salmon in the NEP Area, or adopt protective regulations. Baseline conditions discussed in subsection 5.4, Aquatic Habitat, generally reflect expected conditions under the No-action Alternative.

6.3.3.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Limited Protective Regulations

Alternative 2 would have no direct effect on anadromous salmonid habitat availability. Any effect of Alternative 2 on habitat availability would be indirect, namely, an increased incentive to create additional habitat or to improve existing habitat in the NEP Area. As under the No-action Alternative, suitable habitat for SR winter-run and CV spring-run Chinook salmon spawning and rearing in the NEP Area would continue to exist, and no substantial adverse effects are anticipated.

6.3.3.3 Alternative 3 – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Current Protective Regulations

In contrast to the No-action Alternative and Alternative 2, some long-term benefits to habitat would likely accrue over time under Alternative 3. Increased regulatory requirements as a result of Alternative 3 could lead to additional efforts by non-federal land and water managers to minimize the adverse effects of their actions through avoidance, minimization and/or mitigation measures focused on improving habitat availability and quality for listed SR winter-run and CV spring-run Chinook salmon. Non-federal entities pursuing land and water-related actions that may result in incidental take of SR

winter-run and CV spring-run Chinook salmon within the NEP Area would be required to complete an HCP and apply for an incidental take permit, unless one of the limits or exceptions under the current ESA section 4(d) rule protective regulations apply (50 CFR 223.203), which may involve restoration of degraded habitat, creation of new habitat, or habitat enhancement. The extent of these benefits is unknown, but no adverse effects to anadromous salmonid habitat availability and quality are anticipated.

Under Alternative 3, existing barriers to adult and juvenile passage, including dams, poorly designed or poorly functioning fishways, and road crossings, could eventually be required to meet modern standards for fish passage as a consequence of increased regulatory oversight under the January 9, 2002 (67 Fed. Reg. 1116) section 4(d) rule for salmon and steelhead that would be applied to Chinook salmon in the NEP Area (subsection 1.2.4, ESA Section 4(d) Regulations). Except for Box Canyon, Pit 7, and McCloud Dams, few man-made fish passage barriers are known to exist in the upper Sacramento and McCloud Rivers; however, some unknown barriers may be present in the smaller tributaries of these three rivers. Improved access to currently inaccessible instream fish habitat could result in improved survival and increased carrying capacity for listed Chinook salmon as well as other native fish species in the NEP Area. The extent of this benefit is unknown and no adverse effects to fish passage are anticipated.

6.4 Effects on ESA-listed and non-ESA-listed Wildlife

The analysis area for wildlife resources, except for Southern Resident killer whale, is the same as the NEP Area described in subsection 3.1. Alternative analyses address potential effects of the varying degree and extent the Proposed Action and alternatives would affect wildlife as a food resource in the NEP Area. Species addressed in this subsection are those for which salmon provide direct or indirect foraging opportunities, including wildlife species with federal and/or state listing status, indicating a heightened level of concern (Table56, Table 6, and Table 7). This area represents an area where wildlife species could reasonably be expected to modify their behavior in response to changes in the availability of food resources in the NEP Area under the alternatives. The analysis area for Southern Resident killer whales extends to the Pacific Ocean due to the dependence of Southern Resident killer whales on Chinook salmon as a food resource.

6.4.1 Alternative 1 (No-action) –No Designation of Nonessential Experimental Populations, No Authorization for Release, and No Adoption of Protective Regulations

Under the No-action Alternative, NMFS would not designate NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, or adopt protective regulations. There would be no changes from current conditions and, therefore, no effects to ESA-listed and non-ESA-listed wildlife would occur.

Under the No-action Alternative, species (including the special-status species identified in Table 5 and Table 6) for which salmonids provide direct or indirect foraging opportunities, would continue to forage on fish and other food resources in the NEP Area. This includes the species occurring in the NEP Area with a strong-consistent, or recurrent relationship with salmon as a food resource (as identified based on parameters described in Cederholm et al. 2000), and the five highly aquatic species with an unknown relationship with salmon (see Table 5). The No-action Alternative would not alter feeding patterns of native or special status species such as bald eagles, golden eagles, raccoons, or black bears (Table 4). For Southern Resident killer whales, which occur outside the NEP Area, there would not be small increases in SR winter-run and CV spring-run Chinook salmon in the Pacific Ocean off the California coast where Southern Resident killer whales forage on Chinook salmon. Finally, the No-action Alternative would not affect the presence or absence of any wildlife species in the NEP Area.

6.4.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Limited Protective Regulations

Compared to the No-action Alternative, Alternative 2 would designate and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area. Reintroduction is anticipated to result in re-establishment of this species into historical habitats above Shasta Dam that have been inaccessible since 1942-1943 when upstream fish passage was blocked during construction of Shasta Dam. Unlike the No-action Alternative, Alternative 2 would have a beneficial effect on wildlife species that consume salmon and salmon carcasses, and species that feed on aquatic insects and other taxa beneficially affected by nutrients derived from salmon carcasses.

Unlike the No-action Alternative, authorization of reintroduction of SR winter-run and CV spring-run Chinook salmon into the NEP Area would likely increase the total number of adult salmon in the Pacific Ocean to a small extent. An increase in the number of adult salmon would likely have a small

but beneficial effect on ESA-listed Southern Resident killer whales that feed on salmon adults off the California coast.

Initially, the number of SR winter-run and CV spring-run Chinook salmon reintroduced into the NEP Area under Alternative 2 would be low, and beneficial effects to wildlife with a strong-consistent or recurrent relationship with salmon would likely be negligible. Over time however, the number of returning adults originating from the NEP Area is anticipated to increase, which could provide more foraging opportunities for wildlife in the NEP Area and the Pacific Ocean. Under Alternative 2, more salmon would be available to these species as a food source, which may result in greater abundance of some of these wildlife species over time. Finally, as under the No-action Alternative, Alternative 2 would not likely affect the presence or absence of any wildlife species in the NEP Area even with the availability of salmon as a food source, although the overall abundance of some species could increase temporarily. No significant adverse effects to wildlife species are anticipated.

6.4.3 Alternative 3 – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Current Protective Regulations

In contrast to the No-action Alternative, under Alternative 3, as under Alternative 2, NMFS would authorize release of SR winter-run Chinook salmon and CV spring-run Chinook salmon and designate these fish as experimental populations under ESA section 10(j). However, unlike Alternative 2, NMFS would apply the current January 9, 2002 (67 Fed. Reg. 1116) section 4(d) rule for these fish when in the NEP Area rather than designate a separate section 4(d) rule for the NEP Area. Similar to Alternative 2, under Alternative 3, the reintroduction of salmon and the addition of salmon carcasses to the NEP Area would benefit wildlife species that consume live salmon or salmon carcasses as well as wildlife species that feed on aquatic insects and other taxa that could benefit from marine-derived nutrients. No significant adverse effects to wildlife species are anticipated.

6.5 Effects on Land Use and Ownership

The analysis area for land use and ownership is the NEP Area. None of the alternatives would entail any changes in land ownership or land use designations in the NEP Area or elsewhere as described in subsection 5.6, Land Use and Ownership. The alternatives would not result in different proportions of public, private, and tribal land ownership in the NEP Area. A large proportion of lands within the NEP Area would continue to be under Federal or state management or in private timber production. Analyses in this subsection address the potential for the varying degrees of regulations such as take prohibitions under the alternatives to affect otherwise lawful land use activities.

6.5.1 Alternative 1 (No-action) –No Designation of Nonessential Experimental Populations, No Authorization for Release, and No Adoption of Protective Regulations

Under the No-action Alternative, NMFS would not designate NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, or adopt protective regulations. There would be no changes from current conditions and, therefore, no adverse effects to land use and ownership would occur under the No-action Alternative if SR winter-run and CV spring-run Chinook salmon are not released into the NEP Area. More specifically, there would be no effects to land ownership categories, including private entities, nongovernmental organizations, Federal, tribal, and state or local government ownerships (subsection 5.6). Existing trends in land use would continue to be addressed by Federal, state, county, and municipal planning efforts if SR winter-run and CV spring-run Chinook salmon are not released in the NEP Area. Similarly, land uses would not change under the No-action Alternative if SR winter-run and CV spring-run Chinook salmon are not released in the NEP Area. Resource-based industries such as forest management would be expected to continue to occur within the analysis area under the No- action Alternative, along with other current land uses (subsection 5.6, Land Use and Ownerships).

6.5.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Limited Protective Regulations

In contrast to the No-action Alternative, under Alternative 2, NMFS would authorize the release of SR winter-run and CV spring-run Chinook salmon in the NEP Area, designate the reintroduced SR winter-run and CV spring-run Chinook salmon as experimental populations under ESA section 10(j), and adopt limited protective regulations under ESA section 4(d).

The current take prohibitions and salmon ESA section 4(d) rule protective regulations that prohibit take of CV spring-run Chinook salmon with specific limits or exceptions would apply outside of the NEP (subsection 3.14). Under Alternative 2, a separate ESA section 4(d) rule would be adopted to apply to the experimental populations in the NEP Area. Within the NEP Area, NMFS's ESA section 4(d) rule would provide exceptions to the take prohibitions as appropriate to the circumstances, including an exception for take that occurs incidental to otherwise lawful activities and is unintentional, not due to negligent conduct. Because of this take exception, as well as the limited applicability of ESA section 7 to a NEP of SR winter-run and CV spring-run Chinook salmon in the NEP Area, reintroduction of SR winter-run and CV spring-run Chinook salmon would have little to no adverse effect on land uses such as agriculture, forestry, extractive/industrial activities, commercial/research and development, parks, public lands, military installations or urban/local communities. Because of the substantial regulatory

relief provided by the NEP designations and the exception to the ESA section 4(d) rule protective regulations, NMFS also does not expect Alternative 2 to have any substantial adverse effect on recreational, agricultural, or development activities within the NEP Area.

The proposed ESA section 4(d) rule under Alternative 2 is anticipated to: (1) minimize regulatory requirements on landowners in the NEP Area; and (2) minimize increased ESA liability for land use activities. Additionally, there would be no new or additional actions required on the landowner/local stakeholder's behalf prior to conducting normal land use activities. Therefore, as under the No-action Alternative, Alternative 2 is not expected to result in any changes in the uses or ownership of land in the NEP Area described in subsection 5.6. As under the No-action Alternative, existing trends in land use would continue under Alternative 2. Existing trends in land use would continue to be addressed by Federal, state, county, and municipal planning efforts.

Under Alternative 2, agencies that fund, carry out, or permit actions that may affect the NEP of SR winter-run and CV spring-run Chinook salmon in the NEP Area would not face substantially increased regulatory requirements compared to the No-action Alternative. Alternative 2 would be protective of Federal, state, local and private land use and land ownership interests in the NEP Area. Alternative 2 would minimize the potential for new permitting and regulatory compliance responsibilities associated with future Federal, state, county, municipal and private actions in the watershed, while facilitating the ability to reintroduce SR winter-run and CV spring-run Chinook salmon into the NEP Area.

6.5.3 Alternative 3 – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Current Protective Regulations

Similar to Alternative 2, under Alternative 3, NMFS would designate and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area. However, adoption of the current ESA section 4(d) rule protective regulations for the NEP Area would result in more restrictive ESA take prohibitions in the NEP Area compared to Alternative 2.

Unlike Alternative 2, the current ESA section 4(d) rule protective regulations for threatened species of salmon and steelhead would be adopted and apply to the SR winter-run and CV spring-run Chinook salmon in the NEP Area under Alternative 3 (subsection 1.2.4). Thus, the release of ESA-listed fish to the NEP Area could result in increased restrictions on otherwise lawful land use activities as a result of Alternative 3. Alternative 3 would not change the proportion of public, private, and tribal land ownership in the NEP Area. However, for agencies with management authority for public lands and private landowners, Alternative 3 may restrict the types or extent of actions that those management

agencies and private landowners would implement on their lands due to increased regulatory obligations necessary to comply with the more restrictive ESA section 4(d) rule protective regulations under Alternative 3.

Unlike the No-action Alternative and Alternative 2, Alternative 3 could affect existing land use and recreational activities in the action area because of increased regulatory constraints and potential ESA liability. Changes in land use could include additional restrictions on timber harvest on private lands to avoid or minimize the potential for take of SR winter-run and CV spring-run Chinook salmon in the NEP Area. Changes in private ownership and land use are speculative but are more likely under Alternative 3 because of new regulatory requirements for non-federal landowners engaged in activities that may result in take, including harm, of SR winter-run and CV spring-run Chinook salmon in the NEP Area.

Based on the more stringent protective regulations that would apply under Alternative 3, unlike the No-action Alternative and Alternative 2, non-federal land management agencies and private landowners throughout the NEP Area would likely be required to modify their operations to avoid or minimize the potential for take of SR winter-run and CV spring-run Chinook salmon in the NEP Area. Examples of modification to operations include: (1) implementing erosion control structures near rivers and tributary streams, and (2) implementing road drainage system improvements to minimize or avoid sediment inputs into local waterways, among others. Under Alternative 3, federal, non-federal public, private landowners, and local entities would have various regulatory options under the ESA to seek limits on their potential liabilities from otherwise lawful activities, subject to applicable conditions. These options could include an ESA section 4(d) limit or an ESA section 10(a) permit as applicable, but any applicable options would be limited to certain types of activities and subject to conditions.

6.6 Effects on Tourism and Recreation

The analysis area for Tourism and Recreation is broader than the NEP Area and includes all of Shasta and Siskiyou Counties. Tourism and recreation make a substantial contribution to the quality of life for local residents and small businesses in terms of employment and income (subsection 5.9), as well as the outdoor recreational activities available to them. The three alternatives vary in their potential to result in restrictions on otherwise lawful activities in the action area, including recreational fishing. Under all three alternatives, outdoor recreation, including fishing, would continue to attract visitors to Shasta and Siskiyou Counties. NMFS anticipates current restrictions in California's Freshwater Sport Fishing Regulations would remain in effect.

Analyses in this subsection address the potential effects of the alternatives on the availability of recreation opportunities in the analysis area.

6.6.1 Alternative 1 (No-action) – No Designation of Nonessential Experimental Populations, No Authorization for Release, and No Adoption of Protective Regulations

Under the No-action Alternative, NMFS would not designate NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, or adopt protective regulations. Recreational opportunities (e.g., sightseeing, gold panning, mountain biking, camping, waterfowl and upland hunting, hiking, swimming, horseback riding, use of off-road vehicle trails, backcountry skiing, climbing, and rafting) in the three counties would continue to occur. There would be no changes that directly or indirectly affect visitor facilities, viewpoints, scenic overlooks, walking trails, picnic shelters, or other designated recreation amenities (subsection 5.8). Consequently, because there would be no changes from the current conditions, the No-action Alternative would have no effects on recreational opportunities in the NEP Area.

6.6.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Limited Protective Regulations

In contrast to the No-action Alternative, under Alternative 2, NMFS would designate NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area under ESA section 10(j), and adopt limited protective regulations under ESA section 4(d). Within the NEP Area, NMFS' 4(d) rule protective regulations would provide an exception for take that occurs incidental to otherwise lawful activities and is unintentional, not due to negligent conduct. Because of the substantial regulatory relief provided by the NEP designations and this take exception, Alternative 2 would have little to no adverse effect on tourism and recreational activities within the NEP Area.

Alternative 2 could result in an increase in the number of fish available for recreational viewing in the upper Sacramento and McCloud Rivers, compared to the No-action Alternative. Increased viewing opportunities could expand recreational opportunities in the analysis area with an opportunity to view SR winter-run and CV spring-run Chinook salmon in areas where they have been long extirpated.

Alternative 2 is expected to result in opportunities to view adult Chinook salmon returning to historical holding and spawning areas. The likelihood of recreational viewing is facilitated by the proximity of access roads and USFS campgrounds to these rivers. A potential does exist for harassment of SR

winter-run and CV spring-run Chinook salmon in the NEP Area depending on presence of suitable viewing locations.

Although the number of fish available for recreational viewing is difficult to predict, the unique opportunity to see SR winter-run and CV spring-run Chinook salmon is anticipated to generate some interest among members of the public. In response to the increased public interest, a concomitant increase in tourism may occur as people are drawn to the NEP Area, thereby benefiting small businesses. People visiting would be anticipated to support local community businesses by partaking in food and beverage services, accommodations, retail sales, arts, entertainment and recreation, etc.

Opportunities to engage in recreational fishing would not be reduced under Alternative 2. As under the No-action Alternative, locations of fishing opportunities would not change under Alternative 2.

Under Alternative 2, a separate ESA section 4(d) rule would be adopted for the experimental population in the NEP Area. This proposed rule would generally prohibit take of SR winter-run and CV spring-run Chinook salmon in the NEP Area, but would provide an exception for take that is incidental to an otherwise lawful activity and is unintentional, not due to negligent conduct. This exception would include recreational fishing for non-listed salmonids, and other game and non-game fish. Opportunities to engage in recreational fishing for non-listed salmonid and other fish species would not be reduced with implementation of Alternative 2.

Existing restrictions in California's Freshwater Sport Fishing Regulations under Alternative 2 (subsection 5.8, Tourism and Recreation) are expected to remain in effect. Daily bag and possession limits are closed to the take of salmon and these limits would continue to apply to SR winter-run and CV spring-run Chinook salmon in the McCloud and upper Sacramento Rivers and associated tributaries. As under the No-action Alternative, recreational fishing opportunities would not change under Alternative 2 (subsection 5.8, Tourism and Recreation). Under Alternative 2, a new section 4(d) rule would apply to the proposed experimental populations above Shasta Dam. This new rule would exempt take of Chinook from the proposed experimental populations if such take results from an otherwise lawful activity, including recreational fishing for non-listed Chinook salmon that are planted in Shasta Lake as part of CDFW's Inland Fishing Program.

Some of the nonessential experimental Chinook salmon reintroduced into the upper Sacramento and McCloud Rivers may bypass juvenile collection facilities and enter Shasta Lake. Eventually, some of these fish could be incidentally caught by recreational fishers; however, the number of fish that bypass

the collection facilities and residualize in Shasta Lake is anticipated to compose only a small proportion of the overall number of fish in the NEPs. Because these numbers are anticipated to be low, their loss is expected to have a *de minimus* effect to the overall success of the reintroduction program.

As under the No-action Alternative, no changes to recreational opportunities in the analysis area would occur under Alternative 2 because there would be no changes directly or indirectly affecting visitor facilities, viewpoints, scenic overlooks, walking trails, picnic shelters, or other designated recreation amenities in the analysis area. Additionally, no changes to other recreational opportunities (i.e., boating, water-skiing, swimming, wildlife viewing, hunting, camping, picnicking, hiking, mountain biking, sightseeing, climbing, back country skiing, and horseback riding) within the analysis area would be expected under Alternative 2 (subsection 5.8, Tourism and Recreation).

Under Alternative 2, Federal, state, and local agencies that fund, carry out, or permit actions that may affect the proposed experimental populations of SR winter-run and CV spring-run Chinook salmon in the NEP Area would not face substantially increased regulatory requirements compared to the No- action Alternative. Overall, Alternative 2 would be protective of Federal, state, local and private land use and land ownership interests, while facilitating the reintroduction of salmon into the NEP Area and concurrently protecting tourism and recreational activities.

Under Alternative 2, there would be no section 7(a)(2) consultation requirement for Federal actions in the NEP Area. The NEPs would be treated as species proposed for ESA listing and only two provisions of ESA section 7 would apply: section 7(a)(1) (requiring Federal agencies to use their authorities to further conservation of listed species) and section 7(a)(4) (triggered by Federal actions that may jeopardize the continued existence of the species). Section 7(a)(2) consultations may be required for actions in the geographic range of the proposed experimental population designations that affect other ESA-listed species, and may be required when they affect members of the NEPs outside the NEP Area where SR winter-run Chinook salmon are listed as endangered and CV spring-run Chinook salmon are listed as threatened.

6.6.3 Alternative 3 – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Current Protective Regulations

Alternative 3 is expected to result in opportunities to view adult Chinook salmon returning to historical holding and spawning areas. As under Alternative 2, Alternative 3 would designate and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and would likely increase the number of fish available for recreational viewing in the NEP Area, compared to the

No-action Alternative. As such, Alternative 3 would add incrementally to recreational viewing opportunities in the NEP Area (subsection 5.8) due to the unique opportunity to view these species.

In response to the increased public interest, an increase in tourism also may occur as people are drawn to the NEP Area. Visitors would be anticipated to support the local economy by partaking in food and beverage services, accommodations, retail sales, arts, entertainment and recreation, etc. As with Alternative 2, a potential does exist for harassment of SR winter-run and CV spring-run Chinook salmon in accessible areas in the NEP Area.

Unlike Alternative 2, the current ESA section 4(d) protective regulations that apply to the CV spring- run Chinook salmon ESU downstream of Englebright Dam would also be adopted to apply to reintroduced SR winter-run and CV spring-run Chinook salmon in the NEP Area. NMFS' experience under the current ESA section 4(d) rule protective regulations (50 CFR 223.203) shows that NMFS does authorize take associated with some otherwise lawful activities, but some activities may not meet one of the 10 categories of activities and some activities may be modified during the authorization process to meet the applicable criteria under the current protective regulations. NMFS expects any such modifications or restrictions placed on tourism or recreational activities in the NEP Area under Alternative 3 would be similar to those that are in place outside the NEP Area downstream of Englebright Dam. Application of these restrictions could result in additional restrictions on existing lawful tourist-oriented and recreational activities, including recreational fishing and some upland activities. Upland activities, particularly those that cause erosion, such as mountain biking and motorized off-road vehicle activities, could be subject to seasonal restrictions to minimize sediment input into fish-bearing streams.

NMFS expects that any restrictions placed on tourism or recreational activities in the NEP Area would be similar to those that are in place outside the NEP Area below Keswick Dam within the range of the extant ESUs. Application of these restrictions could result in additional restrictions on existing lawful tourist-oriented and recreational activities, primarily recreational fishing that includes fishing for Chinook salmon in Shasta Lake, that are part of CDFW's Inland Fishing Program. Fishing restrictions could include (1) periodic closures, as has occurred recently below Keswick Dam to protect spawning SR winter-run Chinook salmon, (2) cessation of the Inland Fishing Program, or (3) requirements to individually mark most or all Chinook salmon planted in Shasta Lake.

Federal agencies that fund, carry out, or permit actions that may affect SR winter-run and CV spring- run Chinook salmon in the NEP Area would not face substantially increased regulatory requirements

associated with tourism and recreation compared to the No-action Alternative due to the limited ESA section 7 obligations with an ESA section 10(j) designation (see subsection 4.2.2.3). State regulated recreational fishing would be subject to the more restrictive ESA section 4(d) rule protective regulations under Alternative 3.

Under Alternative 3, Federal, non-Federal public, and private entities would have various regulatory options under the ESA in which to seek limits on their potential liabilities from otherwise lawful activities, subject to applicable conditions. These could include an ESA section 4(d) limit or a section 10(a) permit as applicable, but any available options would be limited to certain types of activities and subject to conditions. Overall, because of the potential for additional restrictions on the recreational fishery and some upland activities, there is the potential for some minor adverse effects to tourism, small businesses and recreation under Alternative 3.

6.7 Effects on Socioeconomics

The analysis area for socioeconomics is broader than the NEP Area, and comprises Shasta and Siskiyou Counties because local residents within these areas would have the greatest potential to be affected by the alternatives.

Commercial fishing of salmon occurs off the United States West Coast in accordance with fishery management plans that identify annual goals for the number of spawners of the major salmon stocks (i.e., "spawner escapement goals"), and allocation provisions of the harvest among different groups (e.g., commercial, tribal, etc.) (PFMC 2019). SR winter-run and CV spring-run Chinook salmon are not actively managed in the commercial fishery and the alternatives would have no adverse effect on commercial fisheries, because none of the alternatives would change the status of SR winter-run and CV spring-run Chinook salmon or applicable restrictions outside the NEP Area.

The three alternatives vary in their potential to result in restrictions on otherwise lawful activities in the analysis area. Under all three alternatives, the population trends in the largest cities, as well as local communities, in Shasta and Siskiyou Counties would likely continue as described in subsection 5.9.

NMFS's Proposed Action and the alternatives would have no direct or indirect effect on population trends in the analysis area. Similarly, the economic bases in Shasta and Siskiyou Counties would continue to be influenced by local, state, and national trends unrelated to the designations and authorization for release of NEPs in the NEP Area. Trends in wages, employment, and unemployment would be expected to continue as described in subsection 5.9.

Analyses in this subsection address the potential socioeconomic effects of the alternatives related to the availability of opportunities for recreational fishing, tourism, small business and other recreational opportunities in the analysis area, as well as the potential for substantial changes in regulatory costs.

6.7.1 Alternative 1 (No-action) –No Designation of Nonessential Experimental Populations, No Authorization for Release, and No Adoption of Protective Regulations

Under the No-action Alternative, NMFS would not designate NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, or adopt protective regulations. There would be no changes from current conditions and, therefore, no adverse effects to recreational opportunities in the NEP Area would occur. Because these actions would not take place, there would be no potential for socioeconomic effects. Tourism would be expected to continue as described in subsection 5.8, and would also continue to contribute to small business or employment and wages in the analysis area as under current conditions. The No-action Alternative would not result in any new regulatory costs for county residents, persons visiting the affected Counties for recreational fishing opportunities, and persons or organizations engaged in water management, timber harvest, grazing, or other similar activities.

6.7.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Limited Protective Regulations

In contrast to the No-action Alternative, under Alternative 2, NMFS would designate and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon under ESA section 10(j), and adopt limited protective regulations under ESA section 4(d). Within the NEP Area, the 4(d) rule protective regulations would provide an exception for take that occurs incidental to otherwise lawful activities and is unintentional, not due to negligent conduct. Because of the substantial regulatory relief provided by the NEP designations and this take exception, Alternative 2 would have no substantial adverse effect on tourism and recreational activities within the NEP Area.

Alternative 2 would be expected to increase the recreational viewing opportunities of salmon in the NEP Area, with a possible concomitant increase in tourism and associated socioeconomic benefits compared to the No-action Alternative. As described in the analysis of effects on tourism and recreation (subsection 5.8), opportunities to engage in recreational fishing would not be reduced, nor would locations of fishing opportunities change by implementation of Alternative 2.

NMFS anticipates a reintroduction would provide increased opportunities for employment related to construction, installation and testing of the requisite facilities (e.g., juvenile salmonid collection facilities and acclimation ponds). Increased economic benefits for local communities within the NEP Area could be realized by hiring local workers, providing housing and other accommodations for temporary workers with specialized expertise, as well as the day-to-day contribution of workers to the local economy from purchasing necessities (e.g., automobile fuel and food). In the long-term, a reintroduction is anticipated to contribute to the local economy by increasing employment opportunities over the duration of the program (employees would be needed to operate and maintain facilities and oversee day-to-day operations). Although Alternative 2 would have no direct effect on environmental justice, Alternative 2 does have the potential to provide both near-term and long-term positive economic benefits to Shasta and Siskiyou Counties.

Similar to existing conditions under the No-action Alternative, Agencies such as USFS and CalFire, as well as local agencies that fund, carry out, or permit actions that may affect the proposed experimental populations in the NEP Area would not face substantially increased regulatory requirements under Alternative 2. Similarly, Alternative 2 would not result in new regulatory costs for residents of Shasta and Siskiyou Counties, recreational fishers, and persons or organizations engaged in water management, timber harvest, grazing, or other similar types of activities. The ESA section 4(d) rule protective regulations under Alternative 2 would generally prohibit take of SR winter-run and CV spring-run Chinook salmon in the NEP Area, but would provide an exception for take that is incidental to an otherwise lawful activity and is unintentional, not due to negligent conduct. As described in the analysis of potential effects on Tourism and Recreation, opportunities to engage in recreational fishing would not be reduced by implementation of Alternative 2.

Under Alternative 2, it is anticipated that new and replacement septic systems and leach fields in Shasta and Siskiyou Counties would continue to be required to adhere to health department requirements, setback requirements, building permits, inspections, and state and county approvals. Water quality compliance regulations for on-site sewage disposal (i.e., septic systems) in proximity to streams and riparian areas in the NEP Area would not be expected to change, relative to the No-action Alternative.

Overall, Alternative 2 would be protective of Federal, state, local and private land use and land ownership interests in the NEP Area. Alternative 2 would minimize the potential for new or exacerbated expenses from increased regulatory compliance responsibilities associated with future Federal, state, county, municipal, and private actions in the watershed, while facilitating reintroduction of SR winter-run and CV spring-run Chinook salmon to the NEP Area. Although the actions associated

with Alternative 2 would not be expected to have a substantial adverse effect on socioeconomics, Alternative 2 does have the potential to result in both near-term and long-term positive economic benefits to the NEP Area.

6.7.3 Alternative 3 – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Current Protective Regulations

As under Alternative 2, under Alternative 3, NMFS would designate and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in NEP Area and would likely increase the number of adult fish available for recreational viewing in the NEP Area compared to the No-action Alternative with a possible concomitant increase in tourism and associated socioeconomic benefits.

Alternative 3, similar to Alternative 2, would provide: (1) increased opportunities for employment related to construction of the requisite facilities; and (2) increased economic benefits for local communities and small businesses from hiring local workers, providing housing and other accommodations for temporary workers with specialized expertise, and the day-to-day contribution of workers to the local economy as a result of purchasing necessities such as automobile fuel, food, etc. Over the long-term, it is also anticipated that the NEPs would contribute to the local economy by increasing employment opportunities because new employees would be required in order to operate and maintain the physical facilities, and to oversee the day-to-day operation of the program.

Unlike Alternative 2, the current ESA section 4(d) protective regulations that apply to the CV spring- run Chinook salmon ESU downstream of Englebright Dam would also be adopted to apply to reintroduced SR winter-run and CV spring-run Chinook salmon in the NEP Area. NMFS' experience under the current ESA section 4(d) rule protective regulations (50 CFR 223.203) shows that NMFS does authorize take associated with some otherwise lawful activities, but some activities may not meet one of the 10 categories of activities and some activities may be modified during the authorization process to meet the applicable criteria under the current protective regulations. NMFS expects any such modifications or restrictions placed on lawful land use, water use, and recreational activities in the NEP Area under Alternative 3 would be similar to those that are in place outside the NEP Area downstream of Shasta and Keswick Dams. Application of these restrictions could result in additional restrictions on existing lawful land use, water use, and recreational activities in the NEP Area.

Additional restrictions on lawful land use, water use, and recreational activities as a result of Alternative 3 would likely result in negative socioeconomic effects compared to the No-action Alternative or Alternative 2. These negative socioeconomic effects could affect persons visiting the

NEP Area for recreational fishing opportunities (and ancillary businesses associated with recreational fishing), residents of Shasta and Siskiyou Counties, and persons or organizations engaged in water management, timber harvest, grazing, or other similar types of activities.

As previously discussed, fish passage conditions in the NEP Area upstream of Shasta Dam could improve as a result of Alternative 3 if existing barriers to adult and juvenile passage (e.g., dams, poorly designed or poorly functioning fishways, and road crossings) are required to come up to modern standards as a consequence of the new regulatory requirements and increased regulatory oversight.

Although improved fish passage conditions as a result of Alternative 3 would provide benefits to fisheries resources, regulatory restrictions would likely impose additional operational constraints, construction-related/permitting responsibilities and financial obligations on local stakeholders in the NEP Area. Consequently, although the extent of benefit associated with improved fish passage in the NEP Area as a result of Alternative 3 is unknown, this alternative would have the potential to result in negative financial and socioeconomic effects to Federal, state, county and local management agencies, private stakeholders, and local communities in the NEP Area, relative to the No-action Alternative and Alternative 2. For agricultural properties adjacent to streams in the NEP Area, water storage and withdrawals for irrigation may be reduced to help preserve water in streams. Timber harvest near streams may also be limited to ensure appropriate streamside shading, Large wood recruitment, and storm water retention, particularly in watersheds with degraded aquatic habitat.

Under Alternative 3, it is anticipated that existing health department requirements, setback requirements, building permits, inspections, and state and county approvals would remain in place.

Under Alternative 3, Federal, non-Federal public, and private entities would have various regulatory options under the ESA in which to seek limits on their potential liabilities from otherwise lawful activities, subject to applicable conditions. These could include an ESA section 4(d) limit or a section 10(a) permit as applicable, but any available options would be limited to certain types of activities and subject to conditions.

Overall, Alternative 3 has the potential to result in both near-term and long-term positive economic benefits to the NEP Area and the potential for adverse socioeconomic effects due to the additional regulatory requirements.

6.8 Effects on Cultural and Historical Resources

Cultural resources include prehistoric and historical archaeological sites, historic structures, and traditional cultural properties (places that may or may not have human alterations, but are important to the cultural identity of a community or Native American tribe). The analysis area for cultural resources is the same as the NEP Area.

6.8.1 Alternative 1 (No-action) –No Designation of Nonessential Experimental Populations, No Authorization for Release, and No Adoption of Protective Regulations

Under the No-action Alternative, NMFS would not designate NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, or adopt protective regulations. There would be no changes from current conditions and, therefore, no effects to cultural and historical resources would occur. The presence of salmon runs, which are of significant cultural importance to Native American tribes, would remain absent from the NEP Area as they have been for more than 75 years.

6.8.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Limited Protective Regulations

In contrast to the No-action Alternative, under Alternative 2, NMFS would designate NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area under ESA section 10(j), and adopt limited protective regulations under ESA section 4(d).

Compared to the No-action Alternative, Alternative 2 would return salmon to the NEP Area, which represents the return of a significant cultural resource to the upper Sacramento and McCloud Rivers. No prehistoric or historical archaeological sites, historical structures, or traditional cultural properties in the analysis area would be affected by the designations and authorization for release of an experimental population and associated protective regulations.

6.8.3 Alternative 3 – Designation of Nonessential Experimental Populations, Authorization for Release, and Adoption of Current Protective Regulations

Under Alternative 3, NMFS would designate and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and apply the current 4(d) rule protective regulations to the NEP Area. Under Alternative 3, a significant cultural resource (salmon runs) would be returned to the NEP Area. No prehistoric or historical archaeological sites, historical structures, or traditional

cultural properties in the analysis area would be affected by designation and authorization for release of experimental populations and associated protective regulations in the NEP Area.

6.9 Environmental Justice

NEPA requires Federal agencies to determine whether minority populations, low-income populations, or Indian tribes are present in the area affected by a Proposed Action, and if present, whether there may be disproportionately high and adverse human health or environmental effects on minority populations, low-income populations, or Indian tribes (CEQ 1997). The analysis area for environmental justice encompasses Shasta and Siskiyou Counties.

This subsection focuses on whether any potential additional restrictions on otherwise lawful activities (e.g., subsistence fishing), and any expected disproportionately high and adverse human health or environmental effects to low income and minority communities would occur in the action area.

6.9.1 Alternative 1 (No-action) –No Designation of Nonessential Experimental Populations, No Authorization for Release, and No Adoption of Protective Regulations

Under the No-action Alternative, NMFS would not designate NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run and CV spring- run Chinook salmon in the NEP Area, or adopt protective regulations. The extent to which dietary habits of low-income or minority families and their economic condition dictate subsistence living (e.g., subsistence fishing, hunting, gathering or farming) in the NEP Area is unknown. Under the No-action Alternative, there would be no changes from current conditions in terms of locations and opportunities to engage in legal fishing and, therefore, no adverse effects to subsistence living in the NEP Area would occur. Under the No-action Alternative, agencies that fund, carry out, or permit actions that may affect the NEP Area would not face increased regulatory requirements, and there would be no change to regulatory requirements affecting minority or low-income populations.

6.9.2 Alternative 2 (Proposed Action/Preferred Alternative) – Designation of Nonessential Experimental Populations Authorization for Release, and Adoption of Limited Protective Regulations

In contrast to the No-action Alternative, under Alternative 2, NMFS would designate NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area, authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area, and adopt limited protective regulations under ESA section 4(d).

The current salmon and steelhead ESA section 4(d) rule protective regulations prohibit take of CV spring-run Chinook salmon downstream of Shasta and Keswick Dams (subsection 1.2.4), subject to specific limits or exceptions, which do not specifically include an exception for take that occurs incidental to otherwise lawful activities. Under Alternative 2, a separate ESA section 4(d) rule would be adopted for the experimental populations in the NEP Area. This rule would generally prohibit take of SR winter-run and CV spring-run Chinook salmon in the NEP Area, but would provide an exception for take that is incidental to an otherwise lawful activity and is unintentional, not due to negligent conduct. The ESA section 4(d) rule will minimize regulatory requirements in the NEP Area associated with reintroduction of SR winter-run and CV spring-run Chinook salmon. As previously discussed in subsection 5.8, locations and opportunities to engage in legal fishing would not be reduced under Alternative 2. NMFS anticipates current restrictions in California's Freshwater Sport Fishing Regulations would remain in effect.

Although the extent to which subsistence living (e.g., subsistence fishing, hunting, gathering or farming) occurs within the NEP Area is unknown, Alternative 2 would not diminish the amount of fish, vegetation and/or wildlife available in the watershed that are consumed by minority populations, low- income populations, or Indian tribes in the area. It is also unlikely that Alternative 2 would change the rate and/or pattern of subsistence consumption by minority populations, low-income populations, and Indian tribes as compared to rates and patterns of consumption of the general population.

NMFS anticipates a reintroduction would provide increased opportunities for employment related to construction, installation and testing of the requisite facilities (e.g., juvenile salmonid collection facilities and acclimation ponds). Increased economic benefits for local communities within the NEP Area could be realized by hiring local workers, providing housing and other accommodations for temporary workers with specialized expertise, as well as the day-to-day contribution of workers to the local economy from purchasing necessities (e.g., automobile fuel and food). In the long-term, a reintroduction is anticipated to contribute to the local economy by increasing employment opportunities over the duration of the program (employees would be needed to operate and maintain facilities and oversee day-to-day operations). Although Alternative 2 would have no direct effect on environmental justice, Alternative 2 does have the potential to provide both near-term and long-term positive economic benefits to Shasta and Siskiyou Counties.

Under Alternative 2, agencies that fund, carry out, or permit actions in the NEP Area would not face substantially increased regulatory requirements compared to the No-action Alternative. Therefore, there would not be increased regulatory requirements disproportionately affecting minority or low-income

populations. Overall, Alternative 2 would be protective of Federal, state, local and private land use and land ownership interests in the NEP Area, and would minimize the potential for disproportionate effects to minority or low-income populations.

6.9.3 Alternative 3 – Designation of a Nonessential Experimental Population, Authorization for Release, and Adoption of Current Protective Regulations

Under Alternative 3, NMFS would designate and authorize the release of NEPs of SR winter-run and CV spring-run Chinook salmon in NEP Area. Unlike Alternative 2, under Alternative 3, NMFS would adopt the current ESA section 4(d) protective regulations that apply to the CV spring-run Chinook salmon ESU downstream of Shasta and Keswick Dams to apply to reintroduced SR winter-run and CV spring-run Chinook salmon in the NEP Area. NMFS' experience under the current ESA section 4(d) rule protective regulations (50 CFR 223.203) shows that NMFS does authorize take associated with some otherwise lawful activities, but some activities may not meet one of the 10 categories of activities and some activities may be modified during the authorization process to meet the applicable criteria under the current protective regulations. NMFS expects any such modifications or restrictions placed on lawful land use, water use, and recreational activities in the NEP Area under Alternative 3 would be similar to those that are in place outside the NEP Area downstream of Shasta and Keswick Dams.

Application of these restrictions could result in additional restrictions on existing lawful land use, water use, and recreational activities in the NEP Area.

Potential effects for Alternative 3 associated with locations and opportunities to engage in legal fishing, as well as daily bag limits, would be the same as those described above for Alternative 2. Although the extent to which subsistence living (e.g., subsistence fishing, hunting, gathering or farming) occurs within the NEP Area is unknown, Alternative 3 would not diminish the amount of fish, vegetation and/or wildlife available in the watershed that are depended upon and consumed by minority populations, low-income populations, or Indian tribes that may be present in the area. It is also unlikely that Alternative 3 would change the rate and/or pattern of subsistence consumption by minority populations, low-income populations, and Indian tribes as compared to rates and patterns of consumption of the general population.

Anticipated positive local economic benefits associated with near-term construction activities and long-term operation and maintenance of a future reintroduction program under Alternative 3 would be the same as those previously described for Alternative 2.

Compared to the No-action Alternative and Alternative 2, Alternative 3 has the potential for an increase in restrictions on lawful land use, water use, and recreational activities in the NEP Area. These additional restrictions could affect persons visiting the NEP Area, residents of Shasta and Siskiyou Counties, and persons or organizations engaged in water management, timber harvest, grazing, or other similar activities.

Under Alternative 3, Federal, non-Federal public, and private entities would have various regulatory options under the ESA in which to seek limits on their potential liabilities from otherwise lawful activities. These could include an ESA section 4(d) limit or an ESA section 10(a) permit as applicable, but any available options would be limited to certain types of activities and subject to conditions. Additional restrictions under Alternative 3 could disproportionately affect minority or low-income populations relative to others. The disproportionate effects would be due to the relative effect on these populations of additional financial costs necessary to comply with additional regulatory requirements.

7.0 CUMULATIVE EFFECTS

According to the Council on Environmental Quality's regulations for implementing NEPA (40 CFR 1508.7), a cumulative impact or effect is the impact on the environment that results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

This section considers the cumulative effects of the two action alternatives when added to the aggregate effects of past actions, existing conditions, and reasonably foreseeable future actions and conditions. Only resources potentially affected by the action alternatives are analyzed for cumulative effects. Past, ongoing, and reasonably foreseeable future actions likely contribute to adverse effects on aquatic habitat and other environmental conditions for fish and wildlife species in the analysis area. Some of these reasonably foreseeable future actions/occurrences include, but are not limited to, dam operations, water diversions, recreation, forestry, livestock grazing, and climate change. Adverse cumulative effects of NMFS's Proposed Action/Preferred Alternative would be minor, if even measurable, on all resources.

7.1 Affected Resources

In Section 6, Environmental Consequences, the resources affected by the Proposed Action are identified and are carried forward for the cumulative effects analysis. Those resources are as follows:

- Fisheries Resources
    - ESA-listed fish species
    - Non-ESA-listed fish species
    - Non-native fish species
    - Fish diseases
- Aquatic Habitat
    - Fish passage
    - Habitat availability and quality
- Wildlife Species
    - ESA-listed and special status wildlife species
    - Non-ESA-listed wildlife species
- Land Use and Ownership
- Tourism and Recreation
- Socioeconomics
- Cultural and Historical Resources
- Environmental Justice

7.2 Geographic Boundaries

The analysis areas for cumulative effects vary by resource, depending on the geographic area of the direct and indirect effects analyzed. For physical and biological resources (except for Southern Resident killer whales), as well as for land use and ownership, the cumulative effects analysis area consists of the NEP Area. For cultural resources, the cumulative effects analysis area consists of the NEP Area and the Sacramento River Watershed below Keswick Dam within the range of Chinook salmon. For social resources (i.e., tourism and recreation, socioeconomics and environmental justice), the cumulative effects analysis area consists of Siskiyou and Shasta Counties.

7.3 Temporal Boundaries

Designation and authorization for release of the proposed NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area and applicability of protective regulations under ESA section 4(d) in the NEP Area (Alternatives 2 and 3) are anticipated to remain in effect until the listed ESUs are delisted. The anticipated time period for recovery and delisting are unknown, but will likely take at least 25 years or longer.

7.4 Effects of Past, Present, and Reasonably Foreseeable Future Actions Other than the Proposed Action

Past, present and reasonably foreseeable future actions that might contribute to cumulative effects in the analysis area are discussed below. Historical and ongoing factors in the NEP Area include blockage of upstream anadromous fish passage at Keswick and Shasta Dams and upstream water diversions and storage, which reduce upstream habitat due to decreased flow, warmer water temperatures, capture and retention of sediment and large wood. Reasonably foreseeable future actions include FERC's issuance of new licenses to upstream hydroelectric projects and increased consumptive water diversions.

7.4.1 McCloud-Pit Hydroelectric Project

The FERC is currently in the relicensing process for the McCloud-Pit Hydroelectric Project (P-2106). FERC's Final Environmental Impact Statement (EIS) (2011) evaluated increased minimum instream flows in the McCloud River and concurred with NMFS that reintroduction was reasonably foreseeable in the McCloud River basin. Once FERC issues a new license to Pacific Gas & Electric (PG&E), it is anticipated that existing baseflow releases from McCloud Dam would likely increase and an aquatic biological monitoring plan would be implemented as a condition of the new license. While minimum streamflows are less than the historical flows that existed in the McCloud River before construction of McCloud Dam, the anticipated increase in baseflow releases from the dam would benefit reintroduced SR

winter-run and CV spring-run Chinook salmon throughout the lower mainstem of the McCloud River once the license is issued.

7.4.2 Shasta Lake Water Resources Investigation

In 2015, Reclamation conducted a feasibility study that included preparation of a decision document and EIS for the Shasta Lake Water Resources Investigation (Reclamation 2015a, 2015b). Studies to date have focused on identifying water resources problems and needs, developing a set of planning objectives, and formulating alternatives. The alternative plans include enlarging Shasta Dam to increase anadromous fish survival and water supply reliability in the Sacramento River below Keswick Dam. On July 29, 2015, Reclamation transmitted to Congress the EIS and Final Feasibility Report (Reclamation 2015a, 2015b).

If Shasta Dam is raised, then the upper limit of the reservoir inundation zone would change on both the upper Sacramento and McCloud Rivers and could affect the design of any future fish collection facilities associated with the reintroduction as a result of changes in lake elevations. Less than 1 mile of the lower reach of each river would be inundated at full pool with the maximum raise analyzed (an 18.5-foot dam raise). This area is not suitable Chinook salmon spawning habitat (Reclamation 2014b) and therefore spawning habitat availability would not be affected; however, the quantity of rearing habitat in lower reaches would be slightly less than under existing lake levels.

7.4.3 Hatchery and Genetic Management Plans

The NEP designations would potentially initiate increased production of SR winter-run Chinook salmon from the Livingston Stone NFH and FRH for CV spring-run Chinook salmon. In the foreseeable future, additional conservation hatchery production would require authorization under the ESA and completion of HGMPs. An HGMP provides detailed descriptions of hatchery programs that are submitted to NMFS for authorization under the ESA and are the basis for NMFS' biological evaluations under ESA sections 7 and 10, or Limit 5 of the current January 9, 2002 (67 Fed. Reg. 1116) section 4(d) rule (subsection 1.2.4, ESA Section 4(d) Regulations).

Production of SR winter-run Chinook salmon for the reintroduction program is included in the Livingston Stone NFH HGMP (subsection 1.2.6.6, SR Winter-run Chinook Salmon HGMP). Because of the best management practices identified in the HGMP for the Livingston Stone NFH, which include methods and monitoring protocols to protect the genetic integrity of the SR winter-run Chinook salmon ESU, there would be no cumulative adverse impacts from the NEP designations or the reintroduction. NMFS anticipates that there would be a need for future authorization for the collection of CV spring-run Chinook

salmon, and subsequent issuance of a 10(a)(1)(A) permit, and a future analysis under the ESA and NEPA when NMFS receives a permit application. The NEPs, and other activities, including future section 10(a)(1)(A) permits, would work in concert with other ongoing recovery and reintroduction efforts for SR winter-run and CV spring-run Chinook salmon and would enhance NMFS' flexibility and discretion in managing listed SR winter-run and CV spring-run Chinook salmon within the Central Valley.

7.4.4 Federal, State, and Local Laws and Regulations

Many of the potential adverse effects from other actions in the analysis area (some identified above) would be avoided or offset through the implementation of federal, state, and local laws and regulations. Projects in or near water with the greatest potential to affect fish and fish-dependent resources are subject to oversight through several regulatory processes. Examples of reviews that would limit the potential for adverse effects on physical and biological resources include the following:

- NEPA and CEQA reviews of agency actions with the potential to significantly affect the quality of the environment.
- CWA section 404 permits for excavating, clearing land, or discharging dredged or fill material into waters of the United States, including wetlands.
- Implementation of HGMPs for hatcheries determined to be necessary for reintroduction efforts.
- FERC relicensing every 30-50 years.
- Approvals for projects that use, divert, obstruct, or change the natural flow or bed of waters of the State.
- Local land use permits for activities in or near locally designated critical areas (e.g., wetlands, fish and wildlife habitat conservation areas, and frequently flooded areas) or in protective buffer zones.

7.4.5 Climate Change

Climate is a major driver of geographic distribution and abundance of salmon and steelhead (NMFS 2016a). Over 60 percent of California's anadromous salmonids are vulnerable to climate change, and future climate change will affect NMFS's ability to influence their recovery in most or all of their watersheds (Moyle et al. 2008; Moyle et al. 2013). California's anadromous salmonids are particularly vulnerable to the adverse impacts of climate change (Crozier et al. 2019).

7.4.5.1 Recent Trends

Impacts from a changing climate are evident in California (Barnett et al. 2008; Bonfils et al. 2008), and these impacts have the potential to significantly alter aquatic habitats over the upcoming decades. For example, the San Francisco Bay Area's average annual maximum temperature has increased by 1.7° F from 1950-2005, and sea level in the Bay Area has risen about 8 inches in the last 100 years (Ackerly et al. 2019). Temperatures over the Sierra Nevada have increased during the last 100 years, resulting in less snowfall (and more rainfall) and an earlier snowmelt (Moser et al. 2009). Nighttime temperatures are rising across California and at a higher rate than daytime temperatures (DWR and Reclamation 2016).

7.4.5.2 Projections to 2100

Since 2006, the State of California has undertaken four comprehensive assessments designed to assess the impacts and risks from climate change. California's Fourth Climate Change Assessment (Sievanen et al. 2018) included over 44 technical peer-reviewed reports examining specific aspects of climate change in California, including projections of impacts, analysis of vulnerabilities and adaptation for various sectors (Table 11). Trends in California will likely include increases in average air temperatures, rising sea levels, changes in precipitation patterns (including storm intensity and timing of runoff), changes in freshwater supply and management of those supplies, and changes in the frequency and severity of extreme events such as heat waves, droughts, and catastrophic fires (Hanak et al. 2011; Mastrandrea and Luers 2012).

Table 11. Current Understanding of Historical and Expected Climate Impacts in California (modified from Sievanen et al. 2018).

Climate Impact	Historical Trends	Future Direction of Change	Confidence for Future Change
Temperature	Warming (last 100+ years)	Warming	Very High
Sea Levels	Rising (last 100+ years)	Rising	Very High
Snowpack	Declining (last 60+ years)	Declining	Very High
Annual Precipitation	No significant trends (last 100+ years)	Unknown	Low
Intensity of Heavy Precipitation Events	No significant trends (last 100 years)	Increasing	Medium-High
Frequency of Drought	No significant trends (last 100 years)	Increasing	Medium-High

Anadromous Salmonid Considerations

Because salmon and steelhead depend upon freshwater streams, estuaries and oceans during different stages of their life history, NMFS (2014) recovery plan reports that these species are likely to be adversely affected by the climate related-impacts listed below.

- More frequent intense winter storms, high stream flow events, and floods.
- Earlier snowmelt, with higher peak flows in winter, less spring runoff, and much lower summer flows.
- Considerably warmer stream, river and ocean water temperatures during the summer.
- Greater inter-annual precipitation variability, more frequent wet and drought years, and extended droughts.
- Years with weaker fall storms, and delays in the onset of high stream flows.
- More frequent wildfires leading to increased erosion and sedimentation into stream and rivers.

NMFS anticipates the above changes will affect freshwater streams and estuaries in California used by Chinook salmon. These climate-related effects occur across different life history stages, and are typically cumulative, which could result in reduced populations (Williams et al. 2016). Information provided below is intended to characterize the potential extent of future climate-related conditions that may be experienced by anadromous salmonids in the NEP Area and downstream.

Freshwater Streams

Freshwater streams may experience increased frequencies of floods, droughts, lower summer flows and higher water temperatures (Luers et al. 2006; Lindley et al. 2007; Schneider 2007; Osgood 2008), as described below.

Precipitation

In the future, at higher elevations in California, precipitation is likely to fall as rain rather than snow (Safeeq et al. 2015), reducing overall snowpack and the critical snowmelt that provides cold water year-round to California's salmonid species (Moyle et al. 2017). As precipitation patterns change and warmer stream temperatures become more common, it will be more difficult to maintain cold-water releases from dams during the summer and fall months to sustain Central Valley Chinook salmon and steelhead populations on the valley floor. Central Valley watersheds are fed predominantly by snowmelt runoff from the southern Cascade and Sierra Nevada Mountains, which has been historically highest during the late spring and early summer. High flows allow CV spring-run Chinook salmon to reach their summer, high elevation, holding areas, while the lower flow extending from the summer into early fall is cool

enough for spawning (NMFS 2014). However, recent trends toward an earlier seasonal runoff and lower flow in spring and summer have reduced the potential for survival in these watersheds, and will make the migration of adults to their spawning streams more difficult. Atmospheric rivers influence flooding events, and studies (Guan et al. 2016; Crozier 2016) suggest that intense atmospheric rivers will occur more frequently as mean temperatures rise, with maximum change affecting northern California (Gao et al. 2015; Payne and Magnusdottir 2015; Radic et al. 2015; Warner et al. 2015). Finally, increases in rainfall during the winter have the potential to increase the loss of salmonid redds via streambed scour from more frequent, high instream flows.

Droughts

Natural climate variations such as droughts can dramatically affect salmon habitat. Based on future climate projections, an increased occurrence of drought may dramatically reduce total quantity and quality of freshwater habitat. Prolonged drought due to lower precipitation shifts in snowmelt runoff, and greater climate extremes could render most existing CV spring-run Chinook salmon habitat unusable, either through temperature increases or lack of adequate flows (NMFS 2014), which could further stress phenotypic diversity of CV spring-run Chinook salmon (Cordoleani et al. 2021).

Climate-related Effects in the Cumulative Effects

Climate change is likely to reduce the quantity, and impair the quality and accessibility, of suitable habitat for many species, exacerbating the adverse effects of other reasonably foreseeable future actions. As described above, anticipated impacts of climate change include increased water temperatures, changes in hydrological processes, and accelerated loss of forest habitat because of forest fires and insect outbreaks, all with concomitant changes in habitat-forming processes (Mantua et al. 2009; Littell et al. 2016). With reductions in snowmelt runoff and increased contributions by rainfall, peak flows may come earlier, which could affect species such as CV spring-run Chinook salmon that have evolved their life history based on predictable runoff patterns (Williams 2006).

Reduction in snowpack owing to climate change will increase water temperatures. Increased water temperatures will reduce reproductive success, particularly at elevations lower than those found in the NEP Area. A recent analysis, modeling changes to average water temperatures in August under two climate change scenarios, predicts an increase of approximately 1° C by 2080 (USFS 2017) in the NYR. This change could reduce the overall quantity of habitat for CV spring-run Chinook salmon by approximately four mainstem miles in the NYR. YSF (2013) evaluated available habitat in the NYR and determined that, depending on water year, between 7.6 and 33.7 miles of the NYR could maintain suitable

holding and summer rearing habitat. If reintroduction occurs in the NYR, a loss of 4 miles, while significant, would still allow, depending on water year, between 3.6 and 29.7 additional miles of habitat than is currently available downstream of Englebright Dam. Furthermore, the fish would be spatially distributed across a greater area making the ESU more resilient to stochastic events.

NMFS expects the action alternatives' potential for greenhouse gas emission would be minimal. Sources of greenhouse gas emissions associated with implementation of the reintroduction are anticipated to occur if the reintroduction program uses trap and haul methods. Trap and haul methods would be limited to vehicle trips for transporting fish and installing collector equipment. Impacts would be extremely small in the local or global context.

7.5 Incremental Impacts When Added to Other Past, Present, and Reasonably Foreseeable Future Actions

For this analysis, the focus is on the contribution of the No-action Alternative or an action alternative to cumulative effects considering other past, present, and future actions that occurred, are occurring, or are expected to occur in the analysis area. Section 5, Affected Environment, describes existing conditions and reflects environmental effects from past and existing conditions for eight resource areas. Section 6, Environmental Consequences, evaluates the direct and indirect effects of the No-action Alternative, the Proposed Action/Preferred Alternative (i.e., Alternative 2) and Alternative 3 on these resources. This section considers the cumulative effects of the alternatives in the context of past actions, present conditions, and reasonably foreseeable future actions and conditions.

7.5.1 Fisheries Resources

In contrast to the No-action Alternative, Alternative 2 and Alternative 3 are anticipated to improve the overall viability of the SR winter-run and CV spring-run Chinook salmon ESUs. Alternative 2 and Alternative 3 would be consistent with NMFS's (2014) final recovery plan for SR winter-run and CV spring-run Chinook salmon. Reintroduction would aid in recovery of the ESUs by increasing abundance and productivity, improving spatial structure and diversity, and reducing the risk of extinction to the ESUs as a whole. Designation and authorization for release of NEPs in the NEP Area under ESA section 10(j) as part of Alternative 2 and Alternative 3 would enhance NMFS's flexibility and discretion in conserving SR winter-run and CV spring-run Chinook salmon.

The potentially adverse cumulative effects to SR winter-run and CV spring-run Chinook salmon and other fisheries resources from ongoing actions in the area, such as some water and land management practices, are anticipated to continue under Alternative 2. Additionally, climate change projections indicate continued pressures on fish habitat from warming trends would exist into the future. Under run

Alternative 2, overall habitat conditions for SR winter-run and CV spring-run Chinook salmon and other fisheries resources in the NEP Area are anticipated to remain suitable, even in consideration of all past, present, and reasonably foreseeable future actions. Overall, adverse cumulative effects to fishery resources are expected to be negligible under Alternative 2 in consideration of all past, present and reasonably foreseeable future actions.

Under Alternative 3, reintroduction of ESA-listed species to an area where they do not currently occur would add to regulatory requirements compared to Alternative 2. Increased regulatory oversight for ongoing actions in the area, such as dam operations and some land management practices, could lead to improvements to instream conditions for successful holding, spawning, and rearing over time. Climate change projections under Alternative 3 would be similar to those under Alternative 2, and indicate continued pressures on fish habitat from warming trends would exist into the future. Overall, no adverse cumulative effects to fisheries resources are expected under the action alternatives in consideration of all past, present and reasonably foreseeable future actions.

7.5.2 Aquatic Habitat

7.5.2.1 Habitat Availability and Quality

As discussed in subsection 5.4.3, current conditions in the NEP Area are suitable for SR winter-run and CV spring-run Chinook salmon, due in large part to the lack of water impoundments and water diversions. Under the No-action Alternative, NMFS would not designate and authorize the release of experimental populations in the NEP Area. Therefore, the No-action Alternative would not affect habitat availability in the NEP Area. Alternative 2 would have no direct effect on anadromous salmonid habitat availability but would have indirect effects. Increased regulatory requirements under Alternative 3 could lead to additional efforts by land and water managers to minimize the adverse effects of their actions through avoidance, minimization and/or mitigation measures focused on improving habitat availability and quality for listed Sr winter-run and CV spring-run Chinook salmon. The extent of these benefits is unknown, but no adverse cumulative effects to anadromous salmonid habitat availability and quality are anticipated under Alternative 3. Therefore, in consideration of all past, present and reasonably foreseeable future actions, no adverse cumulative effects to anadromous salmonid habitat availability and quality are expected to occur under the action alternatives.

7.5.2.2 Water Resources

As a result of ongoing and future FERC relicensing efforts and implementation of future CWA 303(d) TMDL action plans for water temperature, NMFS anticipates future effects to water quality and

availability will either remain substantially the same as current conditions or would improve as a result of implementing new flow regimes as a result of FERC relicensing and implementation of TMDL action plans. Improved flow regimes and cooler water temperatures are expected to improve overall conditions for reintroduced SR winter-run and CV spring-run Chinook salmon in the NEP Area.

Instream flow conditions in the NEP Area under Alternative 2 and Alternative 3 would not change, and would have no effect on CWA 303(d) listings of tributaries and reservoirs for water quality impairments. Compared to the No-action Alternative, Alternative 2 would not result in adverse effects to water quantity in the NEP Area and may result in beneficial effects to the aquatic ecosystem due to the addition of marine derived nutrients. The increased regulatory requirements associated with Alternative 3 could beneficially affect water quality and water resource management in the future. Adverse cumulative effects to water quality are expected to be negligible under the action alternatives in consideration of all past, present and reasonably foreseeable future actions.

7.5.2.3 Wildlife Resources

Potentially adverse cumulative effects on wildlife species or their habitat within the analysis area resulting from implementation of Alternative 2 or Alternative 3 are unlikely for any of the wildlife species addressed in subsection 6.4. Under both Alternative 2 and Alternative 3, climate change projections indicate continued pressures on terrestrial and aquatic habitats from warming trends that would likely exist into the future, which could increase stressors to certain wildlife species in the analysis area. Overall, no adverse cumulative effects to wildlife resources are expected under the action alternatives, in consideration of all past, present and reasonably foreseeable future actions.

7.5.2.4 Land Use and Ownership

Substantial adverse effects on land use and ownership (subsection 6.5) are not anticipated under Alternative 2. Within the NEP Area, NMFS' ESA section 4(d) rule protective regulations would include an exception to take prohibitions for take that is incidental to otherwise lawful activities and unintentional, not due to negligent conduct. This take exception, as well as the limited applicability of ESA section 7 to NEPs of SR winter-run and CV spring-run Chinook salmon in the NEP Area would have little to no effect on land uses such as agriculture, forestry, extractive/industrial activities, commercial/research and development, parks, public lands, military installations or urban/local communities. Because of the regulatory relief provided by NEP designations and the exception to the proposed ESA section 4(d) protective regulations, NMFS also does not expect Alternative 2 to have any substantial adverse cumulative effect on recreational, agricultural, or development activities within the NEP Area in consideration of all past, present and reasonably foreseeable future actions.

Under Alternative 3, potentially adverse cumulative effects may occur to land use and ownership (subsection 6.5) in consideration of all past, present and reasonably foreseeable future actions as a result of adoption of the more restrictive current ESA section 4(d) rule protective regulations for the NEP Area under Alternative 3. For agencies with management authority for public lands and private landowners, Alternative 3 may restrict the types or extent of actions those management agencies and private landowners would implement on their lands because of increased regulatory obligations necessary to comply with the more restrictive ESA section 4(d) rule protective regulations under Alternative 3.

7.5.2.5 Tourism and Recreation

No substantial adverse effects on tourism and recreation (subsection 6.6) are anticipated under Alternative 2. Within the NEP Area, NMFS's ESA section 4(d) rule protective regulations would provide an exception to take prohibitions for take that is incidental to otherwise lawful activities and unintentional, not due to negligent conduct. Because of the regulatory relief provided by the NEP designations and this take exception, Alternative 2 would have little to no effect on tourism and recreational activities within the NEP Area or outside the NEP Area portions of Shasta and Siskiyou Counties. Alternative 2 is expected to result in opportunities for future recreational viewing of salmon. Under Alternative 2, people visiting Shasta and Siskiyou Counties would be anticipated to support local community businesses by partaking in food and beverage services, accommodations, retail sales, arts, entertainment and recreation, et cetera. Opportunities to engage in recreational fishing would not be reduced under Alternative 2. Overall, no adverse cumulative effects to tourism and recreation resources are expected under Alternative 2 in consideration of all past, present and reasonably foreseeable future actions.

Alternative 3, as with Alternative 2, would be expected to result in opportunities to view adult Chinook salmon returning to historical holding and spawning areas over the long-term. However, possible adverse effects on tourism and recreation (subsection 6.6) may occur. Potential incidental take of SR winter-run and CV spring-run Chinook salmon would be subject to greater regulatory restrictions than under Alternative 2. NMFS' experience under the current ESA section 4(d) rule protective regulations (50 CFR 223.203) shows that NMFS does authorize take associated with some otherwise lawful activities, but some activities may not meet one of the 10 categories of activities and some activities may be modified during the authorization process to meet the applicable criteria under the current protective regulations. NMFS expects that any such modifications or restrictions placed on tourism or recreational activities in the NEP Area under Alternative 3 would be similar to those that are in place outside the NEP Area downstream of Shasta and Keswick Dams. One possible exception is the potential to "harass" adult SR winter-run and CV spring-run Chinook salmon by excessive proximity of tourist viewing of holding

adults. Overall, minor adverse cumulative effects to tourism and recreational activities are expected under Alternative 3 in consideration of all past, present and reasonably foreseeable future actions.

7.5.2.6 Socioeconomics

Alternative 2 has the potential to bring positive socioeconomic benefits to the NEP Area, and adverse cumulative effects to socioeconomics are not expected to occur under Alternative 2 in consideration of all past, present and reasonably foreseeable future actions. Alternative 2 would provide increased opportunities for employment related to construction of any requisite facilities (e.g. juvenile collectors) for several years. Increased economic benefits for local communities within the NEP Area could be realized by hiring local workers, providing housing and other accommodations for temporary workers with specialized expertise, as well as the day-to-day contribution of workers to the local economy. In the long-term, when a reintroduction program is implemented, it is anticipated the program would contribute to the local economy by increasing employment opportunities. Overall, Alternative 2 would be protective of Federal, state, local and private land use and land ownership interests in the NEP Area. Alternative 2 would minimize potential for new or higher expenses from increased regulatory compliance responsibilities associated with future Federal, state, county, and municipal actions in the watershed.

When a future reintroduction program is implemented, Alternative 3 has the potential to bring similar economic benefits to the NEP Area as those that are described in the paragraph above for Alternative 2. By contrast, however, potentially adverse socioeconomic effects also may occur under Alternative 3. Relative to Alternative 2, Alternative 3 has the potential for an increase in restrictions to lawful land use, water use, and recreational activities in the analysis area. Overall, compliance with new regulatory requirements associated with Alternative 3 would likely result in negative cumulative effects to socioeconomics compared to effects that would occur with the No-action Alternative or Alternative 2 in consideration of all past, present and reasonably foreseeable future actions. Negative socioeconomic effects would result from regulatory requirements that could affect persons visiting the action area for recreational fishing opportunities (and ancillary businesses associated with recreational fishing), residents of Shasta and Siskiyou Counties, and persons or organizations engaged in water management, timber harvest, grazing, or other similar types of activities.

7.5.2.7 Cultural and Historical Resources

No prehistoric or historical archaeological sites, historical structures, or traditional cultural properties in the analysis area would be affected by designation and authorization for release of experimental populations and associated protective regulations in the NEP Area under the action alternatives. Overall,

no adverse cumulative effects on cultural and historical resources are expected under Alternative 2 and Alternative 3 in consideration of all past, present, and reasonably foreseeable future actions.

7.5.2.8 Environmental Justice

Potentially adverse effects on environmental justice (subsection 6.9) are not anticipated under Alternative 2. Alternative 2 would be protective of Federal, state, local and private land use and land ownership interests in the NEP Area, and would minimize the potential for disproportionate effects to minority or low-income populations, while at the same time facilitating the ability to reintroduce SR and CV spring-run Chinook salmon into the NEP Area. Under Alternative 3, additional restrictions could disproportionately affect minority or low-income populations relative to others. The disproportionate effects would be due to the relative effect on these populations of additional financial costs necessary to comply with additional regulatory requirements. Overall, potentially adverse cumulative effects to environmental justice are not expected to occur under Alternative 2 but could occur under Alternative 3 in consideration of all past, present and reasonably foreseeable future actions.

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9.0 GLOSSARY OF KEY TERMS

Action area: Geographic area where the Proposed Action would take place.

Adfluvial: Fish migrating between rivers or streams and lakes.

Alevins: Newly hatched fish.

Anadromy: A life-history pattern for fish that features early juvenile development in fresh water, migration to seawater, and a return to fresh water for spawning.

Biological Opinion: The written documentation of an Endangered Species Act section 7 consultation.

Centrarchid: A member of the sunfish family (Centrarchidae) of freshwater ray-finned fish, including largemouth bass, bluegill, pumpkinseed, and crappies.

Distinct Population Segment: Under the Endangered Species Act (ESA), the term species includes any subspecies of fish or wildlife or plants, and any "distinct population segment" (DPS) of any species or vertebrate fish or wildlife that interbreeds when mature. The ESA thus considers a distinct population segment of vertebrates to be a "species." The ESA does not, however, establish how distinctness should be determined. Under NMFS policy of Pacific salmon, a population or group of populations will be considered a distinct population segment if it represents an evolutionarily significant unit of the biological species. In contrast to salmon, the National Marine Fisheries Service (NMFS) listed steelhead runs under the joint NMFS-United States Fish and Wildlife Service (USFWS) Policy for recognizing distinct population segments (Distinct Population Segment Policy: 61 Fed. Reg. 4722, February 7, 1996). This policy adopts criteria similar to those in the ESU policy, but applies to a broader range of animals to include all vertebrates.

Ectocommensal ciliate: A single-celled organism that possess cilia (hair-like organelles) living in a commensal relationship (where one organism obtains food or other benefits without harm to the other) on the exterior of another organism.

Endangered Species Act (ESA): A United States law that provides for the conservation of endangered and threatened species of fish, wildlife, and plants.

Evolutionarily Significant Unit (ESU): The ESA defines 'species' to include subspecies and 'distinct population segments' of vertebrates (16 USC §1532(16); 50 CFR 424.02 (k)). For Pacific salmon, NMFS determined that an ESU constitutes a distinct population segment (56 Fed. Reg. 58612, November 20, 1991). A group of Pacific salmon is an ESU if it is (1) substantially reproductively isolated from other salmon of the same species and (2) represents an important component of the evolutionary legacy of the species.

Fluvial: Fish migrating between rivers and/or streams.

Hatchery-origin: A fish that originated from a hatchery facility. Also known as a hatchery fish.

Hatchery program: A program that artificially propagates fish. Most hatchery programs for salmon and steelhead spawn adults in captivity, raise the resulting progeny for a few months or longer, and then release the fish into the natural environment where they will mature.

Hypolimnion: The lower layer of water in a stratified lake.

Incidental take: "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, or collect individuals from a species listed on the ESA. Incidental take is the non-deliberate take of ESA listed species during the course of a Federal action (e.g., fishing under an FMP).

Introgression: The movement of a gene from one species into the gene pool of another species.

Mesotrophic: Having an intermediate level of productivity.

Metalimnion: The zone of rapid temperature change between the epilimnion and hypolimnion.

Monomictic: Lakes that mix from top to bottom during one mixing period each year.

Natural-origin: Natural-origin fish are the offspring of parents that spawned in the natural environment rather than the hatchery environment. Synonymous with native or wild fish.

Parr: Salmon over one year old.

PIT tag: A passive integrated transponder used for marking and later detecting individual fish.

Redd: A shallow depression created by a spawning female where she will lay her eggs. More than one redd can be made by a female when spawning.

Resident fish: Fish that reside in fresh water throughout their life cycle.

Salmonid: Of, belonging to, or characteristic of the family Salmonidae, which includes salmon, trout, char, grayling, and freshwater whitefish.

Smolt: A young salmon that begins the migration from fresh water to marine waters. A smolt is characterized by its physiological changes needed for life in the sea.

Taxa: Plural form of taxon, classification category such as genus or species.

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