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

Sierra Pacific Industries Forestland Management Program Habitat Conservation Plan and Safe Harbor Agreement

NMFS Consultation Number: WCRO-2020-03564

Action Agency: National Marine Fisheries Service

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*)	Endangered	Yes	No	Yes	No
Central Valley spring-run Chinook salmon (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
Southern Oregon/Northern California Coast coho salmon (*O. kisutch*)	Threatened	Yes	No	Yes	No
California Central Valley steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Central Valley fall- and late fall-run Chinook salmon (*Oncorhynchus tshawytscha*)	Species of Special Concern	Yes	No	N/A	N/A

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Upper Klamath/Trinity Rivers Chinook salmon (*Oncorhynchus tshawytscha*)	Petitioned for listing as Federally Threatened or Endangered	Yes	No	N/A	N/A
Klamath Mountains Province steelhead *(O. mykiss)*	No Regulatory Status	Yes	No	N/A	N/A

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	No

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

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Date: September 21, 2021

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1. INTRODUCTION

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

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

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

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

Section 10(a) of the ESA provides exceptions to the section 9 prohibitions on take of listed species through the issuance of two kinds of permits (16 U.S.C. § 1531 *et seq*.). Section 10(a)(1)(A) permits authorize the take of listed species for scientific purposes or to enhance the propagation or survival of listed species. Section 10(a)(1)(B) permits authorize the incidental take of listed species that occurs as a result of carrying out otherwise lawful activities.

Section 10(a)(1)(A) of the ESA provides NMFS with the authority to issue an Enhancement of Survival Permit (ESP) to a landowner in exchange for species and habitat-enhancing activities described in a Safe Harbor Agreement (SHA). The ESP authorizes the Applicant to incidentally take listed species as a result of: 1) otherwise lawful land management operations (including routine viticulture, rangeland, and residential activities), so long as Elevated Baseline conditions[1] are maintained; and 2) activities that return the enrolled property back to the Elevated Baseline condition. Under the NMFS and U.S. Fish and Wildlife Service (USFWS) joint final Safe Harbor Policy (64 FR 32717), the Applicant will promote the conservation, and enhance the survival and recovery, of listed species on the Applicant's property. Take of ESA-listed species found on the Applicant's property at the time the Agreement is formalized (*i.e.*, the baseline population) is not allowed; however, if the population or range of those species increases due to voluntary conservation measures conducted by the Applicant, the incidental take of those individuals above the baseline conditions would be authorized without penalty.

[1] In the SHA, **Baseline Conditions** means the habitat conditions for Covered Species on the Enrolled Property when NMFS approves the SHA. **Elevated Baseline Conditions** means certain Baseline Conditions improved as a result of the implementation of certain Beneficial Management Activities as described in the SHA. The SHA describes Baseline Conditions on the Enrolled Property, and the Applicant and NMFS have agreed upon the Elevated Baseline Conditions, which are described in Section 1.3.9 below.

Section 10(a)(1)(B) of the ESA provides NMFS with the authority to issue an Incidental Take Permit (ITP) to a landowner for taking that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Section 10(a)(2)(A) provides that an Applicant must develop a Habitat Conservation Plan (HCP) that specifies: 1) the impact which will likely result from such taking; 2) what steps the Applicant will take to minimize and mitigate such impacts, and the funding that will be available to implement such steps; 3) what alternative actions to such taking the Applicant considered and the reasons why such alternatives are not being utilized; and 4) such other measures that the Secretary may require as being necessary or appropriate for purposes of the plan.

Under section 10(a)(2)(B), the Secretary shall issue the permit if the Secretary finds, after opportunity for public comment, with respect to a permit application and the related conservation plan that: (i) the taking will be incidental; (ii) the applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking; (iii) the applicant will ensure that adequate funding for the plan will be provided; (iv) the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; and (v) the measures, if any, required by the Secretary as being necessary or appropriate for the purposes of the plan, will be met; and the Secretary has received such other assurances as s/he may require that the plan will be implemented. The permit shall contain such terms and conditions as the Secretary deems necessary or appropriate to carry out the purposes of the plan, including, but not limited to, such reporting requirements as the Secretary deems necessary for determining, whether such terms and conditions are being complied with.

1.1. Background

Sierra Pacific Land & Timber Company (SPL&T) is the largest private forestland owner in the state of California, with ownership currently encompassing approximately 1.79 million acres of timberland throughout the northern and central portions of the state. Sierra Pacific Industries (SPI) is the authorized representative and manager of SPL&T lands. Throughout this document, the term SPI is used because SPI is the sole management entity for the landowners, SPL&T and affiliates. In this document, the term "SPI lands" refers to lands owned by SPL&T and affiliates. Rivers and streams on portions of SPI lands in the Sacramento River and Trinity River basins currently provide habitat for anadromous salmonids, including species listed under the ESA. SPI forestland management activities have the potential to adversely affect fish species and their habitats that are listed, or may be at risk of listing, under the ESA.

SPL&T has applied to NMFS for an ITP under Section 10(a)(1)(B) of the ESA for a 50-year period. The ITP would authorize the incidental take of the following ESA-listed species: endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*); threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*); threatened Southern Oregon/Northern California Coast (SONCC) coho salmon (*O. kisutch*); and threatened California Central Valley (CCV) steelhead (*O. mykiss*).

Additionally, SPL&T's ITP application includes: Central Valley fall- and late fall-run Chinook salmon (*O. tshawytscha*), which are designated as species of concern by NMFS; Upper Klamath/Trinity Rivers (UKTR) Chinook salmon (*O. tshawytscha*), which are currently petitioned for listing as threatened or endangered under the ESA; and Klamath Mountains

Province (KMP) steelhead (*O. mykiss*), which have no current regulatory status. These species are henceforth referred to as non-listed species. Together, the ESA-listed and non-listed species are collectively referred to as the Covered Species.

SPL&T is also applying to NMFS for an ESP under Section 10(a)(1)(A) of the ESA for a 50-year period. The ESP would authorize the potential future incidental take of ESA-listed species that NMFS proposes to reintroduce into rivers and streams on SPL&T lands that are upstream of constructed passage barriers to anadromous fish in the Sacramento River and Trinity River basins.

When considering the issuance of an ITP and/or ESP, NMFS must consult internally under section 7 of the ESA to ensure that issuance of the permit(s), and subsequent implementation of the HCP and SHA, does not appreciably reduce the likelihood of survival and recovery of ESA-listed species or appreciably diminish the value of critical habitat as a whole for the conservation of ESA-listed species. In compliance with Section 7(a)(2) of the ESA, in this opinion, NMFS analyzed the effects of the issuance of an ITP and ESP for SPL&T's HCP and SHA for Sierra Pacific Industries Forestland Management Program exempting incidental take of ESA-listed salmonids.

The non-listed species identified above do not currently have protective federal regulations against take, and a federal permit is not needed to incidentally take them. However, there may be a change in listing status during the permit period, so in this opinion NMFS is also analyzing the effects of the issuance of the ITP and ESP on the non-listed species. If any of the above-mentioned non-listed species are listed as threatened or endangered in the future, the ITP would become effective immediately for these species.

SPI began discussions with NMFS in 2016 regarding the development of the HCP and SHA and continued to meet with NMFS from 2016 to 2019 to further refine the approach for pursuing the ITP and ESA associated with the proposed HCP/SHA. SPI collaborated closely with NMFS to establish the list of Covered Species, the HCP and SHA Action Areas and Plan Areas (see Figure 1 and Figure 2), and the proposed Conservation Strategy. NMFS provided information on the recommended salmonid reintroductions outlined in the Final Recovery Plan for Central Valley Chinook salmon and steelhead (NMFS 2014a) and the SONCC coho Recovery Plan (NMFS 2014b). That information was used to determine the SHA Plan Area. SPI provided a discussion paper to NMFS outlining the proposed organization, content, and mitigation approach for the HCP/SHA.

1.2. Consultation History

In November 2019, SPL&T submitted the permit applications (ITP and ESP) with their Forestland HCP/SHA for the long-term operations and maintenance of their Forest Land Management Program. In June 2020, in accordance with the National Environmental Policy Act (NEPA), NMFS completed a draft Environmental Assessment (EA) to evaluate the effects of the proposed action of issuing an ESP and an ITP under Sections 10(a)(1)(A) 10(a)(1)(B) of the ESA. NMFS solicited public comments on the draft EA until July 2020, and have addressed the comments received in the final EA and the Finding of No Significant Impact (FONSI) that is being issued along with this biological opinion.

In August 2020, SPL&T submitted their Final HCP/SHA and a Biological Evaluation as a supplement to the HCP/SHA to NMFS. NMFS determined that the HCP/SHA was sufficient and initiated the Section 7 consultation on the proposed issuance of the ITP and ESP to SPL&T.

In October 2020, NMFS initiated its Section 106 National Historic Preservation Act (NHPA) consultation with the California State Office of Historic Preservation (CA-OHP). Completion of the Section 7 consultation was stayed during ongoing discussions with CA-OHP over the NHPA consultation.

In June 2021, a letter transmitting NMFS' findings under Section 106 of the NHPA was sent to the State Historic Preservation Officer (SHPO). No comments were received from the SHPO in response to the June 21, 2021 letter. Accordingly, NMFS determined that its responsibilities under Section 106 of the NHPA have been fulfilled for the proposed undertaking. At this time, NMFS resumed the Section 7 consultation on the proposed issuance of the ITP and ESP to SPL&T.

1.3. Proposed Federal Action

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

We considered, under the ESA, whether or not the proposed action would cause any other activities that would have consequences on the species and their critical habitat included in the opinion, and determined that it would cause the use and application of chemicals during forestland management activities. The application of forest chemicals is not a Covered Activity in the HCP/SHA; however, some herbicide use is a reasonably foreseeable outcome of even-aged timber harvesting. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur.

The proposed action is the issuance of an ITP and an ESP pursuant to Sections 10(a)(1)(B) and 10(a)(1)(A) of the ESA respectively, by NMFS. The ITP would require implementation of the HCP, designed to address the potential impacts on Covered Species from SPI's timber harvest activities in watersheds with watercourses accessible to anadromous salmonids or upstream of those watercourses where potential effects have the potential to extend to occupied habitat. The ESP would require implementation of the SHA, developed to address potential impacts of SPI's timber harvest and other activities on ESA-listed salmonids on SPL&T lands in the Sacramento and Trinity River basins upstream of impassable dams where NMFS is proposing to reintroduce populations of listed salmonids. SPI has committed to implementing the HCP/SHA with measures to conserve, monitor, avoid, minimize, and mitigate the effects of their forestland management activities on the Covered Species for the term of the Permits.

Proposed activities under the ITP and ESP (referred to as Covered Activities) include those necessary to conduct forestland management and certain mitigation and conservation measures identified in the HCP/SHA. They also include those activities intended to support reintroduction efforts proposed by NMFS during the permit term. Covered Activities involving forestland management are the primary activities conducted on SPL&T lands by SPI.

The Z'Berg-Nejedly Forest Practice Act of 1973, (14 PRC § 4511, et seq.) and its implementing regulations, the California Forest Practice Rules (CFPRs), regulate timber harvest on private lands in California. Those legal authorities require that landowners develop Timber Harvest Plans (THPs) for all commercial timber harvests. A THP is an environmental review document outlining what timber the landowner intends to harvest, how it will be harvested, and the steps that will be taken to reduce or prevent environmental damage. THPs are prepared by Registered Professional Foresters (RPFs) licensed by the State Board of Forestry and Fire Prevention. THPs are submitted to the California Department of Forestry and Fire Protection (CAL FIRE) for review and approval and must comply with all applicable state and federal regulations. Other state trustee agencies, including the California Department of Fish and Wildlife (CDFW), California Geologic Survey, and California Department of Water Resources, will participate in a multi-disciplinary review process that will provide input to CAL FIRE during the review process and will issue separate enforceable permits to protect trustee resources. CAL FIRE periodically inspects logging operations to ensure compliance with the approved THP and has the authority to shut down operations, and cite or fine RPFs, licensed timber operators, and landowners if forestry practices are out of compliance with the THP. The CFPRs are updated annually by the State Board of Forestry. While implementing the HCP/SHA, SPI will follow the Z'Berg-Nejedly Forest Practice Act and relevant Public Resource Codes, and all CFPRs current for each year of the permit period.

Forest practices under the CFPRs are conducted within a "functional equivalent California Environmental Quality Act (CEQA) program" and requires that significant adverse environmental impacts affected by the project are mitigated to insignificant levels (as defined by CEQA). Timber operations and certain other management actions are conducted as part of the functional equivalent program. The CFPRs regulate all industrial forest management activities and are the primary means by which the goals and conservation measures within the HCP/SHA will be achieved. The CFPRs include implementation measures for timber harvesting and erosion control; site preparation; watercourse and lake protection; and logging roads, landings, and crossings that ensure SPI management within a planning watershed will not result in any significant adverse environmental impacts (CFPRs Articles 4, 5, 6 and 12). The CFPRs in these Articles mandate that any potential negative impacts be mitigated into insignificance (as defined by CEQA). For the purposes of the HCP, SPI has defined significant adverse environmental impacts as a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance (CFPRs 895.1). Extensive and long-term post-harvest monitoring by CAL FIRE and other state and federal agencies (Cafferata and Munn 2002) states "results to date show that implementation rates of the Forest Practice Rules related to water quality are high and that individual practices required by the Forest Practice Rules are effective in preventing hillslope erosion features when properly implemented."

Unpaved roads are likely the dominant source of land use-related sediment pollution in forested landscapes in the United States, with the potential to impact water quality and aquatic biota

(McCashion and Rice 1983; Megahan and Ketcheson 1996; Coe 2006; Cafferata *et al*. (2007); Goode et al. 2012). The contribution of roads to sediment pollution (Gucinski *et al*. 2001) has led the State of California to impose best management practices (BMPs) to hydrologically disconnect forest roads from streams and reduce sediment delivery. SPI designed a forest road model called READI (Road Erosion and Sediment Delivery Index) to address forest road sediment production and delivery to streams.

READI (Benda *et al*. 2019) is designed to provide capabilities and flexibilities currently unavailable, as a set, in other road erosion and sediment delivery models. A detailed field inventory collected on SPI's road network to enumerate, map, and assess all constructed drainage features, forms the foundation for accurate site-specific READI Model results. The READI Model was designed to link the condition of SPI's constructed road network with site-specific road segments and crossings that produce sediment, and to identify locations that potentially deliver erosion to the stream network. Detailed descriptions of SPI's READI Model concept and methods are included in this document and in Appendices I and J of the HCP/SHA (SPL&T 2020).

1.3.1. SPL&T Ownership and SPI Management Context

SPI implements conservation measures consistent with the current CFPRs and the long-term sustained yield plan that SPI has been operating under since 1999. SPI-managed properties are entered and managed on a California Planning Watershed basis. SPL&T ownership within these watersheds varies significantly (as shown in Appendix B of the HCP/SHA). Each of these planning watersheds has management constraints based on soil type, topography, slope stability, watercourse type, road density, fish presence, wildlife protection, and harvest unit adjacency. These planning watersheds are assessed for tree spacing and density once per decade to provide adequate growing space for trees while improving forest health.

Over time, the area of even-aged stands created through even-aged silviculture will decline through the life of the Option A[2] demonstration of maximum sustained production (CFPRs

[2] (a) Where a Sustained Yield Plan (14 CCR § 1091.1), a Non-Industrial Timber Management Plan (NTMP), or a Working Forest Management Plan (WFMP) has not been approved for an ownership, Maximum Sustained Production (MSP) will be achieved by:
(1) Producing the yield of timber products specified by the landowner, taking into account biologic and economic factors, while accounting for limits on productivity due to constraints imposed from consideration of other forest values, including but not limited to, recreation, watershed, wildlife, range and forage, fisheries, regional economic vitality, employment and aesthetic enjoyment.
(2) Balancing growth and harvest over time, as explained in the THP for an ownership, within an assessment area set by the Timber Owner or Timberland owner and agreed to by the Director. For purposes of this subsection the sufficiency of information necessary to demonstrate the balance of growth and harvest over time for the assessment area shall be guided by the principles of practicality and reasonableness in light of the size of the ownership and the time since adoption of this section using the best information available. The projected inventory resulting from harvesting over time shall be capable of sustaining the average annual yield achieved during the last decade of the planning horizon. The average annual projected yield over any rolling 10-year period, or over appropriately longer time periods for ownerships which Project harvesting at intervals less frequently than once every ten years, shall not exceed the projected long-term Sustained Yield.
(3) Realizing growth potential as measured by Adequate Site Occupancy by Species to be managed and maintained given Silvicultural Methods selected by the landowner.
(4) Maintaining good Stand Vigor.
(5) Making provisions for adequate regeneration. At the Plan submitter's option, a THP may demonstrate achievement of MSP pursuant to the criteria established in (b) where a Sustained Yield Plan has been submitted but not approved.

933.11) (*i.e.*, SPI's sustained yield plan). Even-aged management allows stands to accumulate more volume per acre; therefore, the sustainable volume target can be met from smaller areas. As currently estimated, 20 to 30 percent of the HCP Plan Area and SHA Plan Area will not be subject to even-aged silviculture during the term of this HCP. A fully regulated 60-to 80-year harvest rotation would lead to an annual harvest of 1.2 to 1.7 percent of the land available for even-aged silviculture. SPI management practices that result in growing larger trees on a smaller area increases the inventory volume per square mile and reduces the area requiring tree density control through on-the-ground management activities. The general trend towards reduced disturbance over time reduces the risk to Covered Species.

SPI responds to wildfire by moving its logging capacity as feasible out of "green" tree harvesting to harvesting the trees damaged by the wildfire. Over the 20-year period of the Option A, SPI has never exceeded the annual limits on harvesting, even with large wildfires that occurred during that period. This harvest of "substantially damaged timberland" is conducted under the Emergency Notice process of the CFPRs. That process requires no exceptions to and full implementation of the CFPRs operational rules.

CFPR rules require project monitoring during the life of the permit and for up to three years after project completion. Monitoring elements include annual inspections of operational areas to verify tree stocking levels, adequacy of road maintenance practices including stream crossing functionality and mitigation of erosion/sediment production. The policy of conducting entries into every watershed on a decadal basis and completing the evaluations outlined above during the life of the THP and for a period after THP completion is a form of continuous monitoring conducted by SPI and the permitting agencies, including CAL FIRE, CDFW, the California Geologic Survey, and the California Department of Water Resources. By the time that the first decade evaluations and surveys are complete and harvest areas are certified as free to grow under the CFPRs, the next decadal planning process begins with a new round of monitoring activities initiated as part of the THP planning process. Road surveys, terrestrial and aquatic species surveys, and all other assessments required by the CFPRs begin again. Each entry into the planning watershed provides an opportunity to review risks associated with Covered Species identified in this HCP and SHA, and a monitoring opportunity to assess HCP and SHA implementation.

SPI will follow all conservation measures that are proposed in the HCP and included in the CFPRs (CFPR 936.9). Those conservation measures differ between watersheds regulated by CFPR Anadromous Salmonid Protection (ASP) Rules and watersheds not subject to CFPR ASP Rules. The ASP Rules were approved by the State Board of Forestry and Fire Protection (Board) in 2009 and are intended to protect, maintain, and improve riparian habitats for state and federally listed anadromous salmonid species. The goal of the ASP Rules are to ensure that every timber operation shall be planned and conducted to protect, maintain, and contribute to restoration of properly functioning salmonid habitat and listed salmonid species. Measures within ASP watersheds, such as increased buffer width and canopy cover along streams, are more stringent than those in non-ASP watersheds to further minimize potential impacts of timber operations on anadromous salmonids. For the purposes of the HCP, SPI will apply the ASP rules at CFPR 936.9 and not evoke 936.9(w), which provides deviations from the ASP rules for circumstances where other permits (*e.g.*, an HCP) may apply.

The HCP and SHA will be implemented in a manner consistent with the approved fisher Candidate Conservation Agreement with Assurances (SPI 2016) and the spotted owl HCP developed for U.S. Fish and Wildlife Service (SPI 2020). These permits will constrain SPL&T's managed landscape by incorporating harvest deferrals and set-asides, instituting limited operating periods, mandating habitat retention areas, and limiting the acreage available for even-aged management.

Additional aquatic protections related to forest management are provided by the California Fish and Game Code process (F&GC 1600 *et seq*.), which provides for protection and conservation of the fish and wildlife resources of California. SPI is required to obtain a 1600 Agreement from CDFW for any forest management activities that diverts or obstructs the natural flow of a river stream or lake; substantially change or use material from the bed, channel, or bank of any river, stream, or lake; or deposit debris, waste, or other materials that could pass into any river, stream, or lake (F&GC 1600 *et seq*.). CDFW can recommend additional minimization measures that may be incorporated into the 1600 Agreement and become enforceable requirements if agreed to by the parties. Such measures may include timing restrictions, erosion control practices, and design criteria for water crossing structures to protect water quality and fish life. For emergency projects that require immediate repair, the landowner is required to notify CDFW. These Agreements are exclusive and not superseded by this HCP or SHA.

1.3.1.1. Watercourse and Lake Protection Zones (WLPZs)

Any timber operation or silvicultural prescription within any watercourse and lake protection zone (WLPZ) will have protection, maintenance, or restoration of the beneficial uses of water, and properly functioning salmonid habitat and listed aquatic or riparian-associated species as significant objectives. Practices to meet this objective include, but are not limited to, thinning for increased conifer growth, felling or yarding trees for wood placement in the channel, restoration of conifer deficient areas, management to promote a mix of conifers and hardwoods, abandonment and upgrading of non-functioning or high risk roads, watercourse crossings, tractor roads, and landings, and fuel hazard reduction activities that will reduce fire hazards and stand replacing wildfires which would result in significant adverse effects to salmonid species or riparian habitat. Specific objectives and requirements are described below.

Core Zone: The primary objective for this zone is streamside bank protection to promote bank stability, wood recruitment by bank erosion, and canopy retention. Timber operations are generally excluded from this zone and limited to actions which meet the objectives stated above or improve salmonid habitat consistent with 14 CCR § 916.9 [936.9, 956.9] subsections (a) and (c). The WLZP requirements include maintaining a core area of 30 feet on each side of a fish bearing stream.

Inner Zone: The primary objective for this zone is to develop a large number of trees for large wood recruitment, to provide additional shading, to develop vertical structural diversity, and to provide a variety of species (including hardwoods) for nutrient input. This is accomplished through the establishment of high basal area and canopy retention by retaining or more rapidly growing a sufficient number of large trees. Additional specific objectives include locating large trees retained for wood recruitment nearer to the Core Zone and maintaining or improving salmonid habitat on flood prone areas and channel migration zones when present. Timber Operations within WLPZs are limited to those actions which meet the objectives stated above or to improve salmonid habitat consistent with 14 CCR § 916.9 [936.9, 956.9] subsection (a) and (c). The WLPZ requirements include maintaining 70 percent canopy cover within the riparian buffer and maintaining an average diameter of 24 inches for overstory trees.

Outer Zone: The primary objective for this zone is to buffer the Inner and Core Zones and to provide the following functions:

1. Wind resistance where windthrow is common or likely to occur.
2. Additional wood recruitment.
3. Microclimate control in the Inner or Core Zones for purposes other than limiting water temperature change.
4. Habitat for terrestrial wildlife species that depend on riparian areas.
5. Additional sediment filtration on steeper slopes with high or moderate erosion hazard rating when tractor operations are proposed.

1.3.1.2. Stream Class Definitions

The riparian management measures recommended as part of the CFPRs are directed at three broad classes of watercourses. These include:

Class I: Year-round stream in which fish species are always or seasonally present and includes habitat to sustain fish migration and spawning. It may also be a stream that provides a source of domestic water supply including springs, on site and/or within 100 feet downstream of the operations area.

Class II: Stream within 1,000 feet upstream of a Class I watercourse; contains aquatic habitat for non-fish species such as amphibians. May be a seasonal stream.

Class III: No aquatic life present. Capable to sediment transport to a Class I or Class II watercourse under normal high water flow conditions after completion of timber operations. Usually flows in response to storms.

1.3.2. Activities Conducted Under a Timber Harvest Plan

Timber operations and other management activities are conducted under a THP, pursuant to the CFPRs. Timber operations are defined by the California Forest Practices Act (Division 4, Chapter 8 of the Public Resources Code). Operations are described in detail when they occur as part of an approved THP or Emergency or Exemption Notification, which satisfies CEQA analysis requirements. Specific definitions and detailed descriptions of the Covered Activities listed below can be found in Section 2 of the HCP/SHA (SPL&T 2020, pages 27-39). Below is a summary of THP covered activities.

Activities conducted under a standard THP include:

- Felling and bucking timber

  - Felling timber involves cutting a standing tree and dropping it in a desired location. Bucking is the process of cutting a tree into appropriate log lengths.
- Yarding timber
  - Yarding, or skidding, is the movement of logs from the point of felling to the log landing (the area where forest products are concentrated prior to loading for transportation to a different location for further processing).
- Loading and landing operations
- Transportation of forest products and equipment
- Chipping
  - Branches and tops of trees may be chipped to rearrange the structure of post-harvest residue.
- Timber salvage
  - Timber salvage is the removal of trees that are dead, dying, or deteriorating due to damage from fire, wind, insects, disease, flood, or another injurious agent.
- Road construction, reconstruction, maintenance, and abandonment
- Water drafting
  - Water drafting involves pumping water directly from a stream or other water body to fill tank trucks or trailers.
- Watercourse crossing facility placement and maintenance
- Site preparation
- Prescribed burning
- Mastication

Other activities that will be conducted as needed as part of a THP and its accompanying CEQA analysis include, but are not limited to, machinery maintenance, machinery fueling, and fuel storage. The CFPRs also require winter operating plans if operations are planned in the winter period (November 15 to April 1). The winter period operating plan will include specific measures used in the winter operating period to avoid or substantially lessen erosion and soil movement into watercourses, and soil compaction from timber operations.

A winter period operating plan will include the following:

- Erosion hazard rating
- Mechanical site preparation methods
- Yarding system (constructed skid trails and tractor road watercourse crossings)
- Operating period
- Erosion control facilities timing
- Consideration of form of precipitation-rain or snow
- Ground conditions (soil moisture condition, frozen)
- Silvicultural system-ground cover
- Operations within the watercourse and lake protection zone (WLPZ)
- Equipment use limitations
- Known unstable areas
- Logging roads and landings

Covered Activities as part of the HCP/SHA also include actions that are not timber operations per the CFPRs but may be conducted as part of THP activities that are covered by a CEQA analysis or other statutes. Management actions covered by other CEQA analyses are:

- Rock pit development and rock processing
- Transport of aggregate products and heavy equipment
- Watercourse crossing installation
- Machinery maintenance, fueling, and fuel storage

CEQA analysis occurs under applicable regulatory frameworks relating to Regional Water Quality Control Board (RWQCB) Waste Discharge permits or waivers, CDFW 1600 Agreements, the Surface Mining and Reclamation Act of 1975 (SMARA; Public Resources Code, Sections 2710–2796), or California Department of Pesticide Regulation. Government oversight of the implementation of those regulations is provided through CALFIRE, CDFW, the RWQCBs, the California Department of Conservation’s Office of Mine Reclamation, the State Mining and Geology Board, and County Agricultural Commissioners. SPI personnel and their contractors who are responsible for such management actions would have the appropriate licenses from the State of California. A RPF must consult with other resource professionals in cases where additional expertise is required. According to the CFPRs, violations of the applicable regulations can result in civil and criminal penalties for the responsible party.

1.3.3. Activities Not Subject to Timber Harvest Plan Approval

Several Covered Activities are not subject to THP approval or other CEQA review. These activities do not require the THP process or other CEQA review, because the Board of Forestry determined they are minor and potential impacts from these activities are negligible. SPI included these activities in the HCP/SHA for disclosure purposes to show they were considered, and because they occasionally occur in the HCP and SHA Plan Areas. These activities include:

- Routine road maintenance
- Mastication of vegetation within road rights-of-way
- Fuel Break Construction and Maintenance
- Conversion of Brush Fields to Timber Plantations
- Transportation of Materials and Heavy Equipment
- Emergency Fire Suppression
- Harvest of minor forest products
- Grazing
- Timber Cruising
- Timber Harvest Preparation
- Pre-commercial Thinning
- Construction and Operation of Communication Sites
- Scientific Research

1.3.4. Monitoring and Reporting

The HCP/SHA includes a monitoring program using habitat-based surrogates (stream temperature, turbidity) to represent and track the effects caused by the Covered Activities. The HCP/SHA also includes three additional monitoring components: effectiveness monitoring, which evaluates the effects of Covered Activities; implementation monitoring, which summarizes READI Model application and documents other road watercourse crossing improvements; and compliance monitoring to verify whether SPI is implementing the terms of the HCP and ITP. Each of these monitoring components, in addition to Adaptive Management and Reporting are described in further detail below.

1.3.4.1. Effectiveness Monitoring

Effectiveness monitoring and programs measure the success of operating within the CFPRs to meet the biological goals and objectives described as part of the Conservation Strategy. Effectiveness monitoring tracks trends in water quality related to timber operations and forest management activities. It also provides information to better inform the READI Model for designing roads and watercourse crossings to minimize sediment input to nearby watercourses. SPI already monitors several habitat indicators in ASP watersheds (and others) including projects assessing the impacts of fires, ground treatment after fires, logging and road construction, and annual climatic fluctuations on water temperature, stream flows, suspended sediment, and turbidity. The existing monitoring stations represent and monitor the output of all Covered Activities upstream from their geographic location. The stations provide data demonstrating representative conditions, 10 years of baseline conditions, and effectiveness of the CFPRs. The Covered Activities are the same inside or outside of the HCP/SHA Plan Areas; therefore, monitoring stations in the SHA Plan Area or outside both plan areas can represent and monitor Covered Activities anywhere with similar forest types and soils/parent material.

For the purposes of the HCP/SHA, SPI selected three existing water quality stations to represent the Sacramento River basin. These include Judd Creek, Upper San Antonio Creek, and Hazel Creek (HCP/SHA, Figure 17, page 79). These are SPI's longest-tenured stations. They will serve to monitor overall management practices and the habitat-based surrogates selected to determine effects to Covered Species. Upper San Antonio Creek represents southern Sierra Nevada granitic landscapes, Judd Creek represents spring-fed systems in the volcanic Cascade Range, and Hazel Creek represents metavolcanic/metasedimentary lands in the southeastern Klamath Ranges. Upper San Antonio and Judd creeks are within typical moderate mountainous topography, while Hazel Creek represents very steep mountainous topography. In addition to the existing monitoring stations, SPI will install two new water quality monitoring stations in the Trinity River basin HCP Plan Area or SHA Plan Area within 6 months from permit issuance. The final monitoring locations will be selected between SPI and NMFS.

The effectiveness monitoring for the HCP includes two additional components for THPs occurring adjacent to anadromous fish habitat. These efforts are intended to complement the habitat-based surrogate monitoring by focusing on potential site-specific effects. These components include monitoring WLPZ canopy cover effectiveness on stream temperatures, and spawning gravel suitability for Covered Species.

SPI will conduct stream temperature monitoring directly relating to THPs in planning watersheds occupied by state or federally listed Covered Species. When a THP is proposed in a planning watershed with stream habitat occupied by Covered Species that are also state or federally listed, and THP activities will occur in WLPZs, SPI will monitor air and stream temperature the year prior to harvest, the harvest year, and one year following harvest.

The temperature monitoring effort complements the stream and air temperature habitat-based surrogate indicator monitoring by focusing on potential site-specific effects to stream temperatures. Monitoring will be conducted using appropriate air and water temperature logging devices at locations immediately upstream and downstream of the stream reach included in the THP. The monitoring will occur during the summer, as this is the time when potential effects would be most evident and have the highest likelihood of affecting fish. The summer time period is defined as June 1 through August 31. Monitoring data will be analyzed for the subject aquatic/riparian habitats and included in annual monitoring reports.

SPI will also assess and monitor potential spawning gravel characteristics directly relating to THPs occurring in planning watersheds occupied by Covered Species. When a THP is proposed in a planning watershed with stream habitat occupied by Covered Species, and THP activities will occur in WLPZs, SPI will conduct a spawning gravel assessment and monitor potential spawning gravel substrate the year prior to harvest, the harvest year, and one year following harvest.

The spawning gravel monitoring is designed to complement the turbidity habitat-based surrogate indicator monitoring by focusing on site-specific effects to potential spawning redd locations. SPI will conduct the monitoring by performing a habitat assessment of the subject stream reach to determine if spawning habitat for Covered Species is present. If spawning habitat is present, SPI will conduct substrate monitoring in coordination with NMFS using current, standard protocols to measure substrate embeddedness and composition at potential spawning gravel locations immediately upstream and downstream of the stream reach included in the THP. The monitoring will occur during the summer or fall periods when stream conditions allow for instream survey work. The summer and fall time periods are defined as June 1 through August 31, and September 1 to November 30, respectively. SPI will analyze the monitoring data to describe spawning gravel characteristics in the subject stream reaches and include results in annual monitoring reports.

1.3.4.2. Implementation Monitoring

Implementation monitoring includes providing information relating to READI Model application, and documenting other road watercourse crossing improvements. The SPI READI Model serves as a tool for implementing mitigation measures designed to achieve between 85-90 percent hydrologic disconnection for SPL&T roads in the HCP and SHA Plan Areas. As READI Model application proceeds during the first three years of the HCP, SPI will compile output data at the planning watershed scale. These summaries will be provided in the annual monitoring reports to document the planning watersheds completed and summarize percent hydrologic disconnection. As SPI implements projects based on READI Model results, additional documentation will be provided describing the improvement projects and the changes to percent disconnection values.

Implementation monitoring also includes providing summaries of all other road watercourse crossing improvements not directly related to READI Model application, such as stream crossing upgrades during THP implementation or crossing improvements made during post-wildfire rehabilitation. These summaries apply to the HCP and SHA Plan Areas and include the geographic location, planning watershed, stream name, and improvements made.

1.3.4.3. Compliance Monitoring

Compliance monitoring of technical matters will be conducted by a team within SPI, including but not limited to internal forestry, fisheries, and wildlife staff. Monitoring will also include SPI's on-going patrol program, which is coordinated with local law enforcement agencies and includes controlling trespassing, vehicle and off-highway vehicle use, and illegal marijuana cultivation. Collectively, these efforts will ensure compliance with the Conservation Strategy Goals and Objectives (see Sections 1.3.7.1 and 1.3.7.2 below). The monitoring will be implemented or continued as necessary to demonstrate compliance with the HCP. It will also verify that the SHA Plan Area habitat quality does not fall below the Elevated Baseline established in the SHA (see Section 1.3.9 *Elevated Baseline Conditions (SHA)* below).

SPI will work with CAL FIRE to ensure compliance with conditions in the THP. Following the approval of a THP, CAL FIRE Unit Forest Practice Inspectors periodically inspect logging operations. When a THP operation has been completed, SPI submits a completion report to CAL FIRE, which then inspects the area to certify that all rules were followed. SPI is also subject to annual third-party audits through certification by the Sustainable Forestry Initiative (SFI), which annually reviews SPI forest management practices and confirms compliance with the SFI program goals and requirements.

1.3.4.4. Adaptive Management

The SPI Monitoring and Adaptive Management Program incorporates the goals of increasing the understanding of watershed processes and the effects of forestland management activities on the Covered Species and their habitats during the permit term and adapting the HCP Conservation Measures in response to new information. Effectiveness and compliance monitoring will be used to evaluate how well the HCP goals and objectives are being met. If the monitoring results indicate the goals and objectives are not being met, SPI will adjust management strategies, as appropriate. If habitat surrogate thresholds are exceeded at any of the five water quality monitoring stations for a 3-year period, SPI and NMFS will confer to identify possible adaptive management actions to address the condition. SPI will implement the agreed upon adaptive management actions to address the condition as soon as practicable (see *Section 2.9 Incidental Take Statement* for more information related to habitat-based ecological surrogates). SPI will modify those activities across all lands in the HCP and SHA Plan Areas with similar characteristics and management issues to reduce the potential for these exceedances to occur throughout all covered lands. All exceedances, investigations, and resulting actions will be summarized and included in annual monitoring reports submitted to NMFS.

1.3.4.5. Reporting

SPI will provide an annual report to NMFS for the duration of the HCP/SHA to verify that the conservation measures are being implemented and to ensure that the level of authorized take is not exceeded. The report will be prepared by SPI and delivered to NMFS by June 30 of each year, covering the previous calendar year that the HCP and SHA are in effect. The water quality-related monitoring and reporting will include data and analysis for the previous water year (October 1 through September 30). The monitoring report will contain summaries of all effectiveness, implementation, and compliance monitoring including:

- A summary of project implementation
- Monitoring methods and results
- Efforts supporting salmonid reintroduction
- Information on the project status and impacts
- Incidental take tracking
- Avoidance and minimization measures
- A summary of habitat surrogate monitoring results
- Relevant information on mitigation, changed circumstances, and funding
- Summary of CALFIRE violation notices pertaining to HCP Covered Activities, if such notices occur

1.3.5. Changed Circumstances

"Changed circumstances" are defined in 50 CFR 222.102 as changes in circumstances affecting a species or geographic area covered by an HCP that can reasonably be anticipated by HCP developers and NMFS that can be planned for (*e.g.*, the listing of new species, or a fire or other natural catastrophic event in areas prone to such events). If additional conservation and mitigation measures are deemed necessary to respond to changed circumstances, and such measures were not provided for in the HCP, NMFS will not require those additional measures, provided that the commitments and provisions of the HCP have been or are fully implemented. SPI may elect to implement additional voluntary conservation measures. SPI has identified six types of changed circumstances:

1. Effects due to climate change.
2. Fire covering more than 3.9 square miles (2,500 acres) within the HCP Action Area, or more than 1.5 square mile (1,000 acres) within a single watershed in the HCP Action Area but covering less than 23.5 square miles (15,000 acres) of the HCP Plan Area or SHA Plan Area (which is defined as an unforeseen circumstance). If these events occur in any of the five watersheds containing water quality monitoring stations, SPI will meet with NMFS within 30 days and evaluate the need to select another station location, as the fire event could substantially affect monitoring results.
3. Blowdown of previously standing timber extending between 150 and 900 feet along the length of a stream within a WPLZ.
4. Landslides that deliver between 20,000 and 100,000 cubic yards of sediment to a channel.
5. Listing or change in listing status of covered or non-Covered Species or designation or revision of critical habitat for a covered or non-Covered Species that may be affected by a covered activity.

6. Management change due to scientific advances.

The above circumstances, as well as SPI's proposed response to each, are detailed in the following sections.

1.3.5.1. Effects Due to Climate Change

The gradual increase of effects related to climate change may warrant consideration in the HCP/SHA. As a potential driver of increased wildfire intensity and size, fire season length, and as a cause of the additional stressors of drought or storm intensity, climate effects may impact Covered Species and their habitat. When changes in climate become an identifiable changed circumstance during implementation of the HCP/SHA, they will likely be expressed in other changed circumstances. Therefore, we will address the impacts as the potential results of the specific changed circumstances described below, while recognizing that each of these effects may also occur independent of climate change.

1.3.5.2. Fire

SPI actively works to prevent and contain fires on its property. SPI uses prescribed burns to reduce fuels and thins and prunes stands to prevent ground fires from becoming crown fires. SPI hires contractors to control wildfires on an emergency basis to limit burning and to prevent the spread of fire across the landscape. Despite those measures, some fires may spread out of control and have unpredictable impacts on Covered Species. Soils exposed after fire, particularly soils on steep slopes, have the potential to deliver large amounts of sediment to salmonid-bearing streams. If a fire covers more than 3.9 square miles (2,500 acres) within the HCP Action Area and SHA Plan Area, or more than 1.5 square mile (1,000 acres) within a single watershed in the HCP Action Area and SHA Plan Area, SPI will notify NMFS within 30 days. Once the fire is extinguished, SPI will conduct the following prescriptive measures in burned areas:

1. Trees damaged by fire will be considered for salvage. Tree salvage will follow all the conservation measures in the CFPRs.
2. Salvage within WLPZs will be carried out to limit soil erosion to the extent possible, retain structural features that contribute to bank or slope stability, and retain standing dead trees that contribute to the recruitment of LWD to watercourses within the area affected by fire.
3. Burned landscapes, including WLPZs within the area affected by fire will be reforested as soon as possible, but no later than three years following the fire.

Although large fires have occurred during recent years, fires covering more than 23.5 square miles (15,000 acres) in the HCP Plan Area and SHA Plan Area are not likely to occur during the permit term, and will be considered an unforeseen circumstance.

1.3.5.3. Windthrow

Windthrow refers to trees uprooted or broken by wind. Small-scale windthrow is a frequent event, typically with minimal effects to aquatic habitat. If a single windthrow event extends more than 150 feet, measured along the length of the stream within the WLPZ, SPI will implement the following measures:

1. SPI will operate under the emergency notice procedures for Substantially Damaged Timberlands. SPI would retain any downed tree keyed into the ground and in the stream channel.
2. WLPZs within the area affected by windthrow will be reforested as soon as possible.

Windthrow extending more than 900 feet along the length of a stream within a WLPZ is not reasonably foreseeable and would be considered an unforeseen circumstance.

1.3.5.4. Landslides

Landslide rates and processes differ in the various geologic settings in the HCP Plan Area. Conservation measures in the HCP were developed to limit delivery of fine sediment to aquatic ecosystems. Based on historical evidence, landslides delivering between 20,000 and 100,000 cubic yards of sediment to stream channels are uncommon, but may occur during the permit term. If a landslide of such magnitude occurs within the HCP Plan Area, SPI will:

1. Notify NMFS within 30 days that the event has occurred.
2. Coordinate with NMFS to determine if management activities on or adjacent to the landslide could have contributed to the event. If NMFS or SPI determines that management activities contributed to the event, SPI will retain a qualified geotechnical expert to analyze the slide and develop a written report. The report will contain, at a minimum:
    a. An assessment of the factors likely to have caused the slide; and
    b. Any changes to management activities, which, had they been implemented on or adjacent to the area of the slide, would have likely prevented the slide from occurring.
3. Implement recommendations in the geotechnical report as appropriate.

1.3.5.5. New Species Listings

The listing of a new species as endangered or threatened under the ESA could constitute a changed circumstance. SPI has included non-listed species in the HCP to prevent the need to revise the HCP should non-listed salmonids in the Action Area become listed during the permit term. However, other species not included in this HCP could become listed before the ITP expires. If a new species is listed during the term of the ITP, SPL&T may seek to include such newly listed species as Covered Species in the ITP prior to, or after, issuance of the final ITP through a permit amendment.

1.3.5.6. Management Change Due to Scientific Advances

Scientific advances may occur or new information may become available during the permit period warranting revised management considerations. For example, the CFPRs (Article 6, 916.1, 936.1, 956.1) allow proposals for in lieu practices of WLPZ management if justifications suggest these practices are warranted. Recent concerns and increasing amounts of scientific information (*e.g.*, Newton and Ice 2012) suggest current WLPZ standards are not providing functional riparian habitats due to over-shading and limiting disturbance. As the amount of scientific information regarding this issue increases in the near future, conditions may suggest alternative WLPZ management strategies providing additional disturbance in riparian areas could be appropriate. SPI may choose to propose such activities in the HCP/SHA Plan Areas during the permit term. All such proposals would be submitted to NMFS and follow all applicable CFPR requirements.

1.3.6. Unforeseen Circumstances

"Unforeseen circumstances" are defined in 50 CFR 222.103 as changes in circumstances affecting a species or geographic area covered by an HCP that could not reasonably have been anticipated by HCP developers and NMFS at the time of the negotiation and development of the HCP, and that result in a substantial and adverse change in the status of the Covered Species. The purpose of the No Surprises Rule is to provide assurances to non-federal landowners participating in habitat conservation planning under the ESA that no additional land restrictions or financial compensation will be required without their consent for species adequately covered by a properly implemented HCP. If unforeseen circumstances require additional conservation and mitigation measures, those measures will be negotiated between SPL&T and NMFS on a case-by-case basis.

NMFS bears the burden of demonstrating that unforeseen circumstances exist using the best available scientific and commercial data available. In deciding whether unforeseen circumstances exist, NMFS will consider, but not be limited to, the following factors (50 CFR 222.307(g)(3)(iii)):

1. The size of the current range of the affected species;
2. The percentage of the range adversely affected by the conservation plan;
3. The percentage of the range conserved by the conservation plan;
4. The ecological significance of that portion of the range affected by the conservation plan;
5. The level of knowledge about the affected species and the degree of specificity of the conservation program for that species under the conservation plan; and
6. Whether failure to adopt additional conservation measures would appreciably reduce the likelihood of survival and recovery of the affected species in the wild.

In negotiating unforeseen circumstances, NMFS will not require the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources beyond the level otherwise agreed upon for the species covered by the HCP without the consent of the permittee (50 CFR §§ 222.307(g)(3)(i)). If additional conservation and mitigation measures are deemed necessary to respond to unforeseen circumstances, NMFS may require additional measures of the permittee where the HCP is being properly implemented only if such measures are limited to modifications within conserved habitat areas, if any, or to the HCP's operating conservation program for the affected species, while maintaining the original terms of the plan to the maximum extent possible (50 CFR § 222.307(g)(3)(ii)). Additional conservation and mitigation measures will not involve the commitment of additional land, water or financial compensation or additional restrictions on the use of land, water, or other natural resources otherwise available for development or use under the original terms of the HCP without the consent of SPL&T.

1.3.7. Conservation Strategy

NMFS (2014a, 2014b) and the U.S. Bureau of Reclamation (U.S. Bureau of Reclamation 2014, 2016) identified aquatic habitats in the Trinity and Sacramento River basins located upstream of existing man-made barriers to anadromy as high-quality habitat for proposed listed salmonid species reintroduction efforts. These aquatic habitats include lands managed by SPI. The proposed reintroduction areas were selected for these efforts, because they are within the historic species' range and contain high-quality habitats capable of supporting these efforts. SPI's Conservation Strategy Goals and Objectives reflect this understanding and are designed to maintain and improve this high-quality habitat.

SPL&T's role and overall objective in the HCP/SHA process for these Covered Species is continued maintenance of streams and other wetlands providing cold, clean water to lands in the HCP/SHA Plan Areas and downstream habitats supporting anadromous salmonids.

This section lists the Conservation Strategy Goals and Objectives and how they align with other conservation and recovery strategies. This section also details standard conservation and minimization measures and monitoring activities currently performed to minimize or avoid potential impacts on Covered Species. SPI will monitor the potential impacts of Covered Activities to gauge the effectiveness of the conservation and minimization measures, document compliance with the conservation strategy, and will utilize an adaptive management plan to address uncertainties in HCP implementation. SPI will report results to NMFS annually. The conservation strategy has been designed to fully offset incidental take, and provide a net conservation benefit to Covered Species.

1.3.7.1. Conservation Strategy Goals

The HCP goals are descriptive, open-ended statements of desired future conditions used to guide the conservation strategy. SPL&T's goal is to improve watershed conditions to provide high quality habitat and delivery of flow, sediment, wood, heat, and nutrients at levels that maintain high quality habitat downstream. The HCP goals include:

1. Improve habitat for Covered Species on SPL&T lands.
2. Provide cold, clean water to downstream watersheds supporting anadromous species.
3. Improve riparian habitat structure.
4. Reduce sediment delivery at the planning watershed scale to promote high-quality aquatic habitat.
5. Monitor overall management and aquatic habitat quality performance at five continuous water quality monitoring stations.
6. Enhance watershed resiliency by identifying and implementing projects designed to reduce wildfire behavior, intensity, and magnitude.
7. Improve stream crossings at existing or new roads during post-fire salvage and reforestation.
8. Reduce delivery of sediment from the existing SPI road system.
9. Provide an elevated habitat baseline in the SHA Plan Area supporting NMFS listed salmonid species reintroduction efforts.

1.3.7.2. Objectives

Objectives are the incremental steps taken to achieve a goal. They provide a foundation for determining conservation measures, monitoring, and evaluating the effectiveness of the conservation strategy. SPI's objectives include measures for maintaining standard procedures established by the CFPRs to provide conservation and minimization measures for Covered Activities and proactive improvements outside the CFPRs framework. The HCP objectives include:

1. Improve habitat for Covered Species on SPL&T lands by maintaining or improving fish passage and stream flows, reducing sediment sources; and maintaining or improving conditions providing wood, heat, and nutrients at levels supporting high quality habitats on SPL&T lands and habitats and further downstream.
2. Provide cold, clean water to downstream watersheds supporting anadromous species by maintaining stream shade, limiting diversions caused by road systems, and maintaining stream temperatures.
3. Improve riparian structure and function by assuring natural recruitment processes of riparian vegetation, including hardwoods and conifers, will continue.
4. Identify and reduce sources of suspended sediment from Covered Activities by:
    a. Minimizing stream channel network extension by maintaining existing SPL&T roads in proper function, increasing hydrologic disconnection, constructing new roads meeting CFPRs design and function, upgrading stream crossings, and decommissioning roads no longer required for forest management activities.
    b. Implementing road improvement projects at those locations where new drains and surfacing will have the greatest effect in reducing sediment production and delivery to streams. Use SPI's READI Model to identify sediment sources from road runoff.
5. Provide for reduced watershed impacts from fire by implementing safe practices and creating fuel break networks and participating in multi-stakeholder fuel reduction strategies. An example is SPI's Memorandum of Understanding (MOU) with the USFS, the National Fish and Wildlife Foundation, and CALFIRE to coordinate protection of spotted owl habitat to reduce habitat impacts from large-scale, high-severity wildfire. The MOU also coordinates fire suppression planning and response efforts on federal, state, and SPL&T lands with an emphasis on preserving habitat.
6. Establish SPL&T road systems in each HCP Plan Area watershed that are between 85 to 90 percent hydrologically disconnected by completing the READI Model fieldwork, analysis, and specific site improvements. In the Trinity River basin HCP/SHA Plan Areas, SPI will prioritize road improvements on unstable lands based on the landslide risk assessment results and known or potential distribution of Covered Species. Sacramento River basin HCP/SHA Plan Area lands will be prioritized using the NMFS Core and reintroduction classifications, beginning with Core 1 and Core 2 watersheds, followed by Primary and Candidate classifications.
7. Provide an elevated habitat baseline in the SHA Plan Area supporting NMFS' listed salmonid species reintroduction efforts. SPI will use the READI Model to identify

locations of road and drainage improvement projects. Once implemented, these improvements become permanent features in the SHA Plan Area, regardless of current NMFS reintroduction efforts, resulting in improved, or elevated, habitat conditions.

1.3.8. Beneficial Management Actions (SHA)

In the context of a SHA, the management activities are the actions that result in conservation benefits for the Covered Species. The NMFS/USFWS Safe Harbor Agreement Policy defines management activities as, "*voluntary conservation actions to be undertaken by a property owner that the Services believe will benefit the covered species*." Therefore, the management activities identified in an SHA are the underpinnings that ultimately result in the Net Conservation Benefit.

1.3.8.1. Road Design and Future Best Management Practices (BMPs) Evaluation

SPI will continue using the READI Model to identify sources of sediment from SPL&T road runoff and apply road watercourse crossing BMPs (Weaver *et al.* 2015) to further reduce potential sediment delivery. The READI Model is designed to:

1. Evaluate hydrologic connectivity using a simple hydrologic model that can be calibrated using data on runoff and sediment delivery characteristics;
2. Predict effects of changing conditions on runoff and sediment delivery, such as after wildfire when soil infiltration is reduced, or after changing surfacing or traffic levels;
3. Model scenarios, including predicting where additional road drains can be strategically placed to optimize reductions in road disconnections and sediment delivery, and where road surfacing upgrades can optimize reductions in sediment production;
4. Make predictions capable of being tested, including runoff sediment plume lengths below roads;
5. Use a dimensionless index of road sediment production and delivery where local controls on erosion potential are unknown or where sediment yield predictions are not required or reliable;
6. Link sediment delivery storm intensity and duration to provide a physical basis for calculating road to stream hydrologic connectivity and disconnections; and
7. Utilize geo-referenced locations of topographic drainage sites and engineered drainage structures to increase spatial precision. The READI Model can be applied over a range of spatial scales, such as individual THPs, small watersheds, entire road networks, larger watersheds, and entire land jurisdictions. Detailed and extensive field inspections of all road and drainage structures are required to populate the READI Model data set.

To evaluate the effectiveness of existing road engineering, READI assesses each individual road segment in a road system by using road field survey data to assess each road segment, stream crossing, and their potential to deliver sediment to a watercourse. The values calculated for a single segment have much uncertainty, because of the many factors that influence sediment production and transport. READI can serve as a screening tool to characterize road networks in terms of relative rates of sediment and water delivery to streams and to identify areas for improvement, but field observations are required to determine actual road conditions.

For designing mitigation, the READI Model evaluates road slope, area, surface erodibility, and runoff generation on unpaved roads. The READI Model provides an approximation of on-the ground conditions; however, it often over-predicts annual erosion rates and sediment yields (Surfleet *et al.* 2011). Field validation of model predictions and flexibility are used to determine which best road management practices to apply at each site. Not all on-the-ground site conditions are represented in READI because of its reliance on remote sensing and numerical models.

By examining this background information, SPI derives an implementation strategy designed to bring watershed conditions into similar, 80 percent or greater, percent disconnection ranges. Using percentage of road length disconnection as an implementation goal would be to bring each planning watershed into 80 percent or greater hydrologic disconnection to match the percentage disconnection within the SPI monitoring study watersheds. Once that implementation measure is achieved, then road improvement measures to achieve between 85 to 90 percent hydrologic disconnection of SPL&T forest roads would be implemented during the life of the Plan, with the overall goal of establishing a road system between 85 to 90 percent hydrologically disconnected in each planning watershed.

SPI will complete the READI Model fieldwork and data analysis within the HCP Plan Area during the first three years of the permit period. This schedule will provide benefits to Covered Species within the first 3-5 years of the permit term, as NMFS expects that road improvements will commence within the first year following completion of the READI Model fieldwork and data analysis. Therefore, we expect a reduction in road-related sediment delivery in the HCP/SHA Action Area to begin following the minimum life cycle period for salmonid species (3-years). Road improvements will continue throughout the permit period until reaching the 85 to 90 percent disconnection goal for SPL&T roads.

READI Model fieldwork and data analysis within the HCP Plan Area in planning watersheds that have not been surveyed is currently in progress. SPI will provide updated results in annual monitoring reports upon permit issuance.

SPI will plan and implement road construction and maintenance based on the READI Model results by giving highest priority to locations that would provide the greatest conservation benefit based on the following criteria. In the Trinity River basin HCP/SHA Plan Areas, SPI will give highest priority to implementing road improvements on unstable lands based on the landslide risk assessment results and watersheds occupied by Covered Species. Improvements in the Sacramento River basin HCP/SHA Plan Areas will be prioritized using the NMFS Recovery Plan guidelines (NMFS 2014a). Core and reintroduction classifications, beginning with Core 1 and Core 2 watersheds, followed by Primary and Candidate classifications.

SPI will initiate READI Model fieldwork, data analysis, and project implementation in the SHA Plan Area following permit issuance and upon notification from NMFS that reintroduction efforts will occur. SPI understands that NMFS will notify SPI once NMFS determines specifically when and where reintroduction tasks will begin. Upon notification, SPI will initiate planning efforts to perform READI in the appropriate watersheds selected for reintroduction efforts. SPI will complete the READI Model fieldwork and data analysis within these areas during the first three years of the permit period. The READI Model results in the SHA Plan Area will be included in annual monitoring reports.

1.3.8.2. Salmonid Reintroduction

As part of the mitigation for the Covered Activities included in the HCP, SPL&T supports Chinook and coho salmon and steelhead reintroduction to the SHA Plan Area per the NMFS species recovery plans (NMFS 2014a, 2014b). Central Valley Chinook salmon and steelhead are proposed to be reintroduced to the Sacramento River above the Shasta Dam; the McCloud River; Battle Creek, downstream from Whispering falls and Angel Falls; and the Yuba River upstream of Englebright Dam. SONCC coho salmon are proposed to be reintroduced to Stuart's Fork, (upper) Trinity River, and East Fork Trinity River, above the Trinity Dam and reservoir.

SPI will support these reintroduction efforts by maintaining or improving aquatic habitats in the reintroduction areas by reducing potential sediment delivery using the READI Model. SPI will also conduct road improvement projects to establish SPL&T road systems that are between 85 and 90 percent hydrologically disconnected at the planning watershed scale. Other activities include enhancing watershed resiliency by identifying and implementing projects designed to reduce wildfire behavior, intensity, potential and magnitude and improving stream crossings at existing or new roads during post-fire salvage and reforestation. These improvements will provide an elevated habitat baseline in the SHA Plan Area upon completion, regardless of NMFS' continued reintroduction efforts in the future. Additionally, SPI will support NMFS' reintroduction efforts by providing physical access to SHA Plan Area lands and related items such as specific access information, maps, gate key/combination information, physical escort, and relevant existing data.

1.3.9. Elevated Baseline Conditions (SHA)

The Elevated Baseline Conditions are Baseline Conditions that are improved as a result of implementing the Beneficial Management Activities described in the SHA (also see Section 1.3.8 above). The SHA describes the current Baseline Conditions on the Enrolled Property. SPI and NMFS have agreed that the Elevated Baseline Conditions are the improved riparian and habitat conditions resulting from the proposed forest road improvements (*i.e.*, READI Model implementation) and the support of ESA-listed species reintroduction efforts proposed by NMFS.

1.3.10. Net Conservation Benefit (SHA)

SPL&T will provide a net conservation benefit within the SHA Plan Area by maintaining or improving aquatic habitats within and downstream of the Plan Areas and by supporting reintroduction efforts. All proposed recovery actions described in the species recovery plans are collectively linked and include efforts below and above currently impassable barriers to anadromous fish. The conservation measures included in the HCP and SHA Plan Areas contribute to recovery efforts above and below these barriers. Salmonid reintroductions are designed to restore Central Valley Chinook salmon and steelhead, and SONCC coho salmon, to historical habitat in the Sacramento River and the Trinity River watersheds. These reintroductions will contribute to recovery efforts addressing several limiting factors identified in salmonid recovery plans, including:

- Keswick and Shasta dams blocking access to habitat historically used by ESA-listed salmonids in the upper Sacramento River watershed
- Passage impediments and flow fluctuations resulting from hydropower operations on the North and South Forks of Battle Creek
- Englebright Dam blocking access to habitat historically used by Yuba River ESA-listed salmonids
- Lewiston and Trinity Dams blocking access to habitat historically used by Upper Trinity River ESA-listed salmonids

These reintroductions also assist recovery plan objectives for Central Valley Chinook salmon and steelhead by contributing towards the following Diversity Group characteristics, which are necessary for these ESUs/DPS to achieve recovery:

- Sacramento River winter-run Chinook salmon ESU
    - Three populations in the Basalt and Porous Lava Diversity Group at low risk of extinction
- Central Valley spring-run Chinook salmon ESU
    - One population in the Northwestern California Diversity Group at low risk of extinction
    - Two populations in the Basalt and Porous Lava Diversity Group at low risk of extinction
    - Four populations in the Northern Sierra Diversity Group at low risk of extinction
    - Maintain multiple populations at moderate risk of extinction
- California Central Valley steelhead DPS
    - One population in the Northwestern California Diversity Group at low risk of extinction
    - Two populations in the Basalt and Porous Lava Flow Diversity Group at low risk of extinction
    - Four populations in the Northern Sierra Diversity Group at low risk of extinction
    - Maintain multiple populations at moderate risk of extinction

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

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

2.1. Analytical Approach

This section describes the analytical approach used by NMFS to evaluate the likely effects of the proposed action on listed species under NMFS jurisdiction and critical habitat designated for those species. The approach is intended to ensure that NMFS comports with the requirements of the statute and regulations when conducting and presenting the analysis.

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

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

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBFs to mean PCEs or essential features, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44976, 44977), that definition does not change the scope of our analysis and in this opinion we use the terms "effects" and "consequences" interchangeably.

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

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the

likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2. Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each Covered Species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the Covered Species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

Table 1. Description of Covered Species, Current ESA Listing Classifications, and Summary of Species Status.

Species	Listing Classification and Federal Register Notice	Status Summary
Sacramento River winter-run Chinook salmon ESU	Endangered, 70 FR 37160; June 28, 2005	According to the NMFS 5-year species status review (NMFS 2016c), the status of the winter-run Chinook salmon ESU, the extinction risk has increased from moderate risk to high risk of extinction since the 2007 and 2010 assessments. Based on the Lindley *et al.* (2007) criteria, the population is at high extinction risk in 2019. High extinction risk for the population was triggered by the hatchery influence criterion, with a mean of 66 percent hatchery origin spawners from 2016 through 2018. Several listing factors have contributed to the recent decline, including drought, poor ocean conditions, and hatchery influence. Thus, large-scale fish passage and habitat restoration actions are necessary for improving the winter-run Chinook salmon ESU viability.
Central Valley spring-run Chinook salmon ESU	Threatened, 70 FR 37160; June 28, 2005	According to the NMFS 5-year species status review (NMFS 2016b), the status of the CV spring-run Chinook salmon ESU, until 2015, has improved since the 2010 5-year species status review. The improved status is due to extensive restoration, and increases in spatial structure with historically extirpated populations (Battle and Clear creeks) trending in the positive direction. Recent declines of many of the dependent populations, high pre-spawn and egg mortality during the 2012 to 2016 drought, uncertain juvenile survival during the drought are likely increasing the ESU's extinction risk. Monitoring data showed sharp declines in adult returns from 2014 through 2018 (CDFW 2018).

Species	Listing Classification and Federal Register Notice	Status Summary
California Central Valley steelhead DPS	Threatened, 71 FR 834; January 5, 2006	According to the NMFS 5-year species status review (NMFS 2016a), the status of CCV steelhead appears to have remained unchanged since the 2011 status review that concluded that the DPS was in danger of becoming endangered. Most natural-origin CCV populations are very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to natural-origin fish. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead.

Species	Listing Classification and Federal Register Notice	Status Summary
Upper Klamath/Trinity Rivers (UKTR) Chinook salmon ESU	On February 27, 2018, NMFS published a 90-day finding on a petition to list the UKTR Chinook salmon ESU as endangered or threatened or alternatively to create a new ESU to describe Klamath spring-run Chinook and list it as endangered or threatened (83 FR 8410). Based on the information included in Petitioners' filing, NMFS found that the petitioned action may be warranted. Therefore, in accordance with section 4(b)(3)(A) of the ESA and NMFS' implementing regulations (50 CFR 424.14(h)(2)), NMFS has commenced a status review of the UKTR Chinook salmon ESU (currently underway).	The UKTR Chinook salmon ESU includes all naturally spawned populations of Chinook salmon in the Klamath River basin, upstream from the confluence of the Klamath and Trinity rivers. The UKTR Chinook salmon ESU is genetically distinguishable from other California Chinook ESUs (Waples *et al.* 2004). Although fall-run and spring-run Chinook salmon are both part of this ESU, the two runs are treated as separate taxa due to the distinctive adaptive life histories characterized by each group. NMFS completed the first status review for UKTR Chinook salmon in 1998 (Myers *et al.* 1998). Based on the information in the status review, NMFS determined that the UKTR Chinook salmon ESU was not at a significant risk of extinction, nor was it likely to become endangered in the foreseeable future, and therefore did not warrant listing under the ESA (63 FR 11482; March 9, 1998). On January 28, 2011, the Secretary of Commerce received a petition to list UKTR Chinook salmon under the ESA and designate critical habitat. NMFS made a positive 90-day finding, conducted a status review, and made a 12-month not warranted finding on the petitioned actions (77 FR 19597; April 2, 2012). In reaching the not warranted conclusion, NMFS confirmed the earlier finding that spring-run and fall-run Chinook salmon in the UKTR Basin constitute a single ESU and concluded that the overall extinction risk of the ESU was considered to be low over the subsequent 100 years. UKTR spring-run Chinook are considered a Species of Special Concern by CDFW (2015). Genetic risk from low populations and interaction with Trinity River Hatchery fish, climate change impacts, and anthropogenic threats affect UKTR spring-run Chinook salmon and make them vulnerable. UKTR fall-run Chinook are not in immediate danger of extinction, although their numbers have declined in recent decades. There is increasing reliance on hatcheries to maintain fisheries and hatchery production may be masking a decline of wild production in the Klamath-Trinity basins, which does not bode well for the longer-term persistence of wild salmon stocks (Quiñones 2011). They are managed by CDFW for sport and ocean fisheries, and by PFMC for tribal, ocean sport, and commercial fisheries.

Species	Listing Classification and Federal Register Notice	Status Summary
Klamath Mountain Province (KMP) steelhead DPS	Listing was found not warranted in 1995 (60 FR 14253) and again in 2001 (66 FR 17845).	KMP steelhead occur in the Klamath/Trinity River basin and streams north to the Elk River in Oregon, including the Smith River (California) and Rogue River (Oregon). The DPS is listed as a species of high concern by CDFW and appears to be undergoing a long-term decline (Moyle *et al.* 2015). Stream-maturing forms (mostly summer steelhead) are more limited in distribution and face a higher likelihood of near-term extinction than ocean-maturing forms (winter steelhead). The original KMP steelhead ESU (now DPS) was first determined to be "not warranted" for listing under the federal ESA by NMFS in March 1998.
Southern Oregon/Northern California Coast (SONCC) coho salmon ESU	Threatened, 70 FR 37160; June 28, 2005	Although long-term data on coho salmon abundance are scarce, the available evidence from short-term research and monitoring efforts indicate that spawner abundance has declined since the last status review for populations in this ESU (Williams *et al.* 2016). Coho salmon abundance, including hatchery stocks, has declined at least 70% since the 1960s, and is currently 6 to 15% of the population observed during the 1940s (CDFW 2004). Most of the 30 independent populations in the ESU are at high risk of extinction because they are likely below their depensation threshold, which can be thought of as the minimum number of adults needed for survival of a population. The distribution of SONCC coho salmon within the ESU is reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which SONCC coho salmon are now absent (NMFS 2001, Good *et al.* 2005, Williams *et al.* 2011, Williams *et al.* 2016). Extant populations can still be found in all major river basins within the ESU (70 FR 37160; June 28, 2005). However, extirpations, loss of brood years, and sharp declines in abundance (in some cases to zero) of SONCC coho salmon in several streams throughout the ESU indicate that the SONCC coho salmon's spatial structure is more fragmented at the population-level than at the ESU scale. The genetic and life history diversity of populations of SONCC coho salmon is likely very low and is inadequate to contribute to a viable ESU, given the significant reductions in abundance and distribution.

Table 2. Description of Critical Habitat, Listing, and Status Summary.

Critical Habitat	Designation Date and Federal Register Notice	Description
Sacramento River winter-run Chinook salmon ESU	June 16, 1993; 58 FR 33212	Designated critical habitat includes the Sacramento River from Keswick Dam (river mile (RM) 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta (Delta); all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge from San Pablo Bay to the Golden Gate Bridge. The designation includes the river water, river bottom and adjacent riparian zones used by fry and juveniles for rearing. PBFs considered essential to the conservation of the species include: Access from the Pacific Ocean to spawning areas; availability of clean gravel for spawning substrate; adequate river flows for successful spawning, Incubation of eggs, fry development and emergence, and downstream transport of juveniles; water temperatures at 5.8–14.1°C (42.5–57.5°F) for successful spawning, egg incubation, and fry development; riparian and floodplain habitat that provides for successful juvenile development and survival; and access to downstream areas so that juveniles can migrate from spawning grounds to the San Francisco Bay and the Pacific Ocean. Although the current conditions of PBFs for SR winter-run critical habitat in the Sacramento River are significantly limited and degraded, the habitat remaining is considered highly valuable.

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

Critical Habitat	Designation Date and Federal Register Notice	Description
Southern Oregon/Northern California Coast coho salmon	May 5, 1999; 64 FR 24049	Critical habitat for the SONCC coho salmon ESU encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between Cape Blanco, Oregon and Punta Gorda, California (64 FR 24049; May 5, 1999). In designating critical habitat for the SONCC coho salmon ESU, NMFS identified the following five essential habitat types (PBFs): (1) juvenile summer and winter rearing areas; (2) juvenile migration corridors; (3) areas for growth and development to adulthood; (4) adult migration corridors; and (5) spawning areas. Within these areas, essential features of coho salmon critical habitat include adequate: (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions (64 FR 24049 (May 5, 1999)). The condition of SONCC coho salmon critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations.

2.2.1. NMFS Recovery Plans

In July 2014, NMFS released a final Recovery Plan (NMFS 2014a) (CV Recovery Plan) for Central Valley spring-run Chinook salmon, Sacramento River winter-run ESU Chinook salmon, and California Central Valley steelhead. The CV Recovery Plan identified population groups (hereafter referred to as diversity groups), which are delineated based on climatological, hydrological, and geographic characteristics, and reflect the historical distribution of each species. Populations in rivers and streams within these diversity groups are placed into Core categories. Cores are population categories (1, 2, or 3) assigned by NMFS. The three Core categories are based on their potential to support the recovery of the winter-run Chinook salmon ESU, the spring-run Chinook salmon ESU or the steelhead DPS as dependent populations (Core 2 and Core 3) with low extinction risk in the Sacramento River basin (Core 1). Additionally, the CV Recovery Plan classifies rivers and streams within these diversity groups currently outside anadromy limits as Primary, Candidate, or Non-candidate based on their priority for spring-run Chinook salmon or steelhead reintroduction. The CV Recovery Plan identifies recovery criteria and specific recovery actions for these species within each diversity group.

The National Marine Fisheries Service also released a Final Recovery Plan for the SONCC ESU Coho salmon during 2014 (NMFS 2014b) (Coho Recovery Plan). Similar to the CV Recovery Plan, the Coho Recovery Plan classified the species by ESUs and developed recovery criteria, goals, and actions for each ESU.

Table 3. NMFS Recovery and Reintroduction Classifications in the HCP and SHA Plan Areas.

Diversity Group	River, Creek, or Sub-reach	Classification	HCP or SHA Plan Area	SPL&T Stream Ownership (miles)	SPL&T Stream Ownership of Anadromous Waters (miles)
Basalt and Porous Lava	Battle Creek	Core 1	HCP Plan Area	11.00	0.00
Basalt and Porous Lava	Little Sacramento River (upper Sacramento River)	Candidate	SHA Plan Area	3.83	N/A
Basalt and Porous Lava	McCloud River	Primary	SHA Plan Area	0.00	N/A
Northwestern California	Cottonwood/ Beegum	Core 2	HCP Plan Area	4.42	0.43
Northern Sierra Nevada	Middle Yuba River (above Englebright Dam)	Primary	SHA Plan Area	5.71	N/A
Northern Sierra Nevada	South Yuba River (above Englebright Dam)	Candidate	SHA Plan Area	0.53	N/A
Northern Sierra Nevada	Butte Creek	Core 1 and Core 2	HCP Plan Area	16.06	0.00
Northern Sierra Nevada	Big Chico	Core 2	HCP Plan Area	18.76	0.00
Northern Sierra Nevada	Deer Creek	Core 1	HCP Plan Area	0.80	0.77
Northern Sierra Nevada	Mill Creek	Core 1	HCP Plan Area	3.08	3.08
Northern Sierra Nevada	Antelope Creek	Core 2	HCP Plan Area	15.05	5.43

2.2.2. Global Climate Change

Climate change is a major factor affecting the rangewide status of the threatened and endangered anadromous fish in the California's Central Valley and Klamath Mountains. Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen *et al.* 2000). Climate change effects on stream temperatures within northern California are already apparent. For example, in the Klamath River, to which the Trinity River is the major tributary, Bartholow (2005) observed a 0.5°C per decade increase in water temperature since the early 1960's, and model simulations predict a further increase of 1- 2°C over the next 50 years (Perry *et al.* 2011). Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). In the Central Valley, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 14°C to 19°C (57°F to 66°F).

Projected warming is expected to affect Central Valley Chinook salmon and steelhead. Because the runs are restricted to low elevations as a result of impassable rim dams, if climate warms by 5°C (9°F), it is questionable whether any Central Valley Chinook salmon populations can persist (Williams 2006). In the winter-run Chinook salmon, the embryonic and larval life stages that are most vulnerable to warmer water temperatures occur during the summer, so this run is particularly at risk from climate warming. Spring-run Chinook salmon adults are vulnerable to climate change, because they over-summer in freshwater streams before spawning in autumn (Thompson *et al.* 2012). Steelhead also are particularly vulnerable to climate change due to their need for year-round cool water temperatures (Moyle 2002).

In coastal and estuarine ecosystems, the threats from climate change largely come in the form of sea level rise and the loss of coastal wetlands. Sea levels will likely rise exponentially over the next 100 years, with possibly a 29-110 centimeter rise by the end of the 21st century (IPCC 2019). This rise in sea level will alter the habitat in estuaries and either provides an increased opportunity for feeding and growth or in some cases will lead to the loss of estuarine habitat and a decreased potential for estuarine rearing. Marine ecosystems face an entirely unique set of stressors related to global climate change, all of which may have deleterious impacts on growth and survival while at sea. In general, the effects of changing climate on marine ecosystems are not well understood given the high degree of complexity and the overlapping climatic shifts that are already in place (*e.g.*, El Niño, La Niña, and Pacific Decadal Oscillation) and will interact with global climate changes in unknown and unpredictable ways. Overall, climate change is believed to represent a growing threat, and will challenge the resilience of listed salmonids in northern California.

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

2.3. Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The HCP Handbook (USFWS and NOAA 2016) defines the Plan Area as all areas that will be used for any activities described in the HCP, including Covered Activities and the Conservation Strategy. The HCP and SHA each have defined Plan Areas and Action Areas as described below and shown in Figure 1 and Figure 2 below. The Plan Areas includes lands owned by SPL&T where SPI forest management Covered Activities are proposed. The Action Areas include the Plan Areas and adjacent lands affected by Covered Activities in the Plan Areas.

2.3.1. HCP Plan Area

The HCP Plan Area includes all SPL&T lands in planning watersheds (*i.e.*, watersheds within the HCP Plan Area) currently within the known limits of anadromy. SPL&T owns approximately 355,061 acres within these watersheds (Figure 1). All planning watersheds within the current limits of anadromy are subject to the ASP rules of the CFPRs. Portions of watersheds that are immediately upstream of areas accessible to anadromous salmonids are included under ASP rules because of potential effects on water quality downstream.

2.3.2. HCP Action Area

The HCP Action Area comprises areas within planning watersheds in the upper Trinity River basin and the Sacramento River basin currently accessible to anadromous salmonids in which SPL&T owns lands and conducts Covered Activities. The HCP Action Area includes lands within these watersheds likely to be affected by activities in the HCP Plan Area and is used to establish context and the evaluation area for potential impacts of the Covered Activities occurring on SPL&T lands. We define potentially affected lands as planning watersheds in which SPL&T own lands, and the adjacent upstream and downstream planning watersheds.

The HCP includes all activities described in this document, including Covered Activities and conservation strategy, within these lands. We expect the extent of effects resulting from the Covered Activities to extend up to 1 mile downstream, with the greatest extent of effects resulting from sediment-related impacts. The ITP coverage is not extended to other land ownerships in the HCP Action Area. The HCP Action Area occurs within 159 planning watersheds covering approximately 1,459,900 acres in the Sacramento River and Trinity River basins (Figure 2).

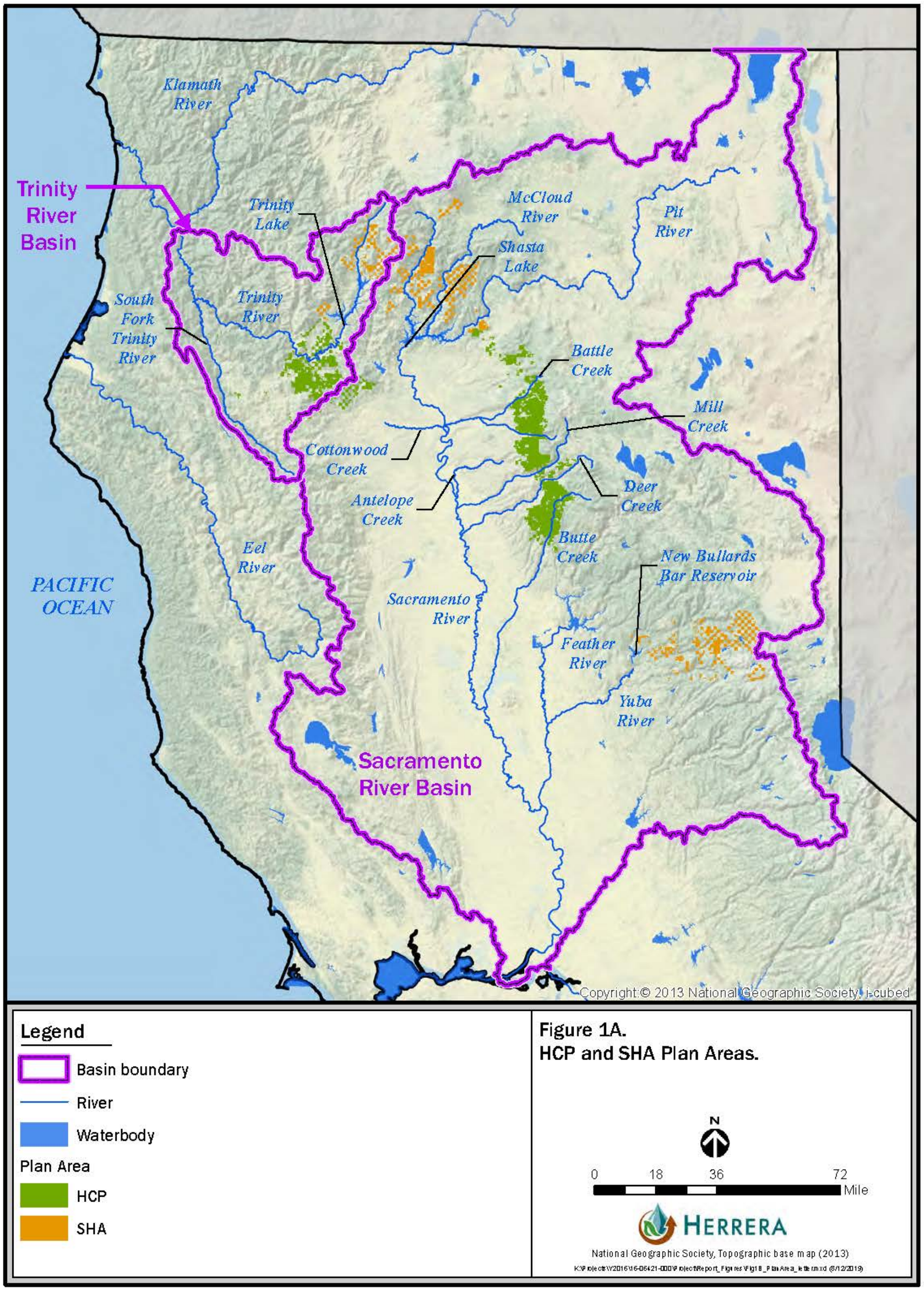

Figure 1. HCP and SHA Plan Areas

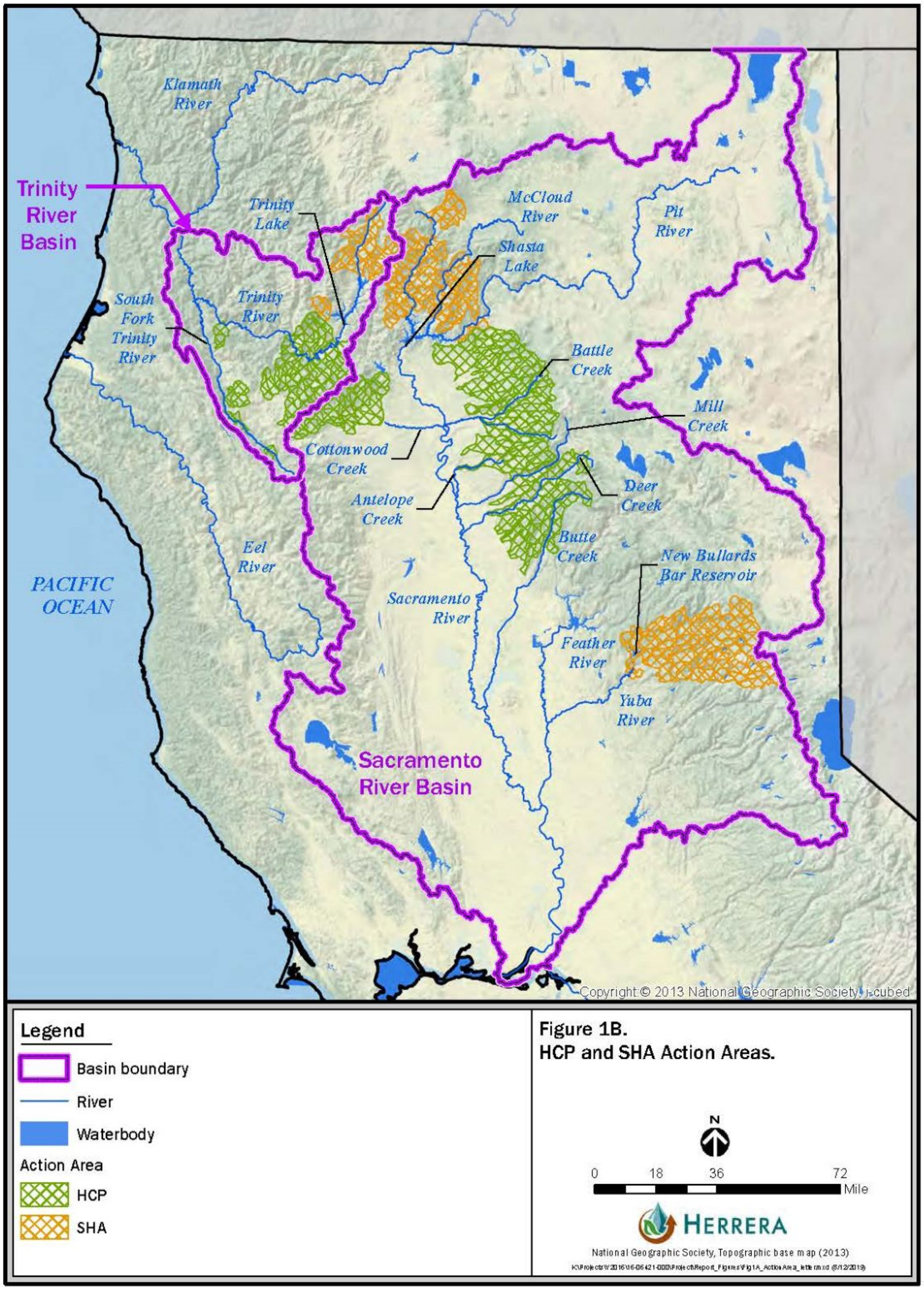

Figure 2. HCP and SHA Action Areas

2.3.3. SHA Plan Area

The SHA Plan Area includes all SPL&T lands in planning watersheds outside the current limits of anadromy in which salmonid reintroductions are proposed. These watersheds are within historically occupied habitat and above currently impassable barriers to anadromy.
The SHA Plan Area includes all SPL&T lands within the SHA Action Area. SPL&T owns approximately 211,824 acres within these watersheds (Figure 1). These planning watersheds are above the current limits of anadromy and not subject to the ASP rules; however, they are managed under the standard CFPRs. The SHA Plan Area includes: (1) SPL&T lands that will be accessible to reintroduced salmonids, and (2) other SPL&T lands that are upstream of the estimated upper limit of anadromy, which are included in the SHA Plan Area, because of potential downstream impacts on water quality associated with Covered Activities.

2.3.4. SHA Action Area

SPL&T proposes to support ESA-listed salmonid reintroduction in watersheds with SPL&T ownership above several man-made barriers in the Trinity River and Sacramento River basins consistent with NMFS reintroduction efforts.

The SHA Action Area comprises 130 planning watersheds currently inaccessible to anadromous salmonids in which SPL&T owns lands and conducts activities. The SHA Action Area includes all ownerships within these watersheds and is used to establish context and the evaluation area for potential impacts of the Covered Activities occurring on SPL&T lands. The SHA incorporates all activities described in this document, including Covered Activities and the Conservation Strategy, within these lands. The ESP coverage is not extended to other land ownerships in the SHA Action Area.

The 130 planning watersheds included in the SHA Action Area occur within approximately 1,057,266 acres in the Sacramento River and Trinity River basins (Figure 2). The specific watersheds targeted for NMFS reintroduction efforts occur in the Upper Sacramento River, the McCloud River, Battle Creek (downstream from the HCP Plan Area), the North, Middle, and South Yuba Rivers, and Stuart’s Fork, Trinity River (upstream from Trinity Reservoir), and East Fork Trinity River.

2.4. Environmental Baseline

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

The "environmental baseline" described in the ESA Section 7 analysis is distinct from the agreed upon Elevated Baseline Conditions in the SHA under Section 10 of the ESA (see Section 1.3.9 *Elevated Baseline Conditions (SHA)*).

2.4.1. Status of Covered Species and Critical Habitat in the HCP Action Area

Salmonid populations in the HCP Action Area follow a similar pattern of decline as other salmonid populations along the West Coast. The following sections describe the status of the Covered Species and their designated critical habitat (if applicable) within the HCP Action Area, including a description of any limiting factors affecting the species and their habitat.

Table 4. Distribution of Covered Species and Habitat within the HCP Action Area.

ESU or DPS	Watersheds with Anadromous Stream Habitat Present on SPL&T Lands	Watersheds with No Anadromous Stream Habitat Present on SPL&T Lands[1]
Central Valley fall- and late fall-run Chinook salmon ESU	Cottonwood Creek, Cow Creek, Deer Creek, Mill Creek	Battle Creek, Bear Creek, Big Chico Creek, Butte Creek, Clear Creek, Paynes Creek
Central Valley spring-run Chinook salmon ESU	Antelope Creek, Cottonwood Creek, Cow Creek, Deer Creek, Mill Creek	Battle Creek, Big Chico Creek, Butte Creek, Clear Creek,
Sacramento River winter-run Chinook salmon ESU	N/A	Battle Creek
California Central Valley steelhead DPS	Antelope Creek, Cottonwood Creek, Cow Creek, Deer Creek, Mill Creek,	Battle Creek, Big Chico Creek, Butte Creek, Clear Creek, Paynes Creek
Upper Klamath/ Trinity Rivers Chinook salmon ESU	Hayfork Creek, Trinity River, South Fork Trinity River	N/A
Southern Oregon/ Northern California Coast (SONCC) coho salmon ESU	Middle Hydrologic Area (HA), South Fork Trinity River HA, Lower Trinity River HA	N/A
Klamath Mountains Province steelhead DPS	Trinity River, Trinity River tributaries	N/A

[1]SPL&T lands in these watersheds are located upstream from the upper limits of anadromy or in tributaries not accessible to anadromous salmonids. Effects of Covered Activities may extend downstream into Anadromous Stream Habitat.

2.4.1.1. Sacramento River Basin

ESA-listed anadromous fish species in the Sacramento River basin HCP Action Area include Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and California Central Valley steelhead. Non-listed anadromous fish species in the Sacramento River basin HCP Action Area include Central Valley fall- and late fall-run Chinook salmon. The proportions of planning watersheds with SPL&T ownerships and the distance from SPL&T lands to known and presumed limits of anadromy are summarized in the HCP/SHA (Appendix B, Table B-1 in the HCP/SHA). In most planning watersheds, the HCP Plan Area is not accessible to anadromous fish, but water quality in streams emanating from, or passing through the HCP Plan Area may affect salmonids in the HCP Action Area further downstream.

2.4.1.1.1. Sacramento River winter-run Chinook salmon

Adult winter-run Chinook salmon begin their upstream migration through the Sacramento/San Joaquin Delta in December and continue through July with a peak occurring between the months of December and April (NMFS 2014). Adult winter-run Chinook salmon return from the ocean prior to reaching full sexual maturity and hold in the Sacramento River for several months before spawning while they mature. Currently, the spawning range of winter-run Chinook salmon is confined to the Sacramento River between Red Bluff Diversion Dam (RBDD) (RM 243) and Keswick Dam (RM 302) (Vogel and Marine 1991; NMFS 2014). Historically, spawning likely occurred upstream of Shasta Dam in spawning reaches which are no longer accessible to anadromous fish (Yoshiyama *et al.* 1998), as well as in an upper tributary to the Sacramento River, Battle Creek (Lindley *et al.* 2004).

Currently, the Sacramento River winter-run Chinook salmon do not use the HCP Action Area for any life history stage. Natural spawning is restricted to the Sacramento River downstream of the Keswick Dam (NMFS 2014a) and Battle Creek below Eagle Canyon Dam. Both areas are outside of the HCP Action Area. The Sacramento River below Keswick Dam is precarious, because limited supplies of cold water in Lake Shasta can be insufficient for winter-run Chinook salmon in critically dry or consecutively dry years (Reynolds *et al.* 1993; NMFS 2014a; Williams *et al*. 2016). The current situation could change if the winter-run Chinook salmon were reintroduced into former habitat above dams on the Sacramento River and tributaries. SPL&T owns forestlands in watersheds where such reintroductions might occur.

Sacramento River winter-run Chinook salmon use the lower reaches of Battle Creek for adult spawning, juvenile rearing, and foraging, though the Eagle Canyon Dam on Battle Creek blocks access to historical spawning grounds. The upper portion of Battle Creek is within the HCP Action Area, above areas where winter-run Chinook salmon may spawn. Battle Creek is subject to a large restoration effort for salmonid species including Sacramento River winter-run Chinook salmon, spring-run Chinook salmon, and steelhead (https://www.usbr.gov/mp/battlecreek/index.html).

In 2017, the USFWS, NMFS, and CDFW, collectively made the decision to spawn winter-run Chinook salmon captive broodstock at Livingston Stone National Fish Hatchery and release their offspring into Battle Creek (USFWS 2017; USFWS 2018), thereby accelerating and modifying the planned process of reintroducing winter-run Chinook salmon to that watershed. This decision was prompted by a severe multi-year drought in California's Central Valley, which significantly decreased natural reproduction of winter-run Chinook salmon in the Sacramento River for two consecutive years. Captive broodstock progeny were first released into Battle Creek during the spring of 2018 (brood year 2017). This action initiated the reintroduction of winter-run Chinook salmon to historic spawning and rearing habitats in the watershed. The 'Jumpstart Project' moniker has become the commonly accepted name for referring to this fast-tracked approach to the reintroduction process. 2019 marked the first year of adult (2-year olds or "jacks") returns to Battle Creek resulting from the juvenile releases that occurred during 2018. During 2020, at least 700 sub-adult and adult winter-run Chinook salmon returned to Battle Creek. These returns were higher than expected, as there was an anticipation to see 500-600 adult fish return during 2020 (USFWS 2020). Although the restoration actions in Battle Creek are not complete and fish are limited to the habitat that is available below Eagle Canyon Dam, it was demonstrated that there is adequate habitat for adult spawning and the successful production of juveniles through redd surveys and juvenile monitoring.

Critical Habitat

Critical habitat for Sacramento River winter-run Chinook salmon was designated in 1993 (58 FR 33212). Sacramento River winter-run Chinook salmon are affected by forest management and timber operation activities that affect water quality (temperature, suspended sediment, turbidity), hydrology (low flow), and available diverse habitat (large wood recruitment). Currently, Sacramento River winter-run Chinook salmon do not use the HCP Action Area for any life history stage. Additionally, there is no overlap between winter-run Chinook salmon critical habitat and the HCP Action Area and SHA Action Areas.

2.4.1.1.2. Central Valley spring-run Chinook salmon

Adult spring-run Chinook salmon enter the San Francisco estuary to begin their upstream spawning migration in late January and early February (CDFG 1998). They enter the Sacramento River between March and September, primarily in May and June (Yoshiyama *et al.* 1998; Moyle 2002). Generally, adult spring-run Chinook salmon are sexually immature when they enter freshwater habitat and must hold in cool, deep pools for up to several months in preparation for spawning in September (Moyle 2002). Currently, the majority of returning adult Central Valley spring-run Chinook salmon in this ESU spawn in the tributaries to the Sacramento River. The Sacramento River mainly functions as both rearing habitat for juveniles and the primary migratory corridor for outmigrating juveniles and spawning adults for all the Sacramento River basin populations. The juvenile life stage of Central Valley spring-run Chinook salmon exhibits varied rearing behavior and outmigration timing. Juveniles may reside in freshwater for 12–16 months (these individuals are characterized as "yearlings"), while some may migrate to the ocean as young-of-the-year (NMFS 2014).

Central Valley spring-run Chinook salmon adults are vulnerable to climate change because they over-summer in freshwater streams before spawning in autumn (Thompson *et al.* 2011). Spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and without cold water refugia (usually input from springs), those tributaries will be more susceptible to impacts of climate change. Even in tributaries with cool water springs, in years of extended drought and warming water temperatures, unsuitable conditions may occur. Additionally, juveniles often rear in their natal stream over the summer prior to emigrating (McReynolds *et al.* 2007) and would be susceptible to warming water temperatures.

Of the historical 18 independent populations of Central Valley spring-run Chinook salmon, four are currently considered independent: Battle, Deer, Mill, and Butte Creeks (Williams *et al.*

2016). The remaining Sacramento River region populations have had very low returns, often zero or near zero since 2007, and are considered dependent (Williams *et al.* 2016). Central Valley spring-run Chinook salmon have been documented in the mainstem Sacramento River and the Feather River, but population sizes have been difficult to determine due to the lack of spatial separation with fall-run Chinook salmon in these systems. This lack of spatial overlap during spawning results in redd superimposition and hybridization between the two runs. In addition, millions of spring-run Chinook salmon have been propagated at the CDFW hatchery on the Feather River, which began operation in the mid-1960s (NMFS 2014a). As of 1998, most of those hatchery fish had been released outside of the Feather River basin (Myers *et al.* 1998, Williams *et al.* 2016). These release practices increased the potential for hatchery fish to stray from the Feather River and interbreed with fish from naturally spawning populations, reducing genetic diversity; however, since 2014 the Feather River Hatchery has released spring-run Chinook salmon juveniles into the Feather River (Williams *et al.* 2016).

Loss of historical spawning and rearing habitat remains a limiting factor to spring-run Chinook salmon, as these areas are still inaccessible due to dams. Since the ESU was listed, limited spawning habitat expansion has occurred compared to the amount of historical habitat loss. Notable exceptions include the removal of the Saeltzer Dam on Clear Creek in 2000, which opened 10 miles of habitat; repair of a partial low flow barrier on Cottonwood Creek in 2010, which improved access to 30 miles of habitat; and removal of the Wildcat Dam in 2010, which improved access to three miles of North Fork Battle Creek below Eagle Canyon Dam (Williams *et al.* 2016).

Due to the presence of large dams in major river systems limiting habitat access throughout the Central Valley, the largest Central Valley spring-run Chinook salmon ESU populations in the HCP Action Area are currently limited to Butte, Mill and Deer Creeks (Williams *et al.* 2016). Small populations also occur in Antelope, Battle, Big Chico, Clear, Cottonwood, and Cow Creeks (Williams *et al.* 2016).

Butte Creek originates in the Jonesville Basin and drains approximately 800 square miles (512,000 acres) of northeastern Butte County (NMFS 2014a). The stream is considered one of the most important Sacramento Valley streams for fish, particularly for spring-run Chinook salmon. Butte Creek historically supported a self-sustaining population of spring-run Chinook salmon despite being at somewhat low elevation (all spawning occurs below 300 meters) and having rather warm summer water temperatures (exceeding 20°C in 2002 in the uppermost and coolest reach) (Lindley *et al.* 2004). In recent years, inflows to Butte Creek from the upper West Branch Feather River deliver cold water that help support Central Valley spring-run Chinook salmon. The cold water import from the West Branch Feather River helps spring-run Chinook salmon to over summer, spawn, and successfully occupy Butte Creek.

Central Valley spring-run Chinook salmon use Mill Creek for spawning, rearing, and migration (NMFS 2014a). Mill Creek is essentially undammed, with only two low irrigation diversions operated by the Los Molinos Mutual Water Company. Both diversion dams are designed to allow passage for migrating fish during high flows and have fish ladders for low flow conditions (Mill Creek Conservancy 2017). There are no physical passage barrier limits to the upstream migration of adult salmonids; however, the combined effect of higher stream gradients and lower stream flows can restrict access to the headwater reaches, which extends to near Morgan Hot Springs, approximately three miles downstream of Lassen Volcanic National Park (Armentrout *et al.* 1998). Beginning in the early 2000s, and until at least 2005, stream flows have been augmented through a water exchange program to improve upstream passage for spring-run Chinook salmon (CalWater 2005). Population estimates conducted since 1947 show a decline in returns in recent years. Prior to 1990s, the average run size was approximately 1,200; since the early 1990s, the average run size has been around 400 (Heiman and Knecht 2010).

In Deer Creek, Central Valley spring-run Chinook salmon spawning extends from Upper Falls downstream nearly 30 miles, but the distribution of spawning can vary based on water temperature and the amount of runoff (Armentrout *et al.* 1998). A fish ladder built in 1943 provided passage above the Lower Falls to an additional five miles of habitat, which is now used for adult holding, rearing and spawning. A second fish ladder was built over Upper Falls in the early 1950s, but is not operational (NMFS 2014a).

Although not considered separate extant viable populations, Central Valley spring-run Chinook salmon use Antelope Creek, Battle Creek, Big Chico Creek, Clear Creek, Cottonwood Creek, and Cow Creek for spawning and rearing in low numbers (Williams *et al.* 2016).

Historically, Antelope Creek supported spring-run Chinook salmon (Reynolds *et al.* 1993); however, at least until 2009, the operation of two water diversions during irrigation season impeded or prevented the upstream migration of spring-run in low-flow years (Chappell 2009). Spring-run Chinook salmon spawning occurs in approximately 16 miles of the Antelope Creek watershed from upstream of Judd Creek on the North Fork, to Buck's Flat on the South Fork, downstream to approximately Facht Place on the mainstem (Armentrout *et al.* 1998, NMFS 2014a).

From 1946 to 1956, Battle Creek spring-run Chinook salmon numbered approximately 2,000 fish in most years (Yoshiyama *et al.* 1996). As reported by Newton et al. (2008), linear regression techniques indicate that the spring-run Chinook salmon population in Battle Creek increased by about 13 fish per year, on average, from 1995 to 2007. This suggests that environmental conditions in Battle Creek have been suitable to maintain and lead to a modest increase in the population; interim flows, provided by PG&E, CVPIA, and CALFED since 1995 have likely been a primary contributing factor to this increase (Newton *et al.* 2008). Due to PG&E's hydroelectric diversion dams blocking historical habitat, the pre-restoration upper limits of spring-run Chinook salmon in the Battle Creek watershed are Eagle Canyon Dam on the North Fork and Coleman Diversion Dam on the South fork (*e.g.*, Newton *et al*. 2007, 2008).

Big Chico Creek also historically supported low numbers of Central Valley spring-run Chinook salmon that used the creek opportunistically (Reynolds *et al.* 1993), but a viable population was no longer believed to exist (CH2MHill 1998; Williams *et al.* 2016). Spring-run Chinook salmon have been observed spawning and rearing in the 9-mile stretch below Iron Canyon in the foothill reach of Big Chico Creek, but passage through Iron Canyon fish ladder has been impeded in low flow years (Chappell 2009).

Since the Dedicated Project Yield Program began providing additional water year-round to increase streamflow since 2001, Clear Creek has been able to provide spawning, rearing, and migration conditions for spring-run Chinook salmon (Giovannetti and Brown 2007). Because the additional streamflow also provided access for fall-run Chinook salmon, the U.S. Fish and Wildlife Service (USFWS) became concerned about the effects of hybridization and redd superimposition between spring-run and fall-run Chinook salmon. Beginning in 2003, USFWS has installed a temporary picket weir at approximately river mile (RM) 8 to protect 10 miles of spring-run Chinook salmon spawning habitat (Newton and Brown 2005). The weir ensures spatial separation of the two runs. The weir is installed in late August and removed in early November to allow access for CCV steelhead (Chappell 2009).

In an evaluation of the Beegum Creek/Cottonwood Creek watershed before 1998, spring-run Chinook salmon spawning and rearing habitat was found to be limited to the South Fork above the confluence with Maple Creek (CH2M Hill 1998); however, in 2002, some spawning was documented on the North Fork (CH2M Hill 2002). Access on the North Fork is limited by a natural barrier upstream of the Ono Bridge (Chappell 2009). Access on the South Fork is limited by a constructed barrier approximately 3.5 miles upstream of Maple Creek.

The Cow Creek watershed occurs in the Basalt and Porous Lava diversity group, which collectively supported historical spring-run Chinook salmon and steelhead populations, presumably because most streams in this area receive large inflows from springs during the summer (NMFS 2014a). Currently, while spring-run Chinook salmon were observed in low numbers in Cow Creek (CH2M Hill 1998), the lack of summer holding pools makes the creek unsuitable for spring-run Chinook salmon spawning (SHN Consulting 2001). The Cow Creek watershed is predominantly rain-fed, and likely only supports spring-run Chinook salmon in years with above-normal rainfall (CH2M Hill 1998). The creek may also support some level of non-natal rearing if conditions are suitable.

Critical Habitat

Critical habitat was designated for the Central Valley spring-run Chinook salmon ESU on September 2, 2005 (70 FR 52488). The HCP Action Area contains designated critical habitat for this ESU, and includes Antelope Creek, Battle Creek, Big Chico Creek, Butte Creek, Clear Creek, Cottonwood Creek, Cow Creek, Deer Creek, and Mill Creek.

Potential limiting factors for Central Valley spring-run Chinook salmon in the Basalt and Porous Lava diversity group during spawning, rearing, or migration include manmade barriers blocking access to historical habitat, passage impediments and flow fluctuations from hydropower operations, and loss of rearing habitat (NMFS 2014a). Agricultural diversions and diversion dams, warm water temperatures, manmade barriers blocking access to historical habitat, entrainment from diversions, and loss of channel connectivity represent potential limiting factors in the Northern Sierra Nevada diversity group; while warm water temperatures, limited spawning habitat availability, loss of rearing habitat, and manmade barriers blocking access to historical habitat are limiting factors in the Northwestern California diversity group (NMFS 2014a). These potential limiting factors functionally do not occur in the HCP Plan Area, as these activities occur in areas outside SPL&T lands.

2.4.1.1.3. California Central Valley steelhead

CCV steelhead exhibit a similar life history to Central Valley spring-run Chinook and occupy a similar geographic range. CCV steelhead also extensively use the Sacramento River and Sacramento/San Joaquin Delta to reach the natal streams. Spawning adults enter the San Francisco Bay estuary and Delta from August to November, with a peak in September (Hallock *et al.* 1961). Spawning occurs in a number of tributaries to the Sacramento River, to which the Delta and Sacramento River serve as key migratory corridors (NMFS 2014). Spawning occurs from December to April, with a peak in January through March, in rivers and streams where cold, well-oxygenated water is available (Hallock *et al.* 1961; McEwan and Jackson 1996; Williams 2006). Adults typically spend a few months in freshwater before spawning (Williams 2006), but very little is known about where they hold between entering freshwater and spawning in rivers and streams. Juvenile CCV steelhead rear in cool, clear, fast-flowing streams and are known to prefer riffle habitat to slower-moving pools (NMFS 2014; Reclamation 2015).

Although steelhead will experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat, the effects may be even greater in some cases, as juvenile steelhead may rear in freshwater over the summer prior to emigrating as smolts (Snider and Titus 2000). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than salmon (McCullough *et al.* 2001). McCullough *et al.* (2001) recommended an optimal incubation temperature at or below 11°C to 13°C (52°F to 55°F), and successful smoltification in steelhead may be impaired by temperatures above 12°C (54°F) (Richter and Kolmes 2005). In some areas, stream temperatures that currently provide marginal habitat for spawning and rearing may become too warm to support naturally spawning steelhead populations in the future.

Historical presence and habitat use for CCV steelhead is not as well documented as for the Central Valley Chinook salmon (Chappell 2009). Yoshiyama *et al.* (1996) concluded that steelhead distribution was probably broader than Chinook salmon distribution due to steelhead's greater jumping ability, the timing of upstream migration, and less restrictive preferences for spawning gravels. At least until 2009, the distribution was also largely unknown due to limited monitoring efforts (Chappell 2009). Much of the known steelhead distribution is based on dated Chinook salmon monitoring data (Busby *et al.* 1996; Low 2007; Chappell 2009).

Within the HCP Action Area, Central Valley steelhead are found in most accessible tributaries of the Sacramento River basin, including but not limited to Antelope, Battle, Big Chico, Butte, Clear, Cottonwood, Cow, Deer, and Mill Creeks. Many of those tributaries include upper reaches within SPL&T ownership. It is possible that naturally spawning populations exist in many other streams but are undetected due to lack of monitoring programs (NMFS 2014a). Access to the Upper Sacramento River is blocked by Keswick Dam, so streams on SPL&T lands in those areas do not currently support anadromous steelhead (although many contain non-anadromous rainbow trout).

There is little information available on steelhead distribution and abundance in Antelope Creek (NMFS 2014a); however, Armentrout *et al.* (1998) speculated they probably use the same spawning areas as Central Valley spring-run Chinook salmon and may extend beyond that range, as they are smaller in size and can use smaller substrates for spawning. Spring-run Chinook salmon spawning occurs in approximately 16 miles of the Antelope Creek watershed from upstream of Judd Creek on the North Fork, to Buck's Flat on the South Fork, downstream to approximately Facht Place on the mainstem (Armentrout *et al.* 1998, NMFS 2014a).

In Battle Creek, steelhead can access approximately 14 miles of spawning and rearing habitat in the North Fork and approximately 18 miles in the South Fork. The Coleman National Fish Hatchery (CNFH) barrier weir allows the USFWS to control fish passage into the upper reaches of Battle Creek through the fish ladder during certain periods throughout the year. While precluding certain fish (*e.g*., hatchery-origin salmonids) from accessing the upper reaches will benefit the Battle Creek Salmon and Steelhead Restoration Project, the weir does not block fish passage at all times. In the past, steelhead were reported to pass over the barrier weir and access the upper watershed during periods of high flow (Kier Associates 1999). CCV steelhead have been identified as priority species for restoration in Battle Creek above CNFH as part of the Restoration Project (https://www.usbr.gov/mp/battlecreek/index.html) and is considered to have high potential to support a viable independent population (Williams *et al.* 2016).

CCV steelhead occur in Big Chico Creek along with resident rainbow trout. Specific data on steelhead distribution and numbers are limited due to the lack of species-specific monitoring (Chappell 2009); however, they are believed to use the higher elevation reaches to spawn except in low water years when they spawn in the lower river (NMFS 2014a).

The status of CCV steelhead in Butte Creek is unknown. Although water temperatures are adequate to support summer rearing and *O. mykiss* are present in high densities through the reach between lower Centerville Diversion Dam and the Centerville Powerhouse, high-quality spawning and rearing habitat is essentially limited to only about five miles of stream. Further monitoring of steelhead in the system, as well as studying the habitat use and needs of steelhead for Butte Creek are needed to develop a recovery strategy for this Creek. However, given that spring-run Chinook salmon are productive in Butte Creek, the potential to support a viable steelhead population appears to moderate at the least.

Steelhead spawning habitat along Clear Creek is limited by the amount of suitable spawning substrate. Before 2001, a gravel augmentation project involved injecting small gravel below Whiskeytown Dam to improve steelhead spawning (Giovannetti and Brown 2007). A study of steelhead redds between 2001 and 2007 found 30 to 40 percent of the redds had injection gravel in them, suggesting that the habitat is still limiting spawning, or that the gravel injection is providing more suitable spawning habitat for steelhead (Giovannetti and Brown 2007; Chappell 2009). Williams *et al.* (2016) stated that steelhead population numbers had increased since first estimated in 2003 but had decreased in the most recent three years of analysis.

As of 2009, steelhead used all the forks and the mainstem of Cottonwood Creek for spawning, rearing, and migrating (Chappell 2009). However, an evaluation in 2002 indicated low flows restrict access to large portions of those habitats (CH2M Hill 2002). Low flows in years with limited precipitation may limit the availability of habitat given the flashy nature (CH2M Hill 2002).

The mainstem of Cow Creek and tributaries including North Cow, Old Cow, and South Cow Creeks provide spawning habitat for steelhead (SHN 2001). Diddy Wells Falls, Clover Creek Falls, and Upper Whitmore Falls create barriers to upstream migration, particularly during normal and low flow years (Chappell 2009). Cow Creek also provides some habitat for rearing steelhead; however, these areas are limited in most years by low flows and high-water temperatures (Chappell 2009).

There is very little information on the distribution and abundance of steelhead on Deer Creek and Mill Creek, but the steelhead range is expected to include and extend beyond the range of spring-run Chinook salmon (Armentrout *et al.* 1998). Deer Creek supports all life history stages of CCV steelhead, although not much is known about the long-term viability of steelhead in Deer Creek. The carrying capacity of steelhead in Deer Creek is not known, but the watershed historically supported strong populations that likely persisted at low levels of extinction prior to water development on the valley floor. Deer Creek has a high potential to support a viable, self-sustaining steelhead population because of the extensive (25 miles) suitable spawning and rearing habitat and the existing occurrence of *O. mykiss* throughout Deer Creek at high densities (up to several thousand rearing fish per mile (CDFW 2005)). The conditions described above for steelhead in Deer Creek also apply for steelhead in Mill Creek.

Critical Habitat

Critical habitat was designated for the CCV steelhead DPS on September 2, 2005 (70 FR 52488). Within the HCP Action Area, CCV steelhead are found in most accessible tributaries of the Sacramento River basin, including but not limited to Antelope, Battle, Big Chico, Clear, Cottonwood, Cow, Deer, and Mill Creeks. Limiting factors for CCV steelhead are similar to those described for Central Valley spring-run Chinook salmon above.

2.4.1.1.4. Central Valley fall- and late fall-run Chinook salmon

Adult Central Valley fall-run Chinook salmon enter rivers as mature individuals and move relatively quickly to spawning grounds. Spawning usually occurs within several weeks to two months of freshwater entry. Peak spawning time is typically in October-November, but can continue through December and into January. Juveniles typically emerge from the gravel in December through March and rear in fresh water for 1-7 months, usually moving downstream into large rivers within a few weeks. Salmon smolts initiate migration during storm events and flow is positively correlated with migration rate (McCormick *et al.* 1998, Michel *et al.* 2013). In the clear upper reaches of the Sacramento River, out-migrating smolts employ a nocturnal migration strategy, a behavior likely influenced by predation. Turbidity also has a strong positive relationship with increased survival during out-migration, likely by decreasing predation efficiency. However, this relationship is also influenced by the strong positive association between turbidity and large flow events (Michel *et al.* 2013).

The basic life history of late fall-run Chinook salmon is intermediate to the “ocean type” fall-run and the “stream type” spring-run, because adults arrive in fresh water already mature and spawn quickly after arriving (similar to fall-run) but juveniles regularly over-summer, out-migrating in their second year of life (similar to spring-run). The details of late fall-run life history, however, are much less well known than those of other Central Valley runs because of the comparatively recent recognition of this run, coupled with its tendency to ascend and spawn at times when the Sacramento River is likely to be high, cold and turbid. This combination of factors makes this run particularly difficult to study. Late fall-run Chinook salmon migrate upstream in December and January as mature fish, although their migration has been documented from November through April (Williams 2006). Historically, the spawning adults would have been comprised of a mixture of age classes, ranging from two to five years old. Currently, most of the run is composed of three-year olds. Spawning occurs primarily in late December and January, shortly after the fish arrive on spawning grounds, although it may extend into April in some years (Williams 2006). Emergence from the gravel begins in April and all fry have usually emerged by early June. Juveniles may hold in the river for 7-13 months before moving out to sea. Peak migration of smolts appears to be in October; however, there is evidence that many may out-migrate at younger ages and smaller sizes during most months of the year (Williams 2006).

Central Valley fall-run Chinook salmon historically spawned in all major rivers of the Central Valley, migrating as far as the Kings River to the south and the Upper Sacramento, McCloud, and Pit rivers to the north. Today, in the Sacramento and San Joaquin River watersheds, they spawn upstream as far as the first impassible dams. Overall, it is estimated that dams have blocked over 70 percent of spawning habitat (Yoshiyama *et al.* 2001), although cold water releases from dams now allow spawning where it did not formerly exist (Yoshiyama *et al.* 1998). Habitat for fall-run Chinook salmon spawning has been impacted less by dam construction than spawning habitat for winter and spring-run Chinook salmon, because the fall-run historically spawned only in low elevation reaches, up to 500 – 1,000 feet above sea level (Yoshiyama *et al.* 2001). Levees also block access for juveniles to the historic floodplain and tidal marsh rearing habitats.

The historical distribution of late fall-run Chinook salmon is not well documented, because the late fall-run Chinook salmon was not recognized as distinct from fall-run Chinook salmon until after the Red Bluff Diversion Dam (RBDD) was constructed in 1966. The late fall-run Chinook salmon most likely spawned in the Upper Sacramento and McCloud Rivers, reaches now blocked by Keswick and Shasta Dams. There is also some evidence that late fall-run Chinook salmon once spawned in the San Joaquin River and other large San Joaquin River tributaries (Yoshiyama *et al.* 1998). Currently, late fall-run Chinook are found primarily in the Sacramento River, where most spawning and rearing of juveniles takes place in the reach between RBDD and Redding (Keswick Dam). R. Painter (CDFW, pers. comm. 1995) indicated that late fall-run Chinook have been observed spawning in Battle Creek, Cottonwood Creek, Clear Creek, Mill Creek, Yuba River and Feather River, but these are presumably a small fraction of the total population. The Battle Creek spawners are likely derived from fish that strayed from Coleman National Fish Hatchery.

In general, Central Valley fall-run and late fall-run Chinook salmon have limited spawning range within the HCP Plan Area. Historically, fall-run Chinook salmon spawned mostly in river reaches now blocked by Keswick Dam, which included the Upper Sacramento River and McCloud River. At present, fall-and late fall-run Chinook salmon spawn in the Sacramento River up to the Keswick Dam (not in the HCP Plan Area). They also spawn in Battle Creek, Bear Creek, Cottonwood Creek, Cow Creek, Clear Creek, Deer Creek, and Mill Creek watersheds (SHN Consulting Engineers 2001; Heiman and Knecht 2010; CDFW 2014a, 2014b; CDFW

2015b, 2015c). Although the reaches of Cottonwood, Cow, Clear, Deer, and Mill Creeks that are within the HCP Plan Area are above areas where fall and late-fall Chinook salmon spawn, the effects of the Covered Activities, especially effects to water quality, may extend downstream of the covered lands into habitat used for spawning and rearing.

Central Valley fall-run Chinook salmon have always comprised the largest population in Battle Creek; however, late-fall, winter-, and spring-run Chinook salmon and steelhead are also native to the Battle Creek watershed. Early accounts by fisheries investigators report that Battle Creek was perhaps the most important tributary for salmon production in the Sacramento River (Rutter 1904). The unique hydrology and geology of the natural Battle Creek watershed ensures a reliable supply of cool water required for adult holding and spawning and year-round rearing of juveniles. Adult fall-run Chinook salmon returning to Battle Creek are primarily of hatchery origin, but lower Battle Creek does support natural spawning of fall-run Chinook salmon of mixed origin, resulting from both hatchery and natural-production. Most fall-run Chinook salmon adults entering Battle Creek originate from production at CNFH. Long-term, continuous, and extensive integration between hatchery and natural fall-run Chinook salmon populations resulted in a genetically homogeneous population of mixed (i.e., hatchery and natural) ancestry.

Information is scarce regarding the abundance of naturally spawning late-fall Chinook salmon in Battle Creek. Generally, late-fall Chinook are considered to spawn in the mainstem Sacramento River. However, some natural-origin (unmarked) and phenotypic late-fall Chinook do migrate into Battle Creek and are collected at CNFH. As a species propagated at CNFH, there is also data available on the proportion of natural-origin late fall-run Chinook salmon used as hatchery broodstock. A target of approximately 10-15 percent of the juvenile late-fall Chinook produced at the CNFH will be the progeny of natural-origin broodstock (USFWS 2011). The number of late-fall Chinook salmon spawning naturally below the CNFH barrier weir is unknown, but is presumed to be small.

Of the different runs of salmon that spawn in the Upper Sacramento River and tributaries, only fall-run Chinook salmon consistently return to Bear Creek. Between 1949 and 2002, spawning runs varied between fewer than 10 fish to up to 500 (Heiman and Knecht 2010). The continued decline of salmon in Bear Creek reflect the overall decline of the Sacramento River fall-run Chinook salmon (Heiman and Knecht 2010).

All three forks of Cottonwood Creek support fall-run Chinook salmon, with an estimated average annual return of 1,000 to 1,500 fall-run Chinook salmon. Numbers have fallen in recent years, consistent with the overall decline of fall-run Chinook salmon in the Sacramento River (Heiman and Knecht 2010; Williams *et al.* 2016). Spawning currently occurs downstream from HCP Plan Area but is within the HCP Action Area.

In lower Clear Creek (below Whiskeytown Dam), fall-run Chinook salmon populations averaged 2,000 fish annually from 1954 to 1994. The populations ranged from 500 to 10,000, depending on the year (Heiman and Knecht 2010). The removal of the Saeltzer Dam in 2000 and management efforts focusing on improving stream conditions restored passage to a significant reach of Clear Creek below Whiskeytown Dam (Heiman and Knecht 2010). From 2000 to 2018, fall-run Chinook salmon populations averaged approximately 8,500 fish annually, ranging from approximately 2,350 to 16,000 fish (CDFW 2019). Spawning currently occurs downstream from HCP Plan Area but is within the HCP Action Area.

Adult Central Valley fall-run Chinook salmon migrate upstream into Deer Creek during the late fall after seasonal rains have increased stream flow (DCWC 1998). Spawning occurs in the lower reaches of Deer Creek, with most of the adult fish spawning in the valley floor (from the Deer Creek Irrigation District diversion downstream to the Southern Pacific Railroad Bridge). When flows are lower than normal, fall-run Chinook salmon adults can be limited to the stream section below Stanford Vina Ranch Irrigation Company diversion dam (Cramer and Hammack 1952).

In Mill Creek, fall-run Chinook salmon mainly use the lower 6 miles. Annual counts from 1952 through 1994 reported an average run size of 2,000 fish. However, given the decline reported in 2010 for the Sacramento River fall-run salmon, current runs are presumed to be much smaller (Heiman and Knecht 2010). The lower 6 miles of Mill Creek used by fall-run Chinook salmon is located approximately 20 miles downstream of the HCP Action Area.

The Central Valley fall-run and late fall-run Chinook salmon ESU is not currently listed under the ESA. Therefore, no critical habitat has been designated.

2.4.1.1.5. SPL&T Ownership within the Sacramento River basin HCP Action Area

Watersheds where SPL&T ownership overlaps with anadromous stream habitat in the Sacramento River basin HCP Action Area include the following: Antelope, Cottonwood, Cow, Deer, and Mill Creeks. SPL&T lands comprise approximately 24 percent of the Sacramento River basin HCP Action Area, while other private landowners encompass approximately 51 percent of those lands. Federal lands account for approximately 22 percent, most of which is managed by the USFS. State lands occupy approximately three percent of the HCP Action Area.

Antelope Creek provides approximately 30 miles of anadromous fish habitat from its confluence with the Sacramento River upstream, and two and three miles of habitat on the North and South Forks of Antelope Creek, respectively, above their confluence (Armentrout et al. 1998). SPL&T lands in the HCP Action Area includes approximately 38.9 percent (30,622 acres) of the Antelope Creek watershed, which has an area of approximately 123 square miles (78,720 acres). This watershed is long and narrow, with moderate to steep slopes in the upper reaches of the watershed (Chappell 2009). SPI manages lands in seven planning watersheds with ownership ranging from 21 to 99 percent. Anadromous habitat is present in three of the seven planning watersheds: Deadhorse, McCarthy and Panther Creeks and totals 5.4 miles. SPL&T lands contain approximately 374 miles of road, of which less than a mile of road is located within 300 feet of anadromous habitat. SPL&T ownership contains 75 miles of perennial stream above anadromy and 99 miles of seasonally flowing streams. There are 313 road watercourse crossings in the watershed, though only two crossings (both in Deadhorse Creek) are in anadromous habitat. Covered Species present in Antelope Creek include Central Valley spring-run Chinook salmon, CCV steelhead, and Central Valley fall-run Chinook salmon.

Beegum/Cottonwood Creek is the largest undammed tributary in the upper Sacramento River Basin. The watershed encompasses over 938 square miles (600,320 acres) of the northwest side of the Sacramento Valley, primarily in Shasta County, from the interior Coast Range and

Klamath Mountains to the Sacramento River near the town of Cottonwood. SPL&T lands in the HCP Action Area encompass approximately 20,178 acres, or about 3.4 percent of the Beegum/Cottonwood Creek watershed. SPI manages lands in 12 planning watersheds in the Beegum/Cottonwood Creek watershed, with ownership ranging from approximately 4 to 55 percent. Approximately 0.43 mile of anadromous stream habitat occurs in one planning watershed (Taylor Gulch). SPL&T lands contain approximately 114 road miles, less than 0.25-mile of which is within 300 feet of anadromous stream habitat. SPL&T ownership contains approximately 90.5 miles of perennial stream above anadromy and 120 miles of seasonally flowing streams. Roads cross these channels at 385 sites in the watershed, though only two crossings are in anadromous stream habitat. Covered Species present in Beegum/Cottonwood Creek include Central Valley spring-run Chinook salmon, CCV steelhead, and Central Valley fall-run Chinook salmon.

The Cow Creek watershed encompasses approximately 425 square miles (272,000 acres) in the northeastern corner of the Sacramento Valley and neighboring mountains. Cow Creek accounts for approximately 21 percent of the peak discharge for the Sacramento River between Shasta Dam and Red Bluff (Heiman and Knecht 2010). An estimated 66 miles of anadromous fish habitat occurs in Cow Creek, although recent fish counts suggest much less production (Heiman and Knecht 2010). SPL&T lands in the HCP Action Area include approximately 8 percent (21,805 acres) of the Cow Creek watershed. SPI manages lands in 17 planning watersheds with ownership ranging from 1-48 percent. Anadromous stream habitat occurs in four of the 17 planning watersheds, a total of approximately 5.6 miles of anadromous stream habitat, including Beal, Tucker, Glendenning, and Mill Creeks. SPL&T lands in the watershed contain approximately 194 road miles, 2.2 miles of which is located within 300 feet of anadromous stream habitat. SPL&T ownership contains approximately 56 miles of perennial stream above anadromy and 85 miles of seasonally flowing streams. Roads cross these channels at 343 sites in the watershed; however, no crossings are in anadromous stream habitat. Covered Species present in Cow Creek include Central Valley spring-run Chinook salmon, CCV steelhead, and Central Valley fall-run Chinook salmon.

The Deer Creek includes a forested upper area where ownership is shared between Lassen National Park, the Lassen National Forest, and SPL&T. SPL&T lands in the HCP Action Area includes approximately 13.2 percent (19,349 acres) of the Deer Creek watershed and SPI manages lands in eight planning watersheds. SPL&T lands subject to anadromy in Deer Creek are limited to less than 1 mile (approximately 0.7 miles) of stream occurring in the Calf Creek planning watershed. SPL&T lands contain approximately 189 road miles, none of which are located within 300 feet of anadromous stream habitat. SPL&T ownership contains approximately 41 miles of perennial stream above anadromy and 65 miles of seasonally flowing streams. The Deer Creek watershed has 285 road watercourse crossings, though none occur in anadromous stream habitat. Covered Species present in Deer Creek include Central Valley spring-run Chinook salmon, CCV steelhead, and Central Valley fall-run Chinook salmon.

SPL&T lands in the HCP Action Area encompass approximately 8.80 square miles (5,631 acres), or about 6.5 percent of the Mill Creek watershed, all in the forested upper portions of the watershed. SPL&T lands subject to anadromy in Mill Creek are limited to approximately three miles of tributary streams occurring in the Mill Creek Rim and South of Big Bend planning watersheds. SPL&T lands contain approximately 374 road miles, and approximately 0.33 mile of road is located within 300 feet of anadromous stream habitat. SPL&T ownership contains approximately 9 miles of perennial stream above anadromy and 19 miles of seasonally flowing streams. There are 23 road watercourse crossings in the watershed, none of which occur in anadromous stream habitat. Covered Species present in Mill Creek include Central Valley spring-run Chinook salmon, CCV steelhead, and Central Valley fall-run Chinook salmon.

Although the following watersheds are included as part of the Sacramento River basin HCP Action Area, no anadromous stream habitat occurs on SPL&T lands in these planning watersheds. However, effects from Covered Activities have the potential to extend to occupied habitat. These watersheds include Battle, Bear, Big Chico, Butte, Clear, and Paynes creeks.

SPL&T lands in the HCP Action Area includes approximately 32 percent (73,212 acres) of the Battle Creek watershed. Covered Species present in Battle Creek include Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, CCV steelhead, Central Valley late fall-run Chinook salmon, and Central Valley fall-run Chinook salmon.

SPL&T lands in the HCP Action Area comprise approximately 4.23 square miles (2,705 acres), or about 2.3 percent of the Bear Creek watershed. Covered Species present in Bear Creek include Central Valley fall-run Chinook salmon.

The Big Chico Creek watershed originates from the southwest slope of Colby Mountain and encompasses an area of approximately 72 square miles (46,080 acres) (NMFS 2014a), of which approximately 48.81 square miles (31,237 acres), or 68 percent, consists of SPL&T lands included in the HCP Action Area. Covered Species present in Big Chico Creek include Central Valley spring-run Chinook salmon, CCV steelhead, and Central Valley fall-run Chinook salmon.

SPL&T lands in the HCP Action Area within the Butte Creek watershed encompass approximately 59.18 square miles (37,876 acres), or 40 percent of the total watershed area. Covered Species present in Butte Creek include Central Valley spring-run Chinook salmon, CCV steelhead, and Central Valley fall-run Chinook salmon.

Most of SPL&T ownership in the Clear Creek watershed is above Whiskeytown Dam and Reservoir, which block access by anadromous fish to the upper watershed. In the Clear Creek watershed below Whiskeytown Dam, there are 2.09 square miles (1,340 acres) of SPL&T lands in the HCP Action Area. SPL&T lands in the portion of the watershed below the dam are in headwater tributaries five miles upstream from the mainstem of Clear Creek, and over 20 miles from the Clear Creek/Sacramento River confluence. Covered Species present in Clear Creek include Central Valley spring-run Chinook salmon, CCV steelhead, and Central Valley fall-run Chinook salmon.

SPL&T lands in the HCP Action Area includes approximately 11.2 percent (6,638 acres) of the Paynes Creek watershed, which encompasses approximately 93 square miles (59,520 acres). Covered Species present in Paynes Creek include CCV steelhead and Central Valley fall-run Chinook salmon.

Table 5. Conditions of HCP Action Area Anadromous Stream Reaches in the Sacramento River Basin.

NMFS Diversity Group	River, Creek, or Sub-Reach	Planning Watershed Name	Area within HCP Plan Area (Sq. mi.)	Miles of Anadromous[1] Stream	Road Length in Anadromous Stream and 300-foot Corridor (miles)	Road Crossings on Anadromous Streams - Bridges (number)	Road Crossings on Anadromous Streams - Culverts (number)	Road Crossings on Anadromous Streams – Fords (number)	Current Percentage of Total Road-Related Sediment Production Delivered to Streams	Area Harvested 2007–2017 (Sq. mi.)	Area Burned by Wildfire 2007–2018 (Sq. mi.)
Basalt and Porous Lava	Cow Creek	Beal	1.29	1.16	0.39	0	0	0	24.34	0.34	0.00
Basalt and Porous Lava	Cow Creek	Tucker	6.00	3.09	0.68	0	0	0	14.00	1.11	0.00
Basalt and Porous Lava	Cow Creek	Glendenning	5.36	0.52	0.31	0	0	0	6.99	0.56	0.00
Basalt and Porous Lava	Cow Creek	Mill Creek	0.43	0.84	0.80	0	0	0	N/A	0.03	0.00
Northern Sierra Nevada	Mill Creek	Mill Creek Rim	8.08	2.05	0.31	0	0	0	6.36	1.15	1.54
Northern Sierra Nevada	Mill Creek	South of Big Bend	0.72	1.03	0.00	0	0	0	N/A	0.00	0.06
Northern Sierra Nevada	Deer Creek	Calf Creek	3.88	0.77	0.00	0	0	0	17.44	1.29	1.73
Northern Sierra Nevada	Antelope Creek	Deadhorse Creek	14.20	4.03	0.85	0	1	1	6.82	2.73	0.03
Northern Sierra Nevada	Antelope Creek	McCarty Creek	14.13	1.27	0.04	0	0	0	8.13	3.23	0.00
Northern Sierra Nevada	Antelope Creek	Panther Spring	6.53	0.14	0.00	0	0	0	11.26	0.65	0.00
Northwestern California	Beegum/ Cottonwood	Taylor Gulch	2.78	0.43	0.15	1	0	1	20.05	1.70	2.31
		Total	**63.40**	**15.33[2]**	**3.53[3]**	**1**	**1**	**2**			

[1]Anadromous species include the Covered Species described in this HCP.
[2]Represents 0.2 percent of the total stream miles occurring on SPI ownership (1,582.99 miles) in the Sacramento Basin.
[3]Represents 0.2 percent of the total road miles occurring on SPI ownership (2,086.91 miles) in the Sacramento Basin.
"NA" represents planning watersheds for which the READI Model has not been completed.

Table 6. Conditions of HCP Action Area Anadromous Stream Reaches in the Trinity River Basin.

Hydrologic Area	Planning Watershed Name	Area within HCP Plan Area (Sq. mi.)	Miles of Anadromous Stream[1] (SONCC coho salmon)	Miles of Anadromous Stream (all anadromy)	Road Length in Anadromous Stream and 300-foot Corridor (miles)	Road Crossings on Anadromous Streams - Bridges (number)	Road Crossings on Anadromous Streams - Culverts (number)	Road Crossings on Anadromous Streams - Fords (number)	Current Percentage Total Road-Related Sediment Delivered to Streams	Area Harvested 2007–2017 (Sq. mi.)	Area Burned by Wildfire 2007–2018 (Sq. mi.)
Lower Trinity	Dutch Creek	3.28	0	2.02	0.89	0	1	0	5.70	0.30	0.17
Lower Trinity	Maxwell Creek	4.79	0.22	1.60	0.08	0	0	0	14.59	0.43	0.00
Lower Trinity	Soldier Creek	1.90	0	0.76	0.05	0	0	0	7.08	0.39	0.00
South Fork Trinity River	Bierce Creek	0.92	0	1.37	0.68	1	0	0	7.29	0.67	0.00
South Fork Trinity River	Hall City Creek	1.09	0	0.74	0.57	0	0	1	8.21	0.98	0.00
South Fork Trinity River	North Fork Hayfork Creek	6.25	0	3.16	1.68	1	0	0	11.58	3.58	0.00
South Fork Trinity River	Wilson Creek	0.31	0	0.86	0.44	0	0	1	15.08	0.31	0.06
South Fork Trinity River	Upper Carr Creek	3.64	0	0.62	0.41	0	1	0	14.81	0.20	0.33
South Fork Trinity River	Duncan Creek	2.27	0	0.56	0	0	0	0	2.82	0.02	0.00
South Fork Trinity River	Lower Carr Creek	1.99	0	0.10	0.23	0	0	0	18.29	0.23	0.49
Middle Trinity	Johnson Gulch	5.37	0	0.78	0	0	0	0	4.63	1.24	1.08

Hydrologic Area	Planning Watershed Name	Area within HCP Plan Area (Sq. mi.)	Miles of Anadromous Stream[1] (SONCC coho salmon)	Miles of Anadromous Stream (all anadromy)	Road Length in Anadromous Stream and 300-foot Corridor (miles)	Road Crossings on Anadromous Streams - Bridges (number)	Road Crossings on Anadromous Streams - Culverts (number)	Road Crossings on Anadromous Streams - Fords (number)	Current Percentage Total Road-Related Sediment Delivered to Streams	Area Harvested 2007–2017 (Sq. mi.)	Area Burned by Wildfire 2007–2018 (Sq. mi.)
Middle Trinity	East Fork Browns Creek	9.46	0	8.02	4.93	3	0	2	10.63	0.41	0.10
Middle Trinity	Middleton Gulch	8.69	2.65	4.44	1.88	2	1	1	8.56	0.6	0.00
Middle Trinity	Hazel Gulch	5.75	1.15	1.14	0.32	0	0	0	7.60	0.46	0.00
Middle Trinity	Chanchelulla Creek	2.22	0	1.66	0.41	0	2	0	5.52	1.72	0.27
Middle Trinity	Dutton Creek	5.48	1.27	2.83	1.77	0	0	0	8.99	0.35	0.05
Middle Trinity	Little Creek	10.33	0	3.88	3.32	0	1	0	8.39	1.75	0.00
Middle Trinity	Lower Reading Creek	8.82	1.68	3.45	1.02	0	0	0	10.29	0.03	0.05
Middle Trinity	Upper Reading Creek	6.62	0	3.19	0.46	1	0	0	7.23	2.06	0.00
Middle Trinity	Middle Indian Creek	6.05	0	3.46	1.92	1	0	0	10.90	0.62	0.00
Middle Trinity	Lower Indian Creek	7.17	1.93	2.26	0.49	0	1	0	7.63	0.7	0.00
Middle Trinity	Tom Lang Gulch	7.53	0.18	0.31	0.06	0	0	0	7.56	0.59	0.00
Middle Trinity	Upper Indian Creek	3.47	0	3.15	0.39	1	0	1	12.06	0.00	0.01
Middle Trinity	Deadwood Creek	4.10	0.31	2.35	2.30	1	0	0	8.08	1.41	2.61
Middle Trinity	Upper Rush Creek	1.05	0.13	0.13	0.02	0	0	0	12.66	0.29	0.00
Middle Trinity	Lower Rush Creek	7.36	1.18	2.79	2.16	1	2	0	13.83	1.39	0.00

Hydrologic Area	Planning Watershed Name	Area within HCP Plan Area (Sq. mi.)	Miles of Anadromous Stream[1] (SONCC coho salmon)	Miles of Anadromous Stream (all anadromy)	Road Length in Anadromous Stream and 300-foot Corridor (miles)	Road Crossings on Anadromous Streams - Bridges (number)	Road Crossings on Anadromous Streams - Culverts (number)	Road Crossings on Anadromous Streams - Fords (number)	Current Percentage Total Road-Related Sediment Delivered to Streams	Area Harvested 2007–2017 (Sq. mi.)	Area Burned by Wildfire 2007–2018 (Sq. mi.)
Middle Trinity	Lower Grass Valley Creek	5.84	0.84	0.59	0.28	0	0	0	11.05	1.37	0.72
Middle Trinity	West Weaver Creek	2.08	0	1.08	0.25	0	0	0	5.04	0.39	0.04
Middle Trinity	Little Browns Creek	3.08	1.42	2.16	1.17	2	0	0	11.77	0.53	0.01
Middle Trinity	Lower Weaver Creek	2.39	0.19	0.27	0.15	0	0	0	7.00	0.21	0.01
Middle Trinity	East Weaver Creek	1.26	0	0.83	0.43	0	0	0	11.13	0.22	0.00
	Total	**140.56**	**13.16**[2]	**60.56**[3]	**28.76**[4]	**14**	**9**	**6**			

[1]Anadromous species include the Covered Species as described in this HCP.
[2]Represents 1.7 percent of the total stream miles occurring on SPI ownership (791.35 miles) in the Trinity River Basin.
[3]Represents 7.7 percent of the total stream miles occurring on SPI ownership (791.35 miles) in the Trinity River Basin.
[4]Represents 3.3 percent of the total road miles occurring on SPI ownership (884.72 miles) in the Trinity River Basin.

2.4.1.2. Trinity River Basin

The HCP Action Area in the Trinity River basin is used by several salmonid populations and includes the Lower, Middle, and South Fork Trinity River CalWater Hydrologic Areas (HAs). These HAs include 53 planning watersheds known or potentially occupied by the Covered Species occurring in the Trinity River basin.

Along the southern Oregon and northern California coast, NMFS identified seven diversity strata (like diversity groups identified for the Central Valley populations) for grouping listed SONCC coho salmon populations with similar geologic and genetic features (Williams *et al.* 2006; NMFS 2014b). Of the seven diversity strata, only the Interior Trinity diversity strata overlaps with the SPL&T HCP Action Area. The Interior Trinity diversity strata includes the Lower Trinity River, South Fork Trinity River, and Upper Trinity River populations (NMFS 2014b).

SPL&T lands within the SONCC coho salmon range included in the HCP Plan Area include approximately 13.2 stream miles occurring in 13 planning watersheds in the Lower and Middle Trinity River populations. SPL&T lands within the UKTR Chinook salmon ESU and KMP steelhead DPS range included in the HCP Plan Area contain an additional 47.4 stream miles occurring in 31 planning watersheds in the Lower, South Fork Trinity, and Middle Trinity River populations. These streams represent approximately 14 percent of all UKTR Chinook salmon ESU and KMP steelhead DPS habitat in the Lower, Middle, and South Fork Trinity River populations.

Collectively, Covered Species on SPL&T lands in the Trinity River Basin occur in 31 planning watersheds included in the Lower, South Fork Trinity, and Middle Trinity River population areas. These planning watersheds include approximately 60.6 stream miles subject to anadromy. The following sections describe the presence and habitat use of those populations in the Interior Trinity diversity strata.

2.4.1.2.1. SONCC coho salmon

The SONCC coho salmon ESU is separated into 7 diversity strata and 40 populations, each of which support several independent coho populations (NMFS 2016). There is some diversity of life history strategies in the Trinity River based on data of run timing and outmigration, but the information is not well documented (NMFS 2014b).

The Interior Trinity River SONCC coho diversity stratum includes populations in the Lower Trinity River, South Fork Trinity River, and Upper Trinity River, and includes portions of the HCP Action Area. Within the HCP Action Area, SONCC coho populations are found in the Upper and South Fork Trinity River sub-basins.

In the Lower Trinity River, several tributaries are known to support coho salmon spawning and rearing. Considering the habitat quality, it can be inferred that coho salmon were historically widely distributed in tributaries throughout the Lower Trinity River sub-basin, but it was likely rare for coho salmon to spawn in the mainstem Lower Trinity River (NMFS 2014b). Approximately 2 miles of the Lower Trinity River is located within the downstream end of the HCP Action Area. Coho salmon have been observed spawning and rearing in Mill Creek, Horse

Linto Creek, Tish Tang Creek, and Sharber-Peckham Creek (NMFS 2014b). Coho salmon presence has also been documented in Manzanita, Big French, Cedar, Supply, Campbell, and Hostler Creeks, and East Fork New River (NMFS 2014b).

Coho salmon are thought to have been well distributed throughout the Upper Trinity River sub-basin, with the highest concentrations in the lower gradient tributaries. Accurate estimates of coho salmon production below Lewiston prior to dam construction are not available; however, presence was documented prior to the construction of the Trinity River Diversion (NMFS 2014b). The current coho salmon distribution has been confirmed in a variety of streams in the Upper Trinity River sub-basin. Coho are found in several streams within the HCP Action Area in the Upper Trinity River sub-basin, including Sidney Gulch, Deadwood Creek, Weaver Creek, East Weaver Creek, and West Weaver Creek.

Currently, in the Upper Trinity River population area, coho salmon are known to spawn in the mainstem Trinity River in the Douglas City/Weaverville area, where several tributaries originating from SPL&T lands (Indian, Reading, Browns, Little Browns, Grass Valley, and Rush Creeks) join the river (NMFS 2014b). Those creeks are used by coho salmon to some degree and are sometimes accessible to both adult and juvenile coho salmon, but population estimates for individual tributaries are unavailable (NMFS 2014b).

In the mainstem Trinity River, rearing juvenile coho salmon occur in highest densities within the first 7 miles downstream of Lewiston Dam, and none use the mainstem downstream of river mile 101 (NMFS 2014b). Further upstream on the mainstem, coho salmon access to the Upper Trinity River is blocked by the Lewiston and Trinity Dams. Therefore, there is no coho salmon access to tributaries emanating from SPL&T lands in that area. Areas above Lewiston and Trinity Dams are discussed in the SHA but not included in the HCP.

Coho salmon are limited in their distribution in the South Fork Trinity River basin and occur only in the mainstem South Fork Trinity River (up to Butter Creek), Butter Creek, Hayfork Creek (up to Corral Creek), Eltapom Creek, Olsen Creek, and Madden Creek (NMFS 2014b). These streams are outside the HCP and SHA Action Areas. Although there are no known barriers to migration for coho salmon in the South Fork Trinity River, coho salmon are not observed upstream of Butter Creek (NMFS 2014b). It is likely that habitat conditions, such as high-water temperatures and low dissolved oxygen, currently limit distribution of coho salmon in the South Fork Trinity River sub-basin. There are no historical accounts of coho salmon in the Hayfork Valley, which is downstream from SPL&T lands in the Hayfork Creek watershed (NMFS 2014b).

Critical Habitat

NMFS designated critical habitat for SONCC coho salmon in 1999 (64 FR 24049), which includes all river reaches accessible to listed coho salmon from Cape Blanco, Oregon, to Punta Gorda, California. The Trinity River, South Fork Trinity River, and accessible tributaries all fall within the critical habitat designation. As defined in the designation, accessible reaches include those that can be reached by any life stage. Thus, several creeks that are tributary to the Trinity River within the HCP Action Area are within designated critical habitat for SONCC coho salmon.

Key emerging or ongoing habitat concerns that contribute to the decline in SONCC coho salmon numbers include insufficient instream flow, unsuitable water temperature, and insufficient winter and summer rearing habitat (NMFS 2016). Like spring-run Chinook salmon, the SONCC coho salmon may be limited by forest management and timber operation activities that affect water quality (suspended sediment, turbidity, temperature), hydrology (low flow), and available diverse habitat (large wood recruitment).

2.4.1.2.2. Upper Klamath-Trinity Rivers Chinook salmon

Salmon in the ESU exhibit both stream-type and ocean-type life history strategies. Genetic differences are not regarded as substantial enough to separate spring-run and fall-run into separate ESUs (Myers *et al.* 1998). On February 27, 2018, NMFS published a 90-day finding on a petition to list the UKTR Chinook salmon ESU as endangered or threatened, or alternatively to create a new ESU to describe Klamath spring-run Chinook and list it as endangered or threatened (83 FR 8410). Based on the information included in Petitioners' filing, NMFS found that the petitioned action may be warranted. Therefore, in accordance with section 4(b)(3)(A) of the ESA and NMFS' implementing regulations (50 CFR 424.14(h)(2)), NMFS has commenced a status review of the UKTR Chinook salmon ESU, which is currently underway.

Within the Klamath River basin, Chinook salmon populations have been reduced by 95 percent from historical levels due to dams, irrigation diversions, mining, timber harvest, and floods. Fall- and spring-run Chinook salmon spawn and rear in the Trinity River and in the Klamath River upstream of the mouth of the Trinity River.

In the Trinity River basin, Chinook salmon spawn in the mainstem and south fork (with their upstream distribution limited by Lewiston Dam); at the Trinity River Hatchery below Lewiston Dam; and in the North Fork, the South Fork, Hayfork Creek, New River, Mill Creek, and Canyon Creek. Historically, most spawning occurred in the mainstem between the North Fork Trinity River and Ramshorn Creek. Portions of that area are now blocked by Trinity and Lewiston Dams. Spawning in the mainstem now occurs primarily above Cedar Flat and in downstream tributaries, as well as in the lower 2 miles of Hayfork Creek (CDFW 2015d). In the Trinity River, the distribution of redds is highly variable. The reaches closest to the Trinity River Hatchery support substantial spawning.

In the Klamath River basin, Chinook salmon formerly ascended into Upper Klamath Lake, Oregon, to spawn in the major tributaries to the lake (Williamson, Sprague, and Wood Rivers), but access to the lake was blocked by Copco Dam, built in 1917. Currently, Chinook salmon are known to spawn in the mainstem Klamath River below Iron Gate Dam; at Iron Gate Hatchery below Iron Gate Dam; and in Bogus Creek, Shasta River, Scott River, Indian Creek, Elk Creek, Clear Creek, Salmon River, Bluff Creek, Blue Creek, and the lower reaches of some of the other smaller tributaries to the mainstem river (CDFW 2015d).

Historically, most spawning occurred between the North Fork Trinity River and Ramshorn Creek (above current Trinity Reservoir). Spawning now occurs primarily above Cedar Flat, and in downstream tributaries and the mainstem Trinity River, as well as in the lower 2 miles of Hayfork Creek (CDFW 2015d), which is outside the HCP Plan Area. In the Trinity River, the distribution of redds is highly variable. The reaches closest to the Trinity River Hatchery (located below the Lewiston Dam) support substantial spawning.

Within the HCP Action Area, UKTR Chinook salmon spawn in the mainstem and South Fork Trinity River (with their upstream distribution limited by Lewiston Dam), and in Hayfork Creek (Myers *et al.* 1998). The HCP Plan Area includes a portion of the North Fork Hayfork Creek watershed. The UKTR Chinook salmon ESU is not listed under the ESA. Therefore, no critical habitat has been designated.

2.4.1.2.3. Klamath Mountains Province steelhead

The KMP steelhead DPS consists of three principal runs distinguished by migration timing: winter-run (ocean-maturing) steelhead, fall-run (stream-maturing) steelhead, and summer-run (stream-maturing) steelhead. Although there is some degree of genetic differentiation among steelhead in the three runs, genetic analysis does not support the hypothesis that winter-, fall-, and summer-run steelhead populations are separate, independent populations. Therefore, all life history variations of the KMP steelhead DPS are considered a single population source (CDFW 2015a).

KMP steelhead are found in the Klamath/Trinity River basin and streams north to the Elk River, Oregon, including the Smith River (California) and Rogue River (Oregon). In the Klamath River, the upstream limit of steelhead migration is Iron Gate Dam near the Oregon border. The historical range included tributaries to Upper Klamath Lake in Oregon (Hamilton *et al.* 2005). Lewiston Dam blocks access to over 105 miles of streams in the upper water shed of the Trinity River (Moyle *et al.* 2008).

Given that much of the habitat for the KMP summer steelhead is blocked by dams, it is likely that the summer steelhead in the Klamath River basin are only a fraction of their original numbers (CDFW 2015a). Two hatcheries, the Iron Gate Hatchery and Trinity River Hatchery, supplement existing populations in the KMP steelhead DPS. While most of the broodstock returning to the Iron Gate Hatchery are from the Klamath River, some eggs were imported from the Trinity River Hatchery and from the Cowlitz Trout Hatchery (Washington) in the late 1960s (Busby *et al.* 1994). The Trinity River Hatchery has also used imported eggs from the Iron Gate Hatchery, the Sacramento River and Eel River basins, the Willamette River in Oregon, and the Washougal River in Washington (Busby *et al.* 1994).

The fall steelhead are largely a stream-maturing run that have been classified as summer-run steelhead by NMFS (Busby *et al.* 1994, 1996). Stream-maturing forms (fall-and summer-runs) are more limited in distribution and face a higher likelihood of near-term extinction than ocean-maturing forms (winter-run steelhead) (CDFW 2015a). This is likely due to the limiting factors present in freshwater habitats (lack of spawning habitat, impaired water quality, etc.), occupied by these runs of steelhead for extended periods of time. Fall-run steelhead use the Lower Trinity River for spawning and rearing. In the mainstem Trinity River, suitable water temperatures downstream of Lewiston Dam provide habitat for summer steelhead, but their current abundance is unknown. There is no historical information on summer steelhead in the South Fork Trinity River, and all current counts are combined with “half-pounder” steelhead (*i.e.*, immature summer steelhead (CDFW 2015a).

Due to the distinctive life history variations (winter, summer, fall, half-pounder, resident forms), diverse watershed characteristics and impairments, and the difficulties in monitoring during periods of high flow/turbidity, abundance estimates for the entire KMP steelhead DPS are not available. Instead, abundance is determined on a smaller scale, focusing on seasonal timing for individual watersheds. Based on seasonal conditions and survey feasibility, summer and fall adult steelhead have the largest data sets.

Details of the abundance and distribution of KMP steelhead throughout the Trinity River basin is largely unknown. The KMP steelhead probably occur as spawners and juveniles in most accessible Trinity River tributaries with suitable water quality, including those in the HCP Action Area.

For the purposes of the HCP, the geographic extent of the KMP steelhead DPS is assumed to include all Class I streams as defined in the CFPRs in all planning watersheds within the HCP Action Area. This area includes all streams considered currently accessible and otherwise restorable for these Covered Species. Using the Class I stream designation represents a conservative estimate of anadromy in the HCP Plan Area, as this designation is based on fish presence, regardless of anadromous or resident status. The KMP steelhead DPS is not listed under the ESA. Therefore, no critical habitat has been designated.

2.4.1.2.4. SPL&T Ownership within the Trinity River Basin HCP Action Area

For the purposes of the HCP/SHA, the geographic extent of UKTR Chinook salmon and KMP steelhead is assumed to include all Class I streams as defined in the CFPRs in all planning watersheds within the Trinity River basin HCP Action Area. This area includes all streams considered currently accessible and otherwise restorable for these Covered Species.

SPL&T lands in the Trinity River basin are managed for long-term timber production and therefore, the planning watersheds have high levels of roads and historic timber harvest. Most non-SPL&T land in the forested portion of the watershed is public land managed by the Shasta-Trinity National Forest. Timber harvest on public lands has been reduced in the past several decades, and consists primarily of thinning, and limited salvage following wildfire. As a result, the amount of timber harvest (and roads) in planning watersheds is directly correlated with the portion of the watershed managed by SPI.

Approximately 26 percent of lands in the Trinity River basin HCP Action Area are owned by SPL&T, while other private landowners collectively own approximately 19 percent. Federal lands account for approximately 55 percent, most of which is managed by the USFS. State lands occupy less that 1 percent of the HCP Action Area.

SPL&T lands in the Lower Trinity HA occur in six planning watersheds in the HCP Action Area. SPL&T ownership includes approximately 18 percent (7,907 acres) of these watersheds. Approximately 4 miles of anadromous stream habitat (Class I streams) occurs in these watersheds. SPL&T lands contain approximately 83 road miles, 1 mile of which occurs within 30 feet of anadromous stream habitat. SPL&T ownership contains approximately 26 miles of perennial stream above anadromy and 30 miles of seasonally flowing streams. There are 171 road watercourse crossings in the Lower Trinity HA, and one crossing occurs in anadromous stream habitat. Covered Species present in the Lower Trinity HA include SONCC coho salmon, UKTR Chinook salmon, and KMP steelhead.

SPL&T lands in the South Fork Trinity HA occur in 18 planning watersheds in the HCP Action Area. These planning watersheds encompass approximately 208 square miles (132,776 acres). SPL&T ownership includes approximately 13 percent (17,162 acres) of these watersheds. Approximately 7 miles of anadromous stream habitat (Class I streams) occurs in these watersheds. SPL&T lands contain approximately 288 road miles, 4 miles of which are located within 300 feet of anadromous stream habitat. SPL&T ownership contains approximately 52 miles of perennial stream above anadromy and 82 miles of seasonally flowing streams. There are 424 stream crossings in the South Fork Trinity River watershed, and five road watercourse crossings occur in anadromous stream habitat. Covered Species present in the Lower Trinity HA include SONCC coho salmon, UKTR Chinook salmon, and KMP steelhead.

SPL&T lands in the Middle Trinity HA occur in 23 planning watersheds in the HCP Action Area. SPL&T ownership includes approximately 40 percent (116.8 square miles) of these watersheds. Approximately 49 miles of anadromous stream habitat (Class I streams) occurs in these watersheds. SPL&T lands contain approximately 561 road miles, 24 miles of which are located within 300 feet of anadromous stream habitat. SPL&T ownership contains approximately 208 miles of perennial stream above anadromy and 334 miles of seasonally flowing streams. There are 1,622 road watercourse crossings in the Middle Fork Trinity River watershed, and 23 crossings occur in anadromous stream habitat. Covered Species present in the Lower Trinity HA include SONCC coho salmon, UKTR Chinook salmon, and KMP steelhead.

2.4.2. Status of Covered Species and Critical Habitat in the SHA Action Area

The SHA Plan Area includes the SPL&T property within watersheds upstream of currently impassable barriers where NMFS intends to reintroduce listed salmonids. The SHA Action Area includes SPL&T lands that will be accessible to reintroduced salmonids, and other SPL&T lands that are upstream of the current known upper limit of anadromy, because of potential downstream impacts on water quality. Due to the location of the SHA Plan Area and Action Area, Covered Species are not currently present. However, due to historic presence of ESA-listed species in these areas, designated critical habitat does overlap with some portions of the SHA Action Area. In the future, NMFS plans to reintroduce ESA-listed salmonids in the following locations in the SHA Plan Area:

- The Sacramento River above the Shasta Dam (also referred to as the Little Sacramento River or the Upper Sacramento River) from Box Canyon Dam downstream to Lake Shasta.
- The McCloud River, extending downstream of Lower McCloud Falls through Lake McCloud to Lake Shasta.
- In the Battle Creek watershed, extending downstream from Whispering Falls on North Fork Battle Creek and downstream from Angel Falls on South Fork Battle Creek to the Coleman National Fish Hatchery.

- In the North Yuba River, above New Bullards Bar Dam, and in the South and Middle Yuba River, upstream of Englebright Dam on the Yuba River.
- In Stuart's Fork of the Upper Trinity River, the East Fork of the Trinity River, and the mainstem of the Trinity River upstream of Trinity Lake as influenced by Trinity Dam.

The NMFS recovery plans (NMFS 2014a, NMFS 2014b) identified potential reintroduction areas based on the historical range of the listed species and that current habitat conditions in these areas are capable of supporting listed salmonid populations. The SHA Action Area is within five CalWater (2018) Hydrologic Units (HUs), and several CalWater Hydrologic Areas (HAs) and Hydrologic Sub-Areas (HSAs). The five HUs include McCloud River, Upper Sacramento River, Shasta Dam, Yuba River, and Trinity River.

Table 7. Conditions of Historically Anadromous Watersheds in the SHA Plan Area.

Cal Water Hydrologic Unit	Hydrologic Unit Area (square miles)	Area Within SHA Action Area (square miles)	Miles of Perennial Stream	Miles of Seasonal Stream	Number of Stream Crossings	Road Density (road miles per square mile)	Area Harvested 2007–2016 (square miles)	Area Burned by Wildfire 2007–2016 (square miles)
Upper Sacramento	423	60	138	147	943	6.1	9.8	0.8
McCloud River	684	47	119	123	650	5.7	13.6	18.0
Shasta Dam	373	35	87	127	656	4.9	2.9	NA
Yuba River	1,495	126	238	443	2,067	5.7	46.1	0.8
Trinity	2,970	63	209	190	1,669	6.3	12.5	NA

2.4.2.1. Upper Sacramento River

The 423-square-mile Upper Sacramento[3] HU originates from water draining from Mount Shasta to the north and from the Klamath Mountains to the west. The basin spreads south for approximately 40 miles and empties into Lake Shasta, above Shasta Dam. SPL&T ownership includes approximately 14.4 percent of the land in the Upper Sacramento River basin; however, much of the surface drainage from Mount Shasta typically only connects to the river above Box Canyon Dam, outside the SHA Action Area. SPL&T lands included in the SHA Plan Area encompass approximately 60 square miles (38,420 acres), or about 9 percent of the 109-square mile Dunsmuir HSA below Box Canyon Dam. Importantly for the SHA, SPL&T owns 29.7 percent of the 169-square-mile Lamoine HA in the lower portion of the Upper Sacramento River Canyon.

[3] The Upper Sacramento River referred to here is the same stream referred to as the Little Sacramento River in NMFS (2014a).

The Upper Sacramento River is classified as a Candidate stream for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and CCV steelhead by NMFS (2014a). Candidate streams are possible areas for reintroduction that are characterized as currently unoccupied habitats requiring further study of their potential for successful reintroduction efforts.

2.4.2.2. McCloud River

The McCloud River HU drains an approximately 684 square mile (437,760 acres) area and is located near the southern end of the Cascade Range. The headwaters are located in Colby Meadows, approximately 85 miles northeast of Redding. The McCloud River flows southwesterly for approximately 50 miles to Lake Shasta, entering the Shasta Dam HU. Overall, SPL&T owns 14.6 percent of the McCloud River HU, which is divided between the Wyntoon and Squaw Creek HAs. Overall, about 60 percent of the Wyntoon HA lies in the McCloud River HU above McCloud Dam and Reservoir, and about two-thirds of SPL&T ownership in the Wyntoon HA is also above the dam and impoundment. These areas of the McCloud River HU are excluded from the SHA.

Below McCloud Dam, the Lower McCloud River and its major tributary, Squaw Valley Creek, run south through steep forested canyons toward Lake Shasta, which is 15 miles downstream. Below McCloud Dam, SPL&T lands included in the SHA Plan Area encompass approximately 27.2 square miles (17,400 acres), or about 26.3 percent and 7.7 percent of land in the Lower McCloud River and Squaw Valley (Creek) HSAs, respectively, representing the most important portion of the McCloud River area for purposes of the SHA.

The McCloud River is classified as a Primary stream for winter-run Chinook salmon, spring-run Chinook salmon, and steelhead reintroduction by NMFS (2014a). Primary streams are areas for reintroductions where there is a known high likelihood of success based on species-specific life history needs, as well as available habitat quality and quantity.

2.4.2.3. Shasta Dam Basin

The 373-square-mile Shasta Dam HU comprises the Lake Shasta HA. The HU includes numerous small streams entering the reservoir, but it does not include the lake’s four major tributaries (Upper Sacramento River, McCloud River, Squaw Creek, and Pit River). SPL&T owns 11 percent of the land within the Shasta Dam HU, but most of SPL&T land within the unit drains into Lake Shasta rather than into the tributaries included in the SHA. The Shasta Dam basin is not included in the NMFS (2014a) reintroduction priority classifications.

2.4.2.4. Yuba River

The 1,495-square-mile Yuba River HU drains from the west slope of the Sierra Nevada at Donner Pass to the Feather River near Yuba City. Most of the flow in the Yuba River comes from its three supporting HAs: North, Middle, and South Yuba Rivers. New Bullards Bar Dam and Bullards Bar Reservoir block the North Yuba River HA. SPL&T owns about 38.7 square miles (24,760 acres), or 8 percent, of the 349-square-mile (223,359 acres) North Yuba River HA; 55.3 square miles (35,432 acres), or 27 percent of the 211-square-mile (135,039 acres) Middle

Yuba River HA; and approximately 32.4 square miles (20,754 acres), or 9.2 percent, of the 353-square-mile (225,920-acre) South Yuba River HA. Below New Bullards Bar Dam, the three forks join to form the mainstem Yuba River, which is then impounded by Englebright Reservoir and Englebright Dam. Englebright Reservoir is over 20 miles downstream from any SPL&T property, except for one parcel of 0.17 square miles (108 acres) located just below New Bullards Bar Dam in the Ure Mountain HA. The HAs of the three Yuba River forks comprise the SHA Action Area in the Yuba River HU.

The North and Middle Yuba Rivers are classified as Primary streams for spring-run Chinook salmon and steelhead reintroduction by NMFS (2014a), while the South Yuba River is classified as a primary stream for steelhead and a Candidate stream for spring-run Chinook salmon (NMFS 2014a).

2.4.2.5. Trinity River

The Trinity River HU encompasses 29,710 square miles. This unit includes the Upper Trinity River HA, which encompasses 1,183 square miles (757,120 acres), and represents the portion of the Trinity River HU upstream of Trinity Lake. Historically, the Upper Trinity River functioned as a dynamic river reach, with quality spawning and rearing habitat for anadromous fish. The 1958 construction of the Trinity River Diversion and the 1963 construction of the Lewiston Dam effectively blocked upstream access and limited production of salmonids downstream of the dam. The SHA Action Area includes three watersheds in the Upper Trinity River HU; Stuart's Fork Trinity River, (upper) mainstem Trinity River, and the East Fork Trinity River. SPL&T lands in these watersheds encompass approximately 6.6 square miles, 29.1 square miles, and 27.0 square miles (4,204 acres, 18,634 acres, and 17,294 acres), respectively.

The Upper Trinity River HU occurs within the Upper Trinity River population of the Interior Trinity Diversity Strata for SONCC coho salmon population (NMFS 2014b). While this HU is above the current anadromous limits, the SONCC population encompassing this area is considered functionally independent and at a moderate extinction risk (NMFS 2014b).

2.4.3. Factors Affecting Covered Species and their Habitat within the Action Areas

A number of factors influence salmonids and salmonid habitat across the HCP and SHA Action Areas. Given the large extent of these Action Areas, the factors affecting salmonids at the ESU and DPS scales as discussed in the Status of the Species section apply similarly to the Action Areas.

2.4.3.1. Dams and Other Passage Impediments

The construction of dams and other structures around the Central Valley has blocked anadromous salmonids from most of their historic spawning and initial rearing habitat, eradicating most historic populations of winter-run Chinook salmon, spring-run Chinook salmon, and steelhead. Between 72 to 90 percent of the original Chinook salmon spawning and holding habitat in the Central Valley drainage is no longer accessible due to dam construction (Cummins *et al.* 2008; Yoshiyama *et al.* 2001). Winter-run Chinook salmon lost three of its four historical spawning populations with the construction of Keswick and Shasta Dams. Perhaps 15 of the 18 or 19 historical populations of Central Valley spring-run Chinook salmon have been extirpated, with their entire historical spawning habitats upstream from impassable dams (Lindley *et al.* 2007). Currently, impassable dams block access to 80 percent of historically available habitat, and block access to all historical spawning habitat for about 38 percent of the historical populations of steelhead (Lindley *et al.* 2006).

Lewiston Dam has blocked access to more than 170 kilometers (km) of habitat on the Trinity River since 1963. Along with Trinity Dam, located just upstream, the dam has greatly reduced flows and altered the natural hydrograph of the mainstem Trinity River. The quality and quantity of salmon and steelhead habitat has been substantially reduced as a result. It has also eliminated the spatial segregation between spring and fall-run Chinook. This has likely led to significant interbreeding between fall- and spring-run Chinook in the Trinity River, to the detriment of each (Myers *et al.* 1998, Kinziger *et al.* 2008). In an effort to restore mainstem habitat, the Trinity River Restoration Program (initiated in 2000 as part of the Trinity River Record of Decision) was implemented with the goal of restoring up to 48 percent of flows into the Trinity River. Since its implementation, restoration has included augmentation of summer flows, habitat improvements, reconnection between the stream channel and floodplain, and spawning gravel supplementation.

Other structures contributing to the decline of salmonids in the HCP/SHA Action Area include road crossings, bridges, culverts, flood control channels, erosion control structures, canal and pipeline crossings, tide-gates and gravel mining pits.

2.4.3.2. Hatcheries

More than 32 million fall-run Chinook salmon, two million spring-run Chinook salmon, one million late fall-run Chinook salmon, 0.25 million winter-run Chinook salmon, and two million steelhead are released annually from six hatcheries producing anadromous salmonids in the Central Valley. All of these facilities are currently operated to partially mitigate for natural historic habitats that have already been permanently lost as a result of dam construction. The loss of this available habitat results in dramatic reductions in natural population abundance, which is partially mitigated for through the operation of hatcheries. During spawning, hatchery-and natural origin salmonids may compete for habitat, and interbreeding may reduce genetic integrity. Throughout juvenile rearing and outmigration, hatchery- and natural-origin salmonids may compete for habitat and food. When larger, juvenile, hatchery-origin steelhead are released into the river, they may predate on smaller natural-origin salmonids.

The impacts of hatchery propagation on wild spring-run fish in the Trinity basin may be substantial. Most naturally spawning fish are considered to be of wild origin, though there is a component of hatchery Chinook salmon that spawn in natural areas, particularly close to the Lewiston Dam (CDFW 2017). Mixed runs of wild and hatchery-reared fish tend to segregate themselves above Junction City, with a significant portion of hatchery fishes returning to the Trinity River Hatchery. However, artificial selection in a hatchery has been demonstrated to reduce fitness in fish reproducing in the wild (Araki *et al.* 2007, 2009). Hatchery spring-run Chinook salmon hybridize with fall-run fish on the Trinity due to reductions in habitat and shifts in run timing (Kinziger *et al.* 2008).

The Trinity River Hatchery also continues to produce relatively large numbers of SONCC coho salmon annually as mitigation for the adverse effects of dam construction on coho salmon populations. In the Trinity River, over 90 percent of returning coho are of hatchery origin, indicating natural spawning of wild-origin fish is depressed (Spence *et al.* 2005). Hatchery returns and 'wild' populations fluctuate more or less in synchrony. The Trinity River Hatchery releases over 500,000 smolts each year, with unknown, but presumably detrimental (density-dependent) effects on wild-produced fish. However, the number of natural origin fish returning to the Trinity River seems to have increased somewhat in recent years (2012, 2013). Total numbers of adults returning to the Trinity River watershed are estimated be between 5,000 and 39,000 fish, with considerable year to year variability; the number of adults that are not of hatchery origin is presumably between 500 and 3900 each year, usually on the lower end of this range (Swales 2016).

2.4.3.3. Mining

The first major anthropogenic impact on the Central Valley watersheds came from hydraulic mining in the years shortly after the California gold rush began in 1848. By 1859, an estimated 5,000 miles of mining flumes and canals diverted streams used by salmonids and sturgeon for spawning and nursery habitat. Habitat alteration and destruction also resulted from the use of hydraulic cannons, and from hydraulic and gravel mining, which leveled hillsides and sluiced an estimated 1.5 billion cubic yards of debris into the streams and rivers of the Central Valley (Lufkin 1991). Mining practices profoundly altered landscape form and process in the following ways: streams were dammed, diverted or drained; soil and vegetation was stripped over large areas; piles of coarse mine tailings reduced floodplain inundation; and excessive sediment loading massively aggraded and armored stream channels. Many of these impacts persist today, with severe and enduring effects on critical habitat for salmon species (NMFS 2014a, NMFS 2014b).

The Trinity River Basin was also a site of active mining; suction dredging, placer mining, and gravel mining continues to the present day. Lode mining for gold, copper and chromite continued as recently as 1987. Water was diverted and pumped for use in sluicing and hydraulic mining operations. Hydraulic mining for gold washed hillslopes down into streams, causing siltation and sedimentation of waterways, degradation of riparian habitats, and alteration of stream morphology. Some believed that the hydraulic mining period resulted in greater impacts to the salmon fishery than the large fish canneries of the era. The negative impacts of stream siltation on fish abundance was observed as early as the 1930s. Following mining, several impacted streams containing large volumes of silt seldom had large populations of salmon or trout (Smith 1939).

Since the 1970s, large-scale commercial mining operations have been eliminated due to stricter environmental regulations. However, smaller mining operations continue including suction dredging, placer mining, gravel mining, and lode mining. These mining operations can negatively affect spawning gravels, result in increased poaching activity, decreased survival of fish eggs and juveniles, decreased benthic invertebrate abundance, adversely affect water quality, and impact streambanks and channels. Unfortunately, the rise in the price of gold in recent decades saw a resurgence of instream mining, mostly through the use of small gasoline-powered vacuum dredges. This activity disturbs fish, turns over streambeds, and reduces water clarity when juvenile salmonids are most stressed because of natural conditions (*e.g.*, warmer temperatures). Fortunately, instream dredging was banned by CDFW in 2016 after a seven-year moratorium.

Gravel and sand removal from streams and adjacent floodplains is common in much of northern California. The greatest demand for these products is for industrial purposes. Removal of these materials from a stream channel may fundamentally alter the routing of water and sediment through the system, resulting in altered channel morphology, decreased stability, accelerated erosion, and changes in the composition and structure of the substrate. For example, complete channel degradation (to bedrock) can occur. This can adversely affect the amount of available salmon spawning habitat and juvenile rearing conditions. The extent to which this type of mining affects streams and rivers depends on many site-specific characteristics, including the geomorphic setting, the quantity of material extracted relative to the sediment supply, and the hydrologic and hydraulic conditions within the stream reach.

2.4.3.4. Climate Change

A factor potentially affecting the condition of watersheds in the Sacramento River and Trinity River basins, and aquatic habitat at large, is climate change. Climate experts predict physical changes to river and stream environments along the West Coast that include rising air temperatures, increased precipitation from rain rather than snow, and diminished snow pack—all of which will result in altered stream flow volume and timing, increased winter flooding, lower late summer flows, and a continued rise in stream temperatures (Williams *et al.* 2016). The increase in air temperatures and decrease in precipitation associated with warmer climate change scenarios also may increase the frequency and severity of wildfires (Sankey *et al.* 2017). The long-term changes may change salmon and steelhead distribution, behavior, growth, and survival, and are important to consider when evaluating existing conditions and potential future conditions relevant to habitat conservation, and potential effects of Covered Activities included in the HCP/SHA. The main impacts of climate change relevant to the Covered Activities include changes in temperature, hydrology, wildfire and associated fine sediment input, and vegetation.

Warmer temperatures associated with climate change may reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen *et al.* 2000). California has recently experienced record high air temperatures (2013 and 2015) (NOAA 2017). Central and north coast California have shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). Water temperatures may rise, especially during the summer months when lower streamflow and warmer air temperatures will contribute to warming regional waters. Such changes may not be spatially homogenous. Areas with elevations high enough to maintain temperatures below freezing for most of the winter and early spring are expected to be less affected. Low-lying areas that have historically received scant precipitation contribute little to no streamflow and may be more affected.

In recent years, California has experienced well below average precipitation (2012, 2013, 2014, and 2015; NOAA 2017), record high air temperatures (2014 and 2015; NOAA 2017), and record low snowpack (2015; Seghesio and Wilson 2016). North coast and central California have shown trends toward an increase in the ratio of rain to snow, shortened and delayed snowfall season, and accelerated rates of spring snowmelt (Kiparsky and Gleick 2003). The altered seasonality results in runoff events occurring earlier in the year due to a shift in precipitation falling as rain rather than snow (Roos 1991; Dettinger *et al.* 2004). Studies suggest that the spring streamflow maximum could occur about 1 month earlier by 2050 (Barnett *et al.* 2005).

The magnitude of snowpack reductions is subject to annual variability in precipitation and air temperature, particularly in the Cottonwood Creek watershed. Factors modeled by VanRheenen *et al.* (2004) show that melt season shifts to earlier in the year, leading to a large percent reduction of spring snowmelt (up to 100 percent in shallow snowpack areas). Additionally, an air temperature increase of 3.8°F is expected to result in a loss of about half of the average April snowpack storage (VanRheenen *et al.* 2004). The decrease in spring snowmelt would be greatest in the region of the Sacramento River watershed and the Trinity River watershed, where snowpack is shallower than in the San Joaquin River watershed located south of the HCP/SHA Plan Areas.

Climate change effects contributing to warming and reduced snowpack, an increase in the number of fire ignitions, and historical land management practices including timber harvest and fire suppression activities likely have led to an increase in the number of large wildfires (greater than 1 square mile) and the total area burned annually across the western United States (Barr *et al.* 2010). Along the west coast, 88 percent of the watersheds are projected to have a 10 percent increase in sediment yield between 2001 and 2050 due to increases in burning and post-fire hillslope erosion (Sankey *et al.* 2017). The increase in sediment yield will likely be caused by climate-change-induced increases in frequency and severity of wildfires through 2050 (Hawbaker and Zhu 2012). Other climate change effects may include issues associated with increases to sediment yield resulting from episodic sediment input due to changes in the magnitude and frequency of large storms. These events may cause increased runoff or slope failure on landscape features impacted by roads and timber management.

Central Valley spring- and winter-run Chinook salmon, SONCC coho salmon, and CCV steelhead are particularly vulnerable to climate change, because they spend summers as pre-spawn adults and/or rearing juveniles in freshwater streams (Williams *et al.* 2016). Based on existing climate models, the most plausible projection for warming over northern California is 4.5°F by 2050 and 9°F by 2100 (Dettinger 2005b). Because most existing salmonid runs are restricted to low elevations by impassable dams, if the climate warms by 9°F, it has been questioned whether any Central Valley or Trinity River salmonid populations can persist (Williams 2006; South Fork Trinity River Spring Chinook Subgroup 2013). Tributaries without cold water refugia (usually input from springs) will be more susceptible to impacts of climate change. Even in tributaries with cool water springs, in years of extended drought and warming water temperatures, unsuitable conditions may occur. Additionally, juvenile salmon often rear in the natal stream for one or two summers prior to emigrating and would be susceptible to warming water temperatures.

2.4.3.5. Timber Harvest and Related Activities

In general, timber harvesting and related activities, such as road construction, are widespread activities that occur throughout the HCP/SHA Action Area and have been one of the more significant impacts on salmonids and their habitat across the entire HCP/SHA Action Area. The greatest historic impacts of commercial forestry on salmonids and their habitat occurred when timber harvest and road construction were unregulated, resulting in a legacy of impacts that are still observed in the environmental baseline. However, since 1973, commercial forestry has been regulated in California, and those regulations have become increasingly more protective of salmonids and their habitat. Accordingly, past impacts are gradually ameliorated through natural processes and improvements in current forest practices, resulting in habitat conditions that are projected to gradually improve over the life of the proposed action. How past activities and baseline trends influence watershed processes and, consequently, influence stream habitat and salmonids are discussed in the following sections (*i.e.*, water quality, temperature, sediment, riparian function, and land use).

2.4.4. Environmental Baseline Conditions in the Sacramento River Basin HCP Action Area

This section provides baseline information for Covered Species and Core watersheds in the Sacramento Basin portion of the HCP Action Area. The environmental baseline conditions on SPL&T lands in the HCP Action Area is influenced by SPI timberland management activities and the CFPRs.

2.4.4.1. Geology

North of the Sierra Nevada, the Cascade Range creates the northeastern boundary of the HCP Action Area. The Cascade Range, which extends from southern British Columbia to northern California, is a chain of volcanic cones created through tectonic activity (Tehama County Resource Conservation District 2010). The Tuscan Formation of the Pliocene age, primarily consisting of ancient volcanic mudflows, dominates the geology of the watersheds of the northeastern California tributaries of the Sacramento River (Armentrout *et al.* 1998). Geologic diversity is also supplied by flows of igneous volcanic rock that overlay the Tuscan Formation to form the Mill and Lost Creek Plateaus. Glacial processes shaped some of the higher elevation landforms (Armentrout *et al.* 1998).

The Basalt and Porous Lava diversity group and the Northern Sierra Nevada diversity group share similar geology and topography (California Geological Survey 2010). The units are primarily in the Tuscan Formation and consist of long, generally parallel streams incised into relatively mobile, volcanic deposits. As waters move from the steep mountainous region to the valley, they form broad and overlapping alluvial fans where erosion from the mountains has been deposited to create separate and distinct soil profiles (Tehama County Resource Conservation District 2010).

On the western portions of the Sacramento River valley in the Northwestern California diversity group, mountains and foothills of the Coast Range and Klamath Mountains Provinces form an 80-mile-wide boundary between the ocean and valley. The mountains consist of various highly erosive formations of poorly lithified, marine sedimentary rocks, in addition to the decomposed granitic soils of the Shasta Bally Batholith (California Geological Survey 2010). Large, active landslides contribute to the sediment discharge in the area, and are caused by relatively high rainfall amounts and poorly composed bedrock.

2.4.4.2. Watershed Conditions

Recent assessments of watershed conditions that pose continuing threats to ESA-listed fish in the Sacramento River basin (NMFS 2014a; Williams *et al.* 2016) include but are not limited to low flows, passage issues and diversions in reaches below forested regions, road density and road watercourse crossings, current and past timber harvests, and wildfires. Appendix D, Table D-1 provides information from the HCP Plan area summarizing the number of road miles, road watercourse crossings and past harvest within planning watersheds encompassing SPL&T lands.

In planning watersheds where road inventories have been conducted, Appendix D, Table D-1 in the HCP/SHA presents additional information showing the number of connected sites and percentage of road miles connected to stream channels (also summarized in Table 5 below). This information relates to the potential for sediment production from existing roads affecting ESA-listed fish and provides a correlation between the planning watersheds with permanent monitoring stations and other planning watershed data. Appendix D, Table D-1 in the HCP/SHA includes watershed conditions data for Judd Creek and Upper San Antonio Creek, which both have long-term monitoring and planning watershed condition data. These two monitoring watersheds show disconnection values of approximately 76 and 90 percent, with approximately five and 13 percent of road-related sediment delivering to streams. The remaining planning watersheds in which READI has been completed show disconnection values ranging from approximately 60 to 99 percent, with an average of 56 percent. Road related sediment contributing to streams ranges from approximately 3 to 23 percent, and averages 16 percent. The potential sediment production values are slightly greater in the planning watersheds than monitoring watersheds; however, the average value in the planning watersheds is near the range in the monitoring watersheds and suggests comparable results overall. Additional READI Model data from un-surveyed planning watersheds and additional monitoring watersheds included to support HCP/SHA monitoring (*i.e.*, greater sample size) will strengthen the correlation between monitoring and other planning watersheds.

Appendix D, Table D-2 in the HCP/SHA shows the planning watersheds (and streams included in Table D-1) and provides road mile and stream crossing summary information relative to the amount of streams subject to anadromy. These summaries show that 11 of 79 of planning watersheds in the Sacramento River basin portion of the HCP Action Area are subject to anadromy, approximately 15 miles of anadromous stream reaches occur on SPL&T lands in these planning watersheds, and 3.5 road miles and four stream crossings occur in these anadromous stream reaches. Additionally, of the four stream crossings occurring in anadromous stream reaches, only two consist of wet crossings (fords) (see Table 5 for road mile and stream crossing summaries for the 11 planning watersheds subject to anadromy).

Precipitation in the Sacramento River basin varies from 25 to 80 inches per year over the range in elevations in the region (approximately 180 to 8,200 feet) (Armentrout *et al.* 1998; Big Chico Creek Watershed Alliance 2017). Flows are lowest in September, increase through October and November, and decrease again in late spring and summer (Kondolf 2001). Peak flows from the watershed are dominated by rain-on-snow events, with most flow events occurring during winter months (December through February) when snow is present in the transient zone (above approximately 3,000 feet in elevation). Earlier season peaks in flow (September through

November) are most likely rain events with little snow influence. Later peaks (mid-March through May) are mostly likely snowmelt-generated peaks (NMFS 2014a).

2.4.4.3. Land Management

Historically, fire has helped sustain natural forest communities and influenced the composition and structure of forests in the watersheds prior to European settlement. The advent of fire suppression early in the 1900s, together with the reduction of fire ignitions by native peoples, have resulted in fire frequencies much different than those present prior to European settlement (Armentrout *et al.* 1989). Intense wildfires remove groundcover and large wood recruitment near streams, and they increase erosion and peak flows until vegetation can recover (Roby and Azuma 1995). In recent years (2007-2018), five watersheds in the HCP Action Area have been the sites of large fires (greater than 10 square miles) (Appendix D of the HCP/SHA, Table D-1), with intense fires predominating. The combination of increasing air temperatures, decreasing precipitation, and fire suppression practices have increased the frequency and severity of wildfires in the Central Valley of California (Westerling and Bryant 2008). In 2017, the Central Valley watersheds within SPL&T covered lands experienced 16 wildfires that burned 1.45 square miles (928 acres) of land (CAL FIRE 2017).

Fire covering more than 3.9 square miles (2,500 acres) within the HCP Action Area, or more than 1.5 square mile (1,000 acres) within a single watershed in the HCP Action Area, but covering less than 23.5 square miles (15,000 acres) of the HCP Plan Area or SHA Plan Area (which is defined as an unforeseen circumstance), is described as a Changed Circumstance within the HCP/SHA.

Road construction and operation has long been understood to be a major factor in water quality degradation (Lieberman and Hoover 1948). More recent research has found logging roads can be a source of landslides and elevated turbidity (Keppeler *et al.* 2008).

2.4.4.4. Temperature

SPI monitors water temperature at two water quality monitoring stations that are representative of SPI management in the HCP Action Area (Upper San Antonio Creek and Judd Creek) and one in the SHA Action Area (Hazel Creek), as well as several stations outside the HCP and SHA Action Areas. Monthly average daily water temperatures for water years 2008 to 2017 were similar for each station and ranged from -1°C in the winter to 18°C in the summer. Monthly maximum daily water temperatures were slightly higher, ranging from 0°C in the winter to 21°C in the summer (Appendix F of the HCP/SHA).

2.4.4.5. Suspended Sediment

When describing water quality parameters, suspended sediment refers to the particulate matter moved by water and is typically measured as milligrams of particulate matter to liters of water (mg/L). Although the watersheds within the Sacramento River basin HCP Action Area have not been sampled for suspended sediment for impaired watershed studies (California Environmental Protection Agency 2017), several watersheds have evidence of increased sedimentation. The Deer Creek and Mill Creek watersheds had increased sedimentation due to road construction and clearcutting within the HCP Action Area in the past (Armentrout *et al.* 1998). More recently, several timber harvest roads have been decommissioned, reducing the sediment loads from previously recorded levels (NMFS 2014a). The Northwestern California diversity group includes the Cottonwood Creek and Clear Creek watersheds. These areas have large quantities of fine sediment in the river system because of historical gold mining activity that used dredge, hydraulic, and ground-sluicing techniques. Sediment level on Clear Creek are also due to removal of the McCormick-Saeltzer Dam (NMFS 2014a).

2.4.4.6. Turbidity

Turbidity, the measure of cloudiness of a liquid by organic matter or inorganic particles, is quantified using nephelometric turbidity units (NTU). Based on criteria developed by the California Regional Water Quality Control Board, the increases in turbidity attributable to controllable water quality factors shall not exceed the following limits (CRWQCB 2016):

- Where natural turbidity is between 0 and 5 NTU, increases shall not exceed 1 NTU.
- Where natural turbidity is between 5 and 50 NTU, increases shall not exceed 20 percent.
- Where natural turbidity is between 50 and 100 NTU, increases shall not exceed 10 NTU.

SPI monitors turbidity at one water quality monitoring station in the HCP Action Area and one in the SHA Action Area. An additional monitoring station is located outside both plan areas (San Antonio Creek), Average daily NTU is generally very low (0 to 10 NTU); however, several measurements in 2016 and 2017 exceeded 10 NTU and reached as high as 35 NTU. Average daily maximum NTU is usually less than 20 NTU, but values as high as approximately 110 NTU occurred in 2017 (Appendix F of the HCP/SHA).

2.4.4.7. Aquatic Habitat

Aquatic habitat in the Sacramento River basin has been degraded by dam construction and operation, water diversions, livestock grazing, mining, and development; particularly in the lower watershed reaches. The HCP Action Areas occur in the upper reaches and headwaters, which typically provide high quality fish habitat compared to lower watershed reaches subject to greater levels of these impacts.

2.4.4.8. Riparian Function

Riparian corridors serve multiple purposes and functions for protecting streams. They preserve water quality by creating shade to maintain cooler water temperatures and filtering sediment from runoff before it enters streams and rivers; protect stream banks from erosion; provide a storage area for flood waters; and provide food and habitat for fish and wildlife. The purpose and function of the riparian corridors is to provide habitat functions in fish bearing streams. Habitat functions include hardwood canopy retention to provide detritus as a food source for benthic macroinvertebrates, which in turn become a food source for fish. Large diameter trees maintained near the watercourses provide potential LWD, thus increasing stream complexity, pool formation, and cover for salmonids. Maintaining cold-water inputs from springs and smaller order watercourses (accomplished using CFPRs canopy retention requirements) provide temperature modifications for the larger, wider fish-bearing stream channels.

To protect riparian conditions and function within the areas of timber harvest on private lands, CFPRs were established in the early 1970s. Initial rules focused on reducing activities within near proximity to streams and retaining live canopy to produce shade. With the establishment of the Threatened and Impaired Watershed Rules in the late 1990s and the ASP rules in 2010, the goals for improved riparian corridors include higher canopy closure, greater numbers of large diameter trees, greater retention of high value wildlife features and less exposed soil in the vicinity of watercourses. CFPR requirements for assessing post-harvest riparian corridor conditions include canopy closures averaging 70 percent, average diameter of overstory trees exceeding 24 inches, no cut core areas of 30 feet on each side of a fish bearing stream, an inner zone of 70 feet within minimal harvest occurring and soil stabilization required when greater than 100 square feet of exposed soil occurs as part of CEQA-approved projects.

Riparian corridors within SPL&T lands meet the CFPRs requirements and are regularly verified during post-harvest inspections. Additionally, riparian corridors in portions of the HCP Plan Area occupied by anadromous fish meet the CFPR ASP rules for anadromous watersheds. SPI plot data in WLPZs from the HCP Plan Area from 5,564 plots covering 22,256 acres shows on average 16.9 trees per acre greater than or equal to 22 inches diameter breast height; of those, 14 are conifers and 2.9 are hardwoods. These areas are within 100 feet of the stream edge and average 310 trees per acre and 153 square feet of basal area. These areas also have canopy closures exceeding 80 percent. Given the CFPR and ASP rules, and the conservation measures in the HCP, these conditions will persist throughout the life of the HCP and continue providing high-quality and functional riparian habitat.

Additional consideration of the differences between vertical canopy cover and ecological shade suggests greater amounts of stream shade occur within riparian areas in the HCP/SHA Plan Areas. The CFPR 50 percent (vertical) canopy cover standard is measured by height independent techniques using overlapping tree crown cover (*e.g.*, spherical densitometer) and provides conservative total canopy cover estimates. When considering canopy closure measurements from techniques that are height dependent (*e.g.*, modeled index using forest plot data), results show vertical canopy cover greater than 60 percent corresponds to approximately 85 percent or greater ecological shade canopy, as these techniques account for non-overstory species that otherwise provide stream shade.

2.4.5. Baseline Conditions within the Trinity River Basin HCP Action Area

This section provides general baseline information for the Trinity River basin and summarizes Covered Species and watershed information in the Trinity Basin portion of the HCP Action Area. The NMFS SONCC Coho Salmon Recovery Plan (NMFS 2014b) classifications are used to summarize SPL&T lands relative to recovery plan classifications and describe common environmental conditions in the basin.

2.4.5.1. Geology

The Trinity River is the largest tributary to the Klamath River and drains approximately 3,000 square miles (1.92 million acres). The terrain in the Trinity River system is predominantly mountainous and forested, with elevations ranging from 9,000 feet in the Trinity Alps and the Trinity Mountains to 190 feet at the Klamath River confluence.

The topography within the Trinity River region is generally steep. Streams and rivers in the region are confined within deep canyons due primarily to the persistent and significant geologic uplift. Landslides are common on the steep valley walls, particularly within streamside inner gorges (USDA 2003). The abundance of mass wasting (*i.e.,* landslides) in these areas is a result of the steep topography, high rainfall amounts, and poorly lithified substrate, which has resulted in the delivery of large amounts of fine sediment in stream channels (USDA 2003).

The geology in the Trinity River region is complex and underlain by two major geologic provinces: the Klamath and Coast mountain ranges. The two ranges differ significantly based on age, lithology, structure, and metamorphism. The Klamath Mountains make up over 98 percent of the Lower and Middle Trinity River watersheds. The South Fork Trinity River watershed straddles the boundary between the Klamath Mountains and the Coast Range.

The Klamath Mountains province is a complex geologic region formed by the accretion of crustal material along the western edge of the North American continent during ancient subduction (California Geological Survey 2010). The region is characterized by elongate, fault-bounded belts of rock representing individual accretion events (USDA 2003). The belts are aligned in a concentric, northwest-trending fashion, and increase in age from southwest to northeast. Rocks in the province include greywacke sandstones, mudstones, greenstones, radiolarian chert, and relatively minor limestone, as well as metamorphic equivalents of those rock types and abundant granitic and intrusive ultramafic rocks (Snoke and Barnes 2006). The arrangement of those materials and their varying permeability often give rise to unstable landscapes capable of producing a large range of sediment from boulders to sand, silt, and clay. The Coast Range is underlain by the Franciscan Assemblage, a highly deformed, faulted, and sheared complex of partly metamorphosed marine sedimentary and volcanic rocks that actively decompose as they are exposed to the atmosphere and generate large volumes of sediment (CalWater 1980).

The Lower Trinity River landscape has historically been sensitive to human disturbance. Many slope failures are attributable to land use activities such as timber harvest, road construction, and hydraulic mining (USDA 2003). Similarly, the South Fork Trinity River watershed is characterized by unstable geology along with erosion-producing land use practices that lead to streamside landslides (NMFS 2014b). The Middle Trinity River includes the Weaverville Formation, a large slice of Oligocene continental material consisting of weakly consolidated mudstone and sandstone conglomerate with an impervious clay matrix. The Weaverville Formation tends to be unstable, particularly along over-steepened road cuts and steep banks (Trinity Resource Conservation and Development Council 2004) and can produce large quantities of fine-grained sediment.

SPI conducted a GIS-based land stability analysis for planning watersheds in the Trinity River Basin HCP Plan Area and SHA Plan area to aid conservation strategy and mitigation planning efforts. The analysis used data compiled by Wills *et al.* (2011) which incorporates landslide inventory, geology, rock strength, and slope to analyze statewide landslide susceptibility. The data creates classes of landslide susceptibility from zero to ten, low to high. SPI overlaid the GIS dataset onto the Trinity River Basin HCP and SHA planning watershed boundaries and summarized landslide risk categories for all HCP Plan Area and SHA Plan Area lands. This summary provides criteria for prioritizing mitigation strategies by planning watersheds and enables SPI to select planning watersheds most prone to slope failure in conjunction with READI Model results for road improvement treatments. This allows SPI the ability to reduce the greatest risk and most likely potential sediment sources during the permit period. The land stability analysis summaries by HCP Plan Area and SHA Plan Area planning watersheds are presented in Appendix E, Tables E-3 and E-4 in the HCP/SHA.

2.4.5.2. Watershed Conditions

Recent assessments of watershed conditions describe several key threats to ESA-listed salmonids in the Trinity River basin (NMFS 2014b) including dams and diversions, hatcheries, and roads; and key stressors that include altered hydrologic function, impaired water quality, and adverse hatchery related effects.

Appendix E, Table E-1 in the HCP/SHA provides information summarizing the number of miles of road, road watercourse crossings, and past harvest within planning watersheds encompassing SPL&T lands. Additionally, where planning watershed data has been collected, additional columns showing the number of connected sites and percentage of the road miles that are disconnected have been populated.

Appendix E, Table E-2 in the HCP/SHA shows the planning watersheds and streams included in Table E-1 and provides road mile and road watercourse crossing summary information relative to the number of streams subject to anadromy. These summaries show the limited amount of planning watersheds subject to anadromy, the limited amount of anadromous stream reaches on SPL&T lands in these planning watersheds, and that relatively few road miles and a limited number of road watercourse crossings occur in these anadromous stream reaches. Additionally, of the 29 stream crossings occurring in known or presumed anadromous stream reaches, 23 (79 percent) consist of bridges or culverts. See Table 6 below for road mile and stream crossing summaries for the 31 planning watersheds subject to anadromy in the Trinity River basin HCP Action Area.

Within the Trinity River basin, mean annual precipitation can reach 70 to 80 inches over the coastal ridges, diminishing with lower elevations to averages of 40 to 60 inches in the foothills. Approximately 90 percent of the precipitation falls between October and April. Snow usually remains at highest elevations through May or June (USDA 2003).

The combination of land use, fire suppression actions, and climate change has contributed to the increase in frequency and severity of wildfires in the western United States (Miller *et al.* 2012). In the Klamath Mountains, fire frequency, size, and total area burned have greatly increased over the last 20 years (Miller *et al.* 2012). A recent study in the Klamath Mountains showed fire severity increases in relation to the amount of time since the previous fire, but is also correlated with other variables such as recent weather patterns and topography (Estes *et al.* 2017). Mechanical treatments for treating fuels and reducing fire hazards are impractical in many areas of the Klamath Mountains due to the steepness of the landscape (Estes *et al.* 2017). In 2017, the

Trinity River basin experienced 12 wildfires that burned 55 square miles (35,200 acres) (CALFIRE 2017). Of the 12 wildfires, only two wildfires accounted for over 99 percent of the area burned (CALFIRE 2017).

Timber harvest within the Trinity River basin has required construction of hundreds of miles of unpaved timber roads (USDOI 1981). Road networks in the Trinity River basin and many areas of the Pacific Northwest are considered the most significant source of anthropogenic sediment input to anadromous fish habitats (USFS 2003). Roads have led to decreased hydrologic function and increased fine sediment input, which have reduced biological productivity of the Trinity River (NMFS 2014b).

The climate in the Lower Trinity River area experiences summer temperatures above 100°F and winter temperatures below freezing. Snow frequently accumulates above elevation 4,000 feet, with elevations between 3,000 and 4,000 feet frequently subjected to rain-on-snow events. The maximum elevation in the watershed is nearly 5,300 feet at the summit of East Fork Willow Creek. The lower Trinity River has 43 water withdrawal permits and 25 other non-permitted water systems, including the domestic water supply to residential areas within the Hoopa Valley from a surface withdrawal in Campbell Creek (USDA 2003). The reduction in surface and subsurface flow in tributaries reduces the amount of cool water refugia (USDA 2003).
Fire is also a large source of habitat disturbance, and several high severity fires have burned through the Lower Trinity River area since fire suppression activities began in the mid-1900s. For example, in 1999, two fires burned 302 square miles (205,000 acres), approximately 53 percent of the New River watershed (NMFS 2014b). Both fires affected the riparian communities and accelerated the delivery of fine sediment to several streams in the Lower Trinity River basin. Since 2007, 0.38 square miles (243 acres) of HCP Action Area in the Lower Trinity River have been burned by wildfire.

Within the Middle Trinity River watershed, the mainstem of the Trinity River leaves Trinity Reservoir and Lewiston Reservoir and flows west through the HCP Action Area. Since 2000, SPI has upgraded or maintained 400 miles of roads in the basin (100 miles were upgraded prior to 2000 and 100 miles need additional maintenance) and has upgraded over 800 water crossings (through either rock armoring, replacing, abandoning, or placing critical dips). The managed hydrology in the mainstem has important effects on the presence of anadromous salmonids in the HCP Action Area. However, the effects of SPI management primarily occur within three watersheds, rather than in the mainstem. Within Browns Creek, Little Browns Creek, and Weaver Creek, several total and partial physical and thermal barriers exist in the lower reaches, hindering access to headwaters (NMFS 2014b).

Fires have swept through the Middle and Upper Trinity River watersheds in the recent past (NMFS 2014b). The altered vegetation characteristics, consisting of stands composed of smaller trees and shrubs, present a higher threat for future high severity fires (Miller *et al.* 2012), which could alter sedimentation processes and riparian vegetation characteristics. Since 2007, 0.04 square miles (25 acres) of HCP Action Area in the Middle Trinity River have been burned by wildfire.

In the South Fork Trinity River watershed, streamflow characteristics vary somewhat throughout the system. For example, the Upper Hayfork watershed experiences variable streamflow due to differences in soil and geologic composition (USDA 1998). As throughout the Trinity River system, impacts of historical mining activities remain apparent within riparian areas on valley floors, especially along Hayfork Creek. Piles of mining tailings line the channel, constricting flow in places, producing fine sediment sources, and reducing the proper functioning condition of the stream and associated riparian zone (USDA 1998). Most of the tailings are at least 10 miles downstream from the HCP Action Area.

Within the South Fork Trinity River watershed, fire is a significant disturbance factor. Prior to the early 1900s, the basin experienced five to 30 year intervals of low intensity surface fires (USFS 2008). The suppression of fire, along with unnatural fuel loading, led to an era characterized by more frequent, high severity fires (USFS 2008). Since 2007, 4.35 square miles (2,784 acres) of the HCP Action Area in the South Fork Trinity River region have been burned by wildfire. The construction of 19.5 miles of roads within the HCP Action Area, along with wildfires and timber harvest, have contributed significant input of fine sediment in the South Fork Trinity River (US EPA 1998, 2001).

2.4.5.3. Land Management

Approximately 70 percent of land within the Trinity River basin is managed by USFS or BLM or is included in the Hoopa Tribal Reservation. The Six Rivers and Shasta-Trinity National Forests, and the Redding District BLM account for most public land management. Nearly half of the public lands are within federally designated wilderness areas or inventoried roadless areas (USDA 1998). Private lands account for the remaining 30 percent of land within the basin, approximately half of which is owned by logging companies. In addition to being used for timber harvest, land within the Trinity River basin, particularly the Upper Hayfork Creek watershed, has been used for mining (USDA 1998). USDA (1998) reported that there were several hundred miles of roads within the watershed, ranging from state highways to rudimentary jeep roads and trails, which provided access for timber harvest and mining, as well as recreation. While road improvements and decommissioning have occurred in recent years, SPI has not found summary documentation of the extent.

Much of the Lower Trinity River watershed is designated as a federal wild and scenic river; however, the area experienced hydrologic mining in the past. Current mining practices consist of small placer sluicing and hard rock milling operations (NCRWQCB 2005). The Helena watershed is mostly designated as wilderness and, therefore, little timber harvesting occurs in that sub-area. Some mining still takes place in the lower part of the watershed.

The South Fork Trinity River watershed is primarily mountainous, forested land, with two broad agricultural valleys occupied by the towns of Hayfork and Hyampom. The area has a mix of private land and public land administered by USFS. Extensive timber harvesting in the past has caused erosion and sedimentation of streams and the Trinity River (NCRWQCB 2005).
The Middle Trinity River watershed has the highest population of the three watersheds in the unit. Douglas City and Weaverville are the population centers (NCRWQCB 2005). The only large-scale agriculture use is cattle grazing. Timber harvest continues, but at a reduced level than in the past on federal lands (NCRWQCB 2005).

2.4.5.4. Temperature

Prior to construction of Lewiston and Trinity Dams, juvenile salmonids and adult spring-run Chinook salmon are thought to have spent much of their time in tributary streams located in the upper watershed reaches. Many of these areas are now inaccessible due to these dams and the lower river reaches that are historically shallow and warm in the summer months. These lower river reaches are now expected to sustain these species and life stages throughout this period. Lewiston Dam releases are now sustained through the summer to provide adequate flow of cool water and meet these temperature needs (TRRP 2017).

Water quality in the Upper Trinity River is primarily impacted on a localized basis by fine sediments and water temperature (NMFS 2014b). Coho salmon distribution in the mainstem Trinity River can be at least partially explained by water temperature. While mainstem water temperatures during the summer months in the Upper Trinity River are usually cool downstream to the vicinity of Douglas City, temperatures can be problematic during drought years when storage in Trinity Reservoir is low, tributary flows are low, and air temperatures are typically high for long durations. Downstream of Douglas City, daily average mainstem water temperatures during the summer months are higher than the published range for juvenile coho salmon rearing, and some smaller tributary streams may be subject to water temperatures increasing to levels stressful for rearing coho salmon during this period (NMFS 2014b).

2.4.5.5. Suspended Sediment

The wet, uplifted marine sedimentary geology of the Trinity River basin is like other areas that have been shown to produce more frequent sediment when logged (Bunn and Montgomery 2004). The South Fork Trinity River watershed experienced extensive timber harvesting in the past that has caused erosion and sedimentation of streams and the river, especially following the flood of 1964. The area is also susceptible to naturally occurring landslides and other mass-wasting events because of steep terrain, loosely consolidated soils (decomposed granite), and heavy precipitation. Mass wasting events also contribute a significant source of sediment to tributary streams and may explain the high sediment loading of Trinity River basin streams, particularly in the South Fork Trinity River watershed. Both the mainstem Trinity River and South Fork Trinity River are listed as impaired due to fine sediment impacts under Clean Water Act Section 303(d). The U.S. Environmental Protection Agency (US EPA) has established total maximum daily loads (TMDLs) for both streams (US EPA 1998, 2001). While noting that conditions were improving in some areas, the TMDLs set sediment load allocations that specify the amount of fine sediment reduction needed to meet the water quality objectives.

The Trinity River basin HCP Plan Area has 964 identified features that meet the CFPR definition of unstable areas. Those features amount to 1.9 square miles (1,218 acres) where timber operations are modified to minimize instability and may be reviewed by a licensed geologist. Mass wasting and road failures within the Trinity River watershed generally occur during episodic events with either high duration, high intensity rainfall or warm atmospheric river events causing rain on snow melting. During the winter of 1997, Trinity County experienced a large storm event resulting from a warm tropical storm that brought large quantities of moisture and hastened the snowmelt below 7,000 feet. This storm closed state Highways 3 and 299 due to eroded fills and mass wasting. The impacts from this storm event and the wet winter of 1998 have resulted in some stream bank destabilization, aggradation of pools, and gravel siltation.

Conversely, these pulses of water have deepened pools, scoured channels, and recruited LWD into the stream channel. An extremely heavy winter rainfall also occurred in 2006. Numerous shallow debris slides were triggered during the 1998 storms, within the Lowden fire near Lewiston. This material moved into watercourses and some sediment eventually reached the Trinity River, where most of the material was flushed downstream during the resultant BOR managed high water flows of spring 2006 (T. Waltz, former SPI Weaverville District Manager, pers. comm.). This ebb and flow of episodic sediment material is typical of all the planning watersheds in the HCP; however, the Trinity River basin has the highest propensity for mass wasting due to topography, parent material, and soil types.

Mass wasting risk as experienced in 1997 generally originates from inner gorge streamside destabilization due to over-steepened slopes adjacent to watercourses or concave headwall swales located in the steepest, highest reaches of a watershed. Inner gorges and headwall swales are characterized in the CFPRs as areas where additional expertise from a professional geologist may be required, if harvest or road building activities are proposed. The CFPRs require identification, disclosure, and review by geologist professionals and protection measure implementation when operations are proposed on unstable areas, inner gorges or headwall swales.

The Middle Trinity River watershed is relatively flat and, therefore, has high levels of sediment deposition. Logging operations and road building and use have caused erosion, sedimentation, and elevated turbidity of tributary streams and the river. Several analyses have been conducted in tributaries in this area. De la Fuente *et al.* (2000) considered Weaver and Rush Creeks to be impaired, based on the stream conditions. The water quality conditions were rated as functioning with regard to physical watershed processes affecting beneficial uses, and the watershed hazard condition is high.

In USFS research prior to the US EPA’s TMDL, De la Fuente *et al.* (2000) determined that Browns Creek was in moderate condition, with a high number of road-stream intersects and road miles on steep slopes. As described above, De la Fuente *et al.* (2000) stated that the high numbers of road/stream intersects and steep roads contributed to the sediment loading in Rush Creek and Weaver Creek. The US EPA (2001) reported turbidity values in Indian, Reading, and Browns Creeks during storm events exceeding 500 NTU, much higher than in high quality reference streams. These streams are located outside the HCP Plan Area in the Middle Trinity HA.

The Lower Trinity River watershed was not subject to as much historical timber harvesting as the Middle Trinity watershed. It also has much greater topographic relief and extensive areas of barren rock than the Middle Trinity watershed. In most locations, sediment loads are lower as a result (North Coast RWQCB 2005). The small area of SPL&T lands in the Lower Trinity River watershed is not expected to be the source of suspended sediment.

2.4.5.6. Turbidity

Turbidity is typically low in the Upper Trinity River during summer conditions and is a natural occurrence during storms or other runoff events (TRRP 2017). High turbidity levels have been measured historically in the Upper Trinity River watershed during high flow events, including the Grass Valley, Indian Creek, and Browns Creek sub-watersheds (California Department of Water Resources 1980). Based on their sampling results and noting approximately 50 percent of these watersheds had been logged during the previous 25 years, the California Department of Water Resources (1980) suggested soils and bedrock in these areas are sensitive to human disturbance. Turbidity effects have also been noted as part of impaired water quality issues in the South Fork Trinity River Watershed (NMFS 2014b).

2.4.5.7. Aquatic Habitat

Most streams within the Trinity River system begin in the Trinity Alps Wilderness area and the upper portions of these watersheds are in very good condition. These areas are outside the HCP and SHA Plan Areas and Action Areas. Outside these areas, the quality of riparian areas and instream habitat decline due to habitat degradation from hydraulic mining, water diversions, and timber harvest and road construction.

The HCP Action Area is primarily in the upper reaches and headwaters, which typically provide high-quality aquatic habitat. SPI does not have data on the aquatic habitat condition of these watersheds. General information on the lower reaches that may affect accessibility to the HCP Action Area are summarized below.

Impoundment of the Trinity River by Trinity and Lewiston Dams during the early 1960s blocked 109 miles of spawning and rearing habitat from access by migrating salmon and steelhead (NMFS 2014b). The dams and the associated diversion also led to substantially different conditions in the river below the dams, especially in the Middle Trinity River watershed, allowing intruding riparian vegetation, simplified instream habitat, embedded substrates, and unnatural seasonal stream flows (USDOI 2000). Reduced flows led to accumulations of fine sediment, particularly from logged areas in the Grass Valley Creek watershed. More recently, the Trinity River Restoration Program (TRRP) has conducted many projects involving mechanical channel modifications and streamflow management (Buffington *et al.* 2014). In addition, BLM has acquired and is restoring 26.6 square miles (17,000 acres) of former private timberlands, primarily in the Grass Valley Creek watershed, and the Trinity County Resource Conservation District and the Natural Resources Conservation Service are implementing extensive erosion control programs (US EPA 2001).

Aquatic habitat in Browns Creek has also been affected by low flows. Although the Browns Creek watershed historically supported spawning Chinook salmon, stream flows are regularly too low to support spawning. In addition, access was reportedly not available until later in the season when increasing precipitation raised flows (LaFaunce 1965). In the 1940s, impoundments and dam removal were considered to increase salmon spawning capacity by providing adequate flows earlier in the season, but such changes were never implemented (USDOI 1995).

Mining and road construction have altered stream channel configuration in the Upper Hayfork Creek drainage (including East Hayfork Creek). Along Hayfork Creek, the removal of riparian forests for mining and roads, fire suppression, and the practice of removing large wood from active channels to prevent flooding have altered the amount and rate of recruitment of large wood into streams (USDA 1998). Such activities have negatively affected the function of stream ecosystems and their dependent fish populations (USDA 1998).

Spawning and rearing habitat in Trinity River tributaries has been affected by grazing, timber harvest, roads, and local diversions, especially in lower reaches with the lower gradients preferred by coho salmon. Past assessments (De la Fuente *et al.* 2000; US EPA 2001) found Weaver and Rush Creeks to be impaired and at risk, and Browns Creek to be in moderate condition. The TRRP, Trinity County Resource Conservation District, and other cooperators have conducted numerous restoration actions in the tributary watersheds, especially the Grass Valley Creek watershed (*e.g.*, 5C Program 2017; TRRP 2017; Tri County Resource Conservation District 2017).

2.4.5.8. Riparian Function

Riparian conditions are measured using metrics on canopy cover (canopy closures average 70 percent), average diameter of overstory trees (exceeding 24 inches), core area harvest restrictions (no cut core areas of 30 feet on each side of fish-bearing streams), and harvest restrictions near unstable soils (an Inner Zone of 70 feet with minimal harvest occurring and soil stabilization required when greater than 100 square feet of exposed soil occurs as part of CEQA approved projects). Although SPI does not have data on these metrics within the HCP Plan Area, riparian corridors within SPL&T lands are consistent with CFPRs. Compliance with the CFPRs reduce activities within close proximity to streams to protect riparian corridors that increase hardwood canopy retention and forage material for salmonids, maintain cold-water inputs from springs and smaller streams, and provide a source of LWD for improving habitat complexity.

2.4.6. Baseline Conditions within the SHA Action Area

This section provides baseline information for Covered Species and watersheds in the SHA Action Area. The NMFS recovery plans identified potential reintroduction areas based on the historical range of the ESA-listed species and that current habitat conditions in these areas are capable of supporting listed salmonid populations.

2.4.6.1. Geology

The Upper Sacramento River HU is in the southeastern portion of the Klamath Mountains. At the highest elevations, the geology is predominantly competent, plutonic granite. On the eastern half of the unit and in its lower reaches, the geology is more diverse and accretionary, typical of the other Klamath Mountain areas. The streams are deeply incised and steep, but generally stable, at least compared to units farther west.

The McCloud River HU headwaters are located in the high-elevation volcanic terrain southeast of Mount Shasta. Those predominantly spring-fed watercourses do not possess the hydrologic variability necessary to increase fine sediment loading, though the relatively young age of the landscape means that extreme events can produce fine sediment on rare occasions. However, the downstream (lower elevation) portions of the McCloud River HU run through the more geologically diverse and complex accreted terrain associated with the Klamath Mountains, and have formed deep canyons that can produce landslides and sediment.

The Shasta Dam HU is exclusively within the southeastern Klamath Mountains and contains many deep valleys drowned by the reservoir in the diverse, accreted terrain. Sediment inputs can be locally significant due the diverse geology, steep terrain, and (artificial) lake level fluctuations. The size and depth of Lake Shasta prevent any coarse sediment from passing further downstream of Shasta Dam.

The Yuba River HU is geographically and geologically distinct from the other basins included in the SHA Action Area. Originating on the crest of the northern Sierra Nevada, headwater streams in the unit consist primarily of plutonic (hard rock) granite, intermixed with ancient, relatively well-lithified volcanic rocks. The streams flow through steep, deeply incised canyons, but are relatively stable. The unit has several large faults oriented perpendicular to the direction of flow (westward).

The Trinity River HU is in the Klamath Mountains in a region characterized by greywacke sandstones, mudstones, greenstones, radiolarian chert, and relatively minor limestone. The substrate arrangement and the substrate permeability often produce unstable landscapes that produce a wide range of sediment including boulders, sand, silt, and clay.

2.4.6.2. Watershed Conditions

Recent assessments of watershed conditions in the SHA Plan Area that would present potential threats to reintroduced ESA-listed fish include: road density and road watercourse crossings, current and past timber harvest, and wildfires.

Higher temperatures, reduced snowpack, and earlier spring snowmelt all contribute to the increased frequency, intensity, and extent of fires in the SHA Action Area (NMFS 2014b). Fire risks will continue to increase as conditions become drier and hotter as a result of climate change. Areas prone to fire risk are spread throughout the Trinity and Sacramento River basins. Since 2007, 46.8 square miles (29,952 acres) of the SHA Plan Area has been burned by wildfires.

In the Upper Sacramento River HU, springs from the volcanic geology of Mount Shasta and the numerous tributary streams driven by precipitation and snowmelt provide a consistent year-round flow of cold water to the Upper Sacramento River. Located in the upper watershed near the city of Mount Shasta, the 26,100 acre-foot Box Canyon Dam/Siskiyou Reservoir is operated by Siskiyou County for hydropower generation and recreation (Heiman and Knecht 2010). Box Canyon Dam maintains a minimum flow that is rapidly augmented by springs and tributaries in the 40–mile reach down to Lake Shasta. Surface flow in the river has been monitored by USGS at a location near Lake Shasta since 1945. Average daily flow is approximately 1,000 cfs, with a peak daily flow of 70,000 cfs (1974) and extreme low of 117 cubic feet per second (cfs) (1977) (Heiman and Knecht 2010). Within the Upper Sacramento River HU, there are approximately 342.87 miles of active roads used for timber operation and forest management.

In the McCloud River HU, most streams flowing south from the southern slopes of Mount Shasta do not reach the upper McCloud River; they sink into the volcanic soils except during periods of glacial melt, when Mud Creek flows to the river upstream of Lake McCloud. The most prominent exception is Squaw Valley Creek, which originates above the town of McCloud and joins the river about nine miles below McCloud Dam. A few small creeks enter the upper river from the south, but nearly all flow in the upper McCloud River enters the river system via springs, most notably Big Springs, which contributes a flow of more than 600 cfs (Heiman and Knecht 2010) a few miles above Lake McCloud.

Approximately nine miles southeast of the town of McCloud, the McCloud River is impounded by McCloud Dam, creating McCloud Reservoir. Approximately 80 percent of the flow entering McCloud Reservoir is diverted at McCloud Dam through a tunnel to PG&E's McCloud-Pit hydroelectric project. However, that water diversion does not significantly influence the larger peak flow events in the lower watershed, where the river flows approximately 23 river miles from McCloud Reservoir into Lake Shasta. Heiman and Knecht (2010) stated that tributaries below Lake McCloud supply more than three times the runoff to the McCloud River than is supplied by the entire Upper McCloud River watershed, but the US Bureau of Reclamation (USBR) reported higher stream flows above McCloud Reservoir than at Lake Shasta. Hawkins, Squaw Valley, Claiborne, and Chatterdown Creeks are major tributaries to the McCloud River below McCloud Reservoir (USDOI 2014). In most years, McCloud River flow into Lake Shasta varies seasonally between 200 and 10,000 cfs, with a mean daily flow of 270 cfs (USDOI 2014). Within the McCloud River HU are approximately 286.2 miles of active roads used for timber operation and forest management.

The Shasta Dam HU is composed of the Lake Shasta HA. The unit includes numerous small streams entering the reservoir, but it does not include the lake's four major tributaries (Upper Sacramento River, McCloud River, Squaw Creek, and Pit River). Shasta Dam, constructed in the early 1940s a few miles north of Redding on the Sacramento River below the four major tributaries, stores up to 4.5 million acre-feet of water (USFWS 1995) in Lake Shasta (California's largest reservoir) and controls the Sacramento River water flow into the Sacramento Valley below the dam. The Shasta Dam HU includes approximately 169.8 miles of active roads used for timber operation and forest management.

The Yuba River HU contains four HAs: Ure Mountain, South Yuba, Middle, Yuba, and North Yuba. Flows in the Yuba River HU are typical of Sacramento Valley tributaries with headwaters in the Sierra Nevada; flows are highest in the winter and spring from rain-on-snow events and decrease quickly in late spring. More than 100 jurisdictional dams or diversions exist within the Yuba River basin, and a large amount of water is diverted from the South Yuba watershed at Lake Spaulding for irrigation and power generation (Heiman and Knecht 2010). The South Yuba watershed alone supports 20 small reservoirs and 20 hydroelectric dams (Heiman and Knecht 2010). Englebright Dam, in the Ure Mountain HA, has a storage capacity of 45,000 acre-feet and provides electricity and recreational opportunities (Heiman and Knecht 2010). The Yuba River HU includes approximately 724.7 miles of active roads used for timber operation and forest management.

The mean annual precipitation in the Trinity River HU can reach 70 to 80 inches. Approximately 90 percent of the precipitation falls between October and April, with snow remaining through May or June at the highest elevations (USDA 2003). Approximately half of the mainstem Trinity River is diverted to the Sacramento Valley, and remaining flows are regulated by Lewiston Dam. Flows above the dam are impounded, creating Trinity Lake. The Trinity River HU includes approximately 397.5 miles of active roads used for timber operation and forest management.

2.4.6.3. Land Management

Timber management is still a common land use on private lands in the Upper Sacramento River basin. Within the McCloud River watershed, land ownership is approximately 50 percent public (USFS and BLM), and land use is dominated by timber management, hydroelectric energy production, grazing, and agriculture. Land use is primarily open space on designated National Forest System Lands, which are managed by the Shasta-Trinity National Forest under their Forest Plan and other applicable laws, policies, and guidelines. Shasta-Trinity National Forest management includes Riparian Reserves and Late Successional Reserves. The Riparian Reserves within the watershed are located along rivers, streams, lakes, and wetlands. They were established to provide natural corridors. The late successional reserves are large blocks of land reserved for northern spotted owl (*Strix occidentalis caurina*) and other species that are dependent on late successional old-growth forest. Late successional reserves are scattered throughout the watershed (USDA and USDOI 1994). Over 95 percent of the Shasta Dam HU is federally owned, and the remaining five percent of lands are held in private ownership (USDOI 2011).

In the Yuba River watershed, timber management is still a prominent land use, but many businesses and communities in the watershed have been shifting from logging to other enterprises that capitalize on the recreational and scenic qualities of the watershed (Heiman and Knecht 2010). Although population is sparse, the South Yuba and Middle Yuba River watersheds have been extensively developed for hydroelectric power generation and consumptive uses. The South Yuba River watershed contains South Yuba River State Park. Additionally, historical reminders of Native Americans and the gold rush era are woven throughout the landscape. Evidence of prehistoric uses in the area, such as camps, along with activities, such as pioneer trails, ridges, mining features, and logging camps are scattered throughout the basin (Heiman and Knecht 2010).

2.4.6.4. Temperature

Temperature is a significant water quality concern in the Yuba River HU. Warming water temperatures can be attributed to dams, water diversions, inadequate shading due to reduced riparian cover, and low instream flows.

Observations of July water temperatures in the Upper Sacramento River during 2003 through 2012 varied from 50°F below Box Canyon Dam to 69°F just above Lake Shasta (USDOI 2014). In the McCloud River, USDOI (2014) reported stream temperatures for summer months varying from 55°F below McCloud Dam to 65°F above Lake Shasta. Water temperature in the McCloud River below Lake McCloud has increased because of PG&E hydropower operations. Before construction of the dam, water temperatures in the river largely were regulated by Big Springs, which provided a constant flow of 45°F water to the river and never exceeded 60°F. Following completion of the reservoir, stream temperatures as high as 75°F have been recorded in the lower river by the CDFW (Heiman and Knecht 2010).

2.4.6.5. Suspended Sediment

The McCloud River and Yuba River HUs, and the Upper Trinity River HA all experience elevated fine sediment levels (Heiman and Knecht 2010). A watershed assessment for the Upper Sacramento (North State Resources 2010) reported few data were available to describe sediment conditions. Modeling identified relative hazard areas for sediment delivery, with reaches in the middle and lower portions of the watershed demonstrating higher erosion potential. Suspended and settleable sediment levels were below the level of harm for aquatic life, but localized erosion and fine sediment problems still need to be addressed (Heiman and Knecht 2010).

Within the McCloud River HU, high flows during winter rains increase suspended sediment and turbidity, which quickly drop to pre-storm levels following peak flow events. Mud Creek, in the upper watershed, carries glacial silt into McCloud Reservoir that can become re-suspended and move downstream through the McCloud River (Heiman and Knecht 2010). Water clarity in the McCloud River fluctuates from excellent during most of the year to highly turbid for short periods (Heiman and Knecht 2010).

Sediment loads in the Yuba River basin can be attributed to historical mining and human activities, such as road construction associated with rural housing development, logging, and recreation (Heiman and Knecht 2010).

2.4.6.6. Aquatic Habitat

The headwaters of the McCloud River and Upper Sacramento River watersheds above the Shasta Dam historically provided clean, loose gravel; cold, well-oxygenated water; and optimal stream flow in riffle habitats for spawning and incubation. They also provided the cold, productive waters necessary for egg and fry development and survival, and juvenile rearing over the summer. Nearly 300 miles of tributary spawning habitat is now inaccessible to winter-run Chinook salmon and other anadromous species due to Shasta Dam (NMFS 2014a). In general, waterbodies above the dam provide good quality, aquatic habitat. Following dam construction, stream channel width decreased, and channel sinuosity, hillslope, topographic aspect, and vegetation cover increased (USDOI 2014). The quality of physical spawning and rearing habitat attributes generally improve progressing downstream from Dunsmuir to Lake Shasta (USDOI 2014).

The steady supply and volume of cold, clean water in the Upper Sacramento River basin supports high quality aquatic habitat conditions. Anadromous salmon and steelhead populations that historically were abundant in the basin ended with the 1943 completion of Shasta Dam (Heiman and Knecht 2010).

USDOI (2014) rated salmonid spawning habitat in the Upper Sacramento River watershed as fair to good throughout. In general, habitat quality for spawning and rearing increases with distance from Box Canyon Dam. Spawning and rearing habitat in the McCloud River watershed was rated fair to good, with some limitation of deep pools, with rearing habitat improving with downstream distance. Regarding potential reintroduction of winter-run Chinook salmon, NMFS (2014a) indicated that the McCloud River is more favorable, because of stream temperature limitation in reaches of the Upper Sacramento River watershed that otherwise contain good spawning habitat.

2.4.6.7. Riparian Function

The riparian conditions and function in the SHA Plan Area are similar to the HCP Plan Area and have been subject to the standard CFPRs watercourse protection measures since the early 1970s. The buffer zones are 50 to 100 feet and the minimum required canopy retention is 50 percent. The LWD recruitment trees are retained based on proximity to the watercourse and propensity to lean towards the watercourse. Stream crossings are designed to provide passage for all life stages of fish, including salmonids.

The CFPR ASP rules do not apply to the SHA Plan Area, as these areas are outside the range of anadromy and upstream from any (direct) hydrologic connection due to dams and reservoirs. While lower canopy retention requirements are allowed in non-ASP watersheds under the CFPRs, streamside habitats in the SHA Plan Area are in good condition and provide fully functional riparian functions including shade and LWD recruitment, particularly considering the previously described differences between vertical canopy cover and ecological shade.

2.4.7. Recovery Plan Criteria and the Environmental Baseline

The Central Valley Salmonid Recovery Plan (NMFS 2014a), included recovery down/delisting criteria and diversity group priorities. Historically Sacramento River winter-run Chinook salmon only occurred in the Basalt and Porous Lava diversity group. The recovery criteria includes reestablishment of three viable populations, including the current population in the mainstem Sacramento River (downstream of Shasta Dam and Keswick Dam), as well as priority reintroductions into Battle Creek (underway), and one of the rivers upstream of Shasta Dam (likely McCloud River). Recovery Criteria and diversity group priorities for Central Valley spring-run Chinook salmon includes establishment of two viable populations in the Basalt and Porous Lava diversity group (Battle Creek, and reintroduction to a river upstream of Shasta Dam (likely McCloud River), one in the Northwestern California diversity group (Clear Creek, and maintaining Core 2/dependent population in Cottonwood/Beegum Creek), four in the Northern Sierra Nevada diversity group (Mill, Deer, Butte creeks and reintroduction into the Yuba River upstream of Englebright Dam); as well as maintaining Core 2/dependent populations (Feather River, the Yuba River downstream of Englebright Dam, and Antelope Creek). Finally, for CCV steelhead, recovery criteria and diversity group priorities include two viable populations in the Basalt and Porous Lava diversity group (Battle Creek and reintroduction into the McCloud River, as well as maintaining Core 2/dependent populations in Cow Creek, and other tributaries), one population in the Northwestern California diversity group (Clear Creek, and maintaining Core 2 population in Cottonwood/Beegum Creek), four populations in the Northern Sierra Nevada diversity group (Antelope, Deer, and Mill creeks, and reintroduction in the Yuba River upstream of Englebright Dam, as well and maintaining Core 2 populations (lower Yuba River, Butte Creek, Feather River, Big Chico Creek, Auburn Ravine, and the American River).

The HCP Action Area and SHA Plan Area include a portion of almost all of these priority watersheds identified for the recovery of all three Central Valley salmonid species. Improvements to habitat for these populations would support recovery, and support for any reintroductions would help advance those recovery action priorities.

2.5. Effects of the Action

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

2.5.1. Assumptions

The proposed ITP and ESP would have a 50-year term. Therefore, the analyses will consider effects over the life of the 50-year permit terms, and effects that would continue beyond the life of the ITP and ESP. For example, harvesting in the last decade of the ITP has the potential to influence landslide rates beyond the 50-year permit period. Since many of the activities influence watershed processes that respond over long time periods (*e.g*., wood recruitment), much of the effects analysis addresses conditions existing in the decades following the 50-year permit period when the entire ownership has been subject to HCP/SHA implementation.

For the purpose of this analysis for this biological opinion, we also assume that timber harvest and other activities that have potential environmental effects will occur across the majority of SPL&T lands over the life of the HCP/SHA. SPI-managed properties are entered and managed on a California Planning Watershed basis. These planning watersheds are assessed for tree spacing and density once per decade to provide adequate growing space for trees while improving forest health. We assume that harvest will be distributed throughout the HCP and SHA Plan Areas and it will occur at a sustainable rate as required by California law (*i.e*., the CFPRs). We also realize that a portion of covered lands may not be subjected to harvest practices during the term of the permits due to regulatory constraints, conservation commitments, and a planned harvest rotation (*i.e*., SPI's Sustained Yield Plan, see Section 1.3.1 above) that will not necessarily result in the harvest of all available stands over the life of the permit.

During the implementation of the HCP/SHA, we assume that all Covered Activities will be conducted in accordance with law and as prescribed by the HCP/SHA. We assume that failure to identify features requiring buffers or avoidance will be rare. We also assume that failure to identify unstable features will be infrequent for smaller features and rare for larger features. We make these assumptions, because the HCP and SHA Plan Areas will be visited several times by RPFs, licensed geologists, fish and wildlife specialists, and representatives of regulatory agencies during the THP development and permit approval process. Adaptive Management, monitoring, and changed circumstances processes included in the HCP will permit adjustments to plan measures over time as new information is developed through proposed monitoring programs.

The effects analysis includes the following overall assumptions:

- Compliance with CFPRs, including winter period operation plans and ASP watershed rules in all applicable planning watersheds currently subject to anadromy. The CFPRs are updated annually. NMFS assumes that these annual updates will maintain or improve upon the conservation measures associated with the 2020 CFPRs.
- READI Model implementation and road/road watercourse crossing reconstruction and improvement work will be conducted using the following priority considerations:
    - Complete READI Model fieldwork and analyses in the HCP Plan Area within three years upon permit issuance;
    - Complete READI Model fieldwork and analyses in the SHA Plan Area upon notification from NMFS that proposed ESA-listed salmonid reintroduction activities will occur; and
    - Plan and implement road construction and maintenance improvements based on the READI Model results in the Sacramento River basin by giving highest priority to Core and reintroduction classifications, beginning with Core 1 and Core 2 watersheds, followed by Primary and Candidate classifications that would provide the greatest conservation benefit. In the Trinity River basin, SPI will give highest priority to watersheds with unstable lands based on the landslide risk assessment results and known or potential distribution of Covered Species.
- The amount of skid trails and landings will increase slightly over the course of the permit period, with more area subject to harvest as treatments move from clearcutting to selection and thinning prescriptions.

The effects analysis considers the risk of exposure to impacts from Covered Activities to be similar for all Covered Species within their respective basins in the HCP Action Area. There is considerable temporal and spatial overlap among the different species of salmonids within each basin, and their habitat needs (PBFs) and responses to stressors are comparable. The CFPRs and the ASP rules will be applied in all watersheds with anadromous salmonids present, regardless of listing status. If potential exposure to the Covered Activities will be greater for one or more of the Covered Species, we have noted where this is the case. Otherwise, we assume that likelihood of exposure to the effects of the Covered Activities will similar among the Covered Species and the response of individual salmonids and their habitat from changes in watershed products will be comparable, and therefore can be described generally.

2.5.2. Effects to Watershed Products from the Covered Activities

The decline and extinction of Pacific salmon populations have been linked to habitat loss and degradation in their spawning and rearing streams (Nehlsen *et al.* 1991). Beechie *et al.* (1994) identified three principal causes for these habitat losses, in order of importance, as hydro-modification (*e.g.*, dams and diversions), migration-blocking culverts, and forest practices. Because the proposed Covered Activities have the potential to adversely affect aquatic habitat, this effects assessment is primarily habitat-based.

Available information indicates that populations of threatened and endangered Pacific salmon are limited by the existing condition of aquatic habitat, and these populations were depleted, at least partially, due to past forestry practices (Tschaplinsky and Hartman 1983; Lichatowich

1989; McMahon and Holtby 1992; Reeves *et al.* 1993; Beechie *et al.* 1994; Gregory and Bisson 1997). However, continued development of the CFPRs and the annual updates to the CFPRs have resulted in improved habitat conditions relative to historic practices as past impacts are gradually ameliorated. The most notable rule changes with input from NMFS, CDFW, and other State agencies are the 2010 ASP Rules and the 2012 Road Rules. These rules have resulted in expanded stream-buffer widths, less damaging road and harvest techniques, and limits on riparian harvesting that will collectively improve instream and riparian habitat and function over the long-term.

The impacts of forestry activities on Covered Species vary depending on the type of activity and the species and life stage considered. Covered Activities under the HCP/SHA may generate stressors affecting Covered Species and critical habitat by potentially degrading salmonid habitat (*e.g.*, water quality). This potential degradation of salmonid habitat may result in behavioral effects such as avoidance of the immediate area, reductions in foraging efficiency and a reduced ability to avoid predators. Injury or death is also possible. Therefore, rather than assess the effects of the individual Covered Activities listed in Sections 1.3.2 and 1.3.3 above, the HCP/SHA considers the potential effects of Covered Activities on watershed products, and the impacts of these changes to elements of fish habitat (Table 8 and Table 9).

Table 8. Effects of Timber Harvest Activities on Watershed Products and Habitat

Activity	Related Activity(s)	Activity Effect	Changes of Concern (Environmental Stressor) – Watershed Product	Changes of Concern (Environmental Stressor) – Habitat Element(s)
Timber harvest	Skidding/yarding	Loss of ground cover/compaction, Compaction (increased runoff)	Sediment, Water	Turbidity, Substrate, Channel morphology
Timber harvest	Loading/landing	Loss of ground cover/compaction, Compaction (increased runoff)	Sediment, Water	Substrate, Bed (gravel) scour
Timber harvest	Site preparation	Loss of ground cover/compaction	Sediment	Spawning substrate, Pools
Timber harvest	Felling bucking	Removal of stream shade, Changes in stand structure, Removal of vegetation, Increased soil moisture	Sediment, Water, Heat, Nutrients, Wood	Sediment, Flow regime, Water temperature, Large wood recruitment

Activity	Related Activity(s)	Activity Effect	Changes of Concern (Environmental Stressor) – Watershed Product	Changes of Concern (Environmental Stressor) – Habitat Element(s)
Timber harvest	Mastication	Compaction (increased runoff)	Water	Peak flows
Timber harvest	Maintenance, fueling, and fuel storage	Fuel spills	Water	Water contamination
Road construction	Water Drafting	Entrainment	N/A	Entrainment
Road construction	Watercourse crossing facility placement and maintenance	Disturbance of habitat, Sediment delivery	Sediment	Sediment, Channel morphology
Road construction	Maintenance, fueling, and fuel storage	Fuel spills	Sediment	Water contamination
Road construction	Construction	Disturbance of unstable lands, Loss of ground cover/ compaction	Sediment	Sediment
Road use/ maintenance/ reconstruction	Water Drafting	Disturbance of habitat, Sediment delivery	N/A	Entrainment
Road use/ maintenance/ reconstruction	Watercourse crossing facility placement and maintenance	Disturbance of habitat, Sediment delivery, Equipment in channels	Sediment	Sediment, Channel morphology, Direct impact on fish
Road use/ maintenance/ reconstruction	Maintenance, fueling, and fuel storage	Fuel spills	Water	Water contamination
Road use/ maintenance/ reconstruction	Mechanical mastication of vegetation along roads	Compaction (increased runoff)	Water	Peak flows
Road use/ maintenance/ reconstruction	Crossing infrastructure	Barriers to movement, Crossing failure, Concentrated surface flow	Sediment	Fish passage, Sediment, Turbidity, Substrate

Activity	Related Activity(s)	Activity Effect	Changes of Concern (Environmental Stressor) – Watershed Product	Changes of Concern (Environmental Stressor) – Habitat Element(s)
Road use/ maintenance/ reconstruction	Road surfaces	Compaction (increased runoff)	Water	Sediment, Peak flows

Table 9. Effects of Non-Timber Harvest Activities on Watershed Products and Habitat

Activity	Related Activity(s)	Activity Effect	Changes of Concern (Environmental Stressor) – Watershed Product	Changes of Concern (Environmental Stressor) – Habitat Element(s)
Prescribed fire	N/A	Loss of ground cover, Loss of vegetation, Hydrophobic soils	Sediment, Water	Sediment, Turbidity, Flow regime, Peak flows
Site preparation	N/A	Loss of ground cover/compaction	Sediment	Turbidity
Mastication	N/A	Compaction (increased runoff)	Water	Peak flows
Rock pit development and rock processing	Access roads and hauling	Loss of ground cover, Compaction areas, areas with low infiltration	Sediment, Water	Sediment, Turbidity
Chipping	N/A	Increase in ground cover	N/A	N/A
Harvest of minor forest products	N/A	N/A	N/A	N/A
Conversion of brush fields to timberland	N/A	Loss of ground cover, Compaction	Sediment, Water	Sediment, Turbidity
Fire suppression	Dozer line construction	Loss of ground cover, Compaction	Sediment, Water	Sediment, Turbidity
Fire suppression	Water drafting and water dipping	Entrainment	N/A	Entrainment

Stand-specific project information is not available at this time. Therefore, we will analyze the effects of the proposed action by considering how project elements are likely to impact important salmonid habitat indicators, and then consider how exposed individuals and the PBFs of their critical habitat are likely to respond to the impacts on those habitat indicators. The effects assessment on the Covered Species and their habitat is organized using the five watershed products described by Lisle (1999):

1. Water Quantity (Peak Flows and Water Yield)
2. Temperature
3. Suspended Sediment
4. Large Wood (*i.e.*, LWD)
5. Chemicals and Nutrients

These products are responsible for providing and maintaining salmonid habitat, which support fish species. This effects assessment evaluates how the Covered Activities, specifically timber harvest and road management, affect processes and functions in the HCP Action Area watersheds, and then translate how changes affect watershed products and impact habitat and salmonids, including individuals and populations. In addition to the five watershed products, we have considered three additional factors; habitat connectivity, Covered Activities that occur directly in salmonid habitat, and fish entrainment during water drafting.

2.5.2.1. Changes in Peak Flows and Water Yield

Changes in peak and water yield (*i.e.*, base flows) due to the Covered Activities is likely to adversely affect Covered Species. Forest management activities, particularly timber harvest and forest roads, can affect the rate that water is stored or discharged within a watershed. They can increase both peak and base instream flows, and may also cause peak discharges to occur earlier in the year than would normally occur (Jones and Grant 1996; Satterlund and Adams 1992). The intensity of these effects depend largely on the type of activity (*i.e.* the type of timber harvest and road design), the proportion of the basin that has been altered, and the affected area's location within a watershed (Grant *et al*. 2008).

Peak flow response is strongly correlated with chronic sediment delivery; the magnitude of which is discussed below (see Section 2.5.2.3). The risk of exposure to peak flows in the HCP Action Area is greatest in those watersheds that will be subject to even-aged silviculture (*i.e.*, clear cutting), and those with the greatest density of roads and road watercourse crossings (see Appendix D, Table D-1 and Appendix E, Table E-1 in the HCP/SHA for data on road and road crossing density).

Water yield, also known as water crop or runout, generally refers to water runoff from a particular drainage basin, including ground-water outflow (USGS 2019). Research on timber harvest and water yield (Keppeler 1998; Lewis *et al.* 2001; Troendle, 2007) supports the assertion that water yield, and possibly summer low flows have been increased at the site of timber harvest and in some watersheds within the HCP Action Area due to reduced vegetation and associated water uptake. This results from the amount of regeneration cutting and site preparation to reduce competing species in conifer plantations over the past two decades. Water yields are greatest in areas where harvest is concentrated over a relatively short time period. Responses are dependent on numerous factors including amount of precipitation and if the precipitation is dominated by rain or snow.

Much of the HCP Action Area is located in the transient snow zone where rain-on-snow events are common in the winter months. Precipitation in the Sacramento River basin varies from 25 to 80 inches per year over the range in elevations in the region (approximately 180 to 8,200 feet) (Armentrout *et al.* 1998; Big Chico Creek Watershed Alliance 2017). Flows are lowest in September, increase through October and November, and decrease again in late spring and summer (Kondolf 2001). Peak flows from the watershed are dominated by rain-on-snow events, with most flow events occurring during winter months (December through February) when snow is present in the transient zone (above approximately 3,000 feet in elevation). Earlier season peaks in flow (September through November) are most likely rain events with little snow influence. Later peaks (mid-March through May) are mostly likely snowmelt-generated peaks (NMFS 2014a).

Within the Trinity River basin, mean annual precipitation can reach 70 to 80 inches over the coastal ridges, diminishing with lower elevations to averages of 40 to 60 inches in the foothills. Approximately 90 percent of the precipitation falls between October and April. Snow usually remains at highest elevations through May or June (USDA 2003). Snow frequently accumulates above elevation 4,000 feet, with elevations between 3,000 and 4,000 feet frequently subjected to rain-on-snow events. Grant *et al*. (2008) concludes that watersheds located within the transient snow zone are the most sensitive to peak flow changes. The authors also report that altered flows are most detectable within small drainage areas (up to about 2,470 acres), with the ability to detect changes diminishing as the size of the drainage area approaches the sub-watershed scale because the magnitude of increase is typically less than the inter-annual variability.

Timber Harvest Effects on Peak Flows and Water Yield

The intensity of flow change tends to diminish over time (Grant *et al*. 2008; Jones 2000; Jones and Grant 1996). Jones and Post (2004) report that the greatest flow increases due to timber harvest generally occur in the first one to five years after cutting. Moore and Wondzell (2005) estimate that flows generally recover to pre-harvest conditions after about 10 to 20 years, but Jones and Post (2004) report that significant flow changes have been detected in some Pacific Northwest forests up to 35 years afterward. Timber harvest typically increases total water yield due to reduced evapotranspiration (Duncan 1986; Harr 1976; Harr *et al*. 1975; Hetherington 1982; Jones 2000; Keppler and Zeimer 1990) and decreased water interception (Reid and Lewis 2007). Based on the work of Keppeler (1998), the expectation is that water yield increases would gradually diminish over a 12-year period. Flow increases appear to be proportional to the amount of timber that is cut within the watershed (Bosch and Hewlett 1982; Grant *et al*. 2008; Keppler and Zeimer 1990).

Changes in peak flows are highly variable, but are typically undetectable until about 20 percent of a basin is harvested. Similarly, Troendle (2007) estimates that measurable increases in water yield are likely when 20 percent or more of the basal area is removed from a given area. Grant *et al*. (2008) report no measurable flow changes when less than 19 percent of the watershed is clear-cut. Stednick (1996) suggests that flow changes are not measurable when less than 25 percent of the watershed is clear-cut. In catchments where 20 to 40 percent of the trees were cut, peak flows increased 20 to 90 percent (King 1989; Troendle and King 1985). In another study, Van Haveren (1988) reported that 100 percent clearcutting resulted in a 50 percent increase in peak flow.

The relative proportion of SPL&T's land subject to even-aged silviculture per decade has decreased from the first decade of the sustained yield plan as follows:

- 22 to 25 percent in decade one (1999 through 2009)
- 16 to 18 percent in decade two (2009 through 2018)

The relative proportion of SPL&T land subject to even-aged silviculture per future decade is projected as follows:

- 13 to 16 percent in decade three (2019 through 2028) (HCP decade one)
- 11 to 13 percent in decade four (2029-2038) (HCP decade two)

Starting in decade five of SPI's sustained yield plan, most of the projected harvest volume will be accomplished by commercial thinning, and therefore the actual clearcutting in decades five through seven (HCP decades three to five) ranges from one percent to three percent annually. The stands where this commercial thinning will occur are the stands generated by the harvesting in the first two decades of the sustained yield plan (1999-2019). As a result of SPI's sustained yield plan, clear-cut harvesting will decrease and thinning will increase throughout the permit term. These treatments retain more canopy cover and basal area than regeneration cutting and do not reduce evapotranspiration to the levels of clear-cutting. This reduction in clear-cutting is expected to reduce the magnitude and frequency of increased peak flows and water yield resulting from the Covered Activities.

Grant *et al*. (2008) recommend using the equivalent clear-cut area (ECA) within a sub-watershed as an index to determine if timber harvest may cause increased peak flows. Based on the information presented by Moore and Wondzell (2005), NMFS has used forested areas within the HCP Action Area that were less than 10 years old (harvest occurring during 2007-2017) as the index for ECA (i.e. hydrologically immature) to help assess expected impacts on peak and base flows. Spence *et al*. (1996) recommend that for salmonid conservation, no more than 15 to 20 percent of a watershed be in a hydrologically immature state at any given time.

Due to past timber harvests, about 94.5 square miles of the Sacramento River basin HCP Action Area is covered by forest that are younger than 10 years (SPL&T 2020), which equates to an existing ECA of about 23 percent. Approximately 25.7 square miles of the Trinity River basin HCP Action Area is covered by forest that are younger than 10 years (SPL&T 2020), which equates to an existing ECA of about 16.5 percent. As previously described, in decade one of the HCP, up to 16 percent of SPL&T lands will be subject to clear-cutting through SPI's sustained yield plan. This level will be reduced to 13 percent during decade two.

Effect of Roads on Peak Flows and Water Yield

Forest roads can also cause hydrologic effects that can increase in-stream flows. Roads that are directly connected to streams by drainage ditches, and overland flow from cross-drain culverts and stream crossings increase the amount of runoff directly to routed stream channels (Wemple *et al.* 1996). The existing road network within the Sacramento River basin HCP Action Area is estimated at about 2,135 miles, only 3.5 miles of which are within watersheds occupied by Covered Species or within the 300-feet corridor of anadromous fish habitat. The road density in the Sacramento River basin HCP Action Area is approximately 5.25 miles of road per square mile. In the Trinity River basin HCP Action Area, the existing road network is estimated at about 880 miles, with approximately 29 miles of project-related roads within watersheds occupied by Covered Species or within the 300-feet corridor of anadromous fish habitat. The road density within in the Trinity River basin HCP Action Area is approximately 5.64 miles of road per square mile. Road watercourse crossings also contribute to peak flows in the HCP Action Area. We expect that watersheds with the greatest number of road watercourse crossings will be subject to increased peak flows. In the Sacramento River basin HCP Action Area, there are four road watercourse crossings in anadromous stream habitat. In the Trinity River basin HCP Action Area, there are 28 road watercourse crossings in anadromous stream habitat.

The planned construction of 30-50 miles of new roads during the first decade of the HCP and 15-30 miles of new road during the second decade would increase total road length and density in the Sacramento River basin HCP Action Area by about 2.35 percent during the first decade and 1.5 percent during the second decade. This level of planned road construction would increase total road length and density in the Trinity River basin HCP Action Area by about 5.7 percent during the first decade and 3.4 percent during the second decade. Only a subset of the newly constructed roads would be located in areas where they might increase stream flows. As new roads are constructed, they are designed, constructed, and maintained according to the CFPRs to reduce environmental impacts. Furthermore, minimization measures for the design and location of all forest roads and landings include avoiding unstable areas, out-sloping logging roads and landings, draining with waterbreaks, and hydrologically disconnecting logging roads and landings from watercourses and lakes. Per the HCP, SPI will not build any new roads in the currently identified WLPZs on anadromous stream reaches during the permit term. As such, the construction of new roads are expected to only minimally increase instream flows in stream reaches occupied by Covered Species. However, the ones that do affect instream flows may continue to do so for years after they are constructed, while the native vegetation regrows and natural hydraulic processes recover.

SPI's proposed implementation of road improvement projects based on the READI Model results are intended to reduce the number of road-stream convergent points and the amount of road surface connected to stream channels. These improvements are expected to reduce the magnitude and frequency of peak flows. The road improvements will result in slightly greater rates of recovery of hydrologic processes, given the greater emphasis on improving fish passage and passage of storm water and wood through water-crossing structures, repair of existing road failures, and design improvements for new roads. While reduced at the planning watershed scale, localized impacts (*e.g.*, enlargement of receiving channels and increased sediment delivery) associated with peak flows could occur at the site scale. The distribution of stand ages across the

HCP Action Area greatly diminishes the likelihood of concentrated peak flows resulting from timber harvest. Therefore, we expect that increased peak flows and water yield from roads will be greatest during the first decade of the permit term. Road improvements are expected to commence in year four of the permit term (once the remaining fieldwork and data collection for the READI Model is complete), resulting in a reduction in the magnitude and frequency of increased peak flows and water yield within the HCP Action Area.

Expected Effects to Covered Species: Peak flow and water yield increases in HCP Action Area watersheds as a result of Covered Activities are expected to gradually diminish during the permit period, as silvicultural treatments transition from predominantly regeneration (clear-cut) harvest to thinning and selections. Given the assumed 12-year recovery period, it is unlikely that peak flow water yield increases would be detectable from HCP Action Area watersheds after the first decade of the permit period. Following that period, peak flows and water yield would likely remain constant at the planning watershed scale due to the combination of clear-cut, regeneration, and selection harvests.

As described above, the estimated ECA for the Sacramento River basin HCP Action Area is approximately 23 percent due to harvest occurring during the last decade (2007-2017). Because this is above the 20 percent ECA threshold, the Covered Activities are likely to cause detectable increases in water yield and peak flows within the Sacramento River basin HCP Action Area during the first decade of the permit term. As the percentage of clear-cutting on SPL&T lands is reduced in subsequent decades as a result of SPI's sustained yield plan, any increases in peak flow and water yield resulting from timber harvest are likely to be undetectable. The estimated ECA for the Trinity River basin HCP Action Area due to timber harvest occurring during the past decade (16.5 percent) is currently below the 20 percent ECA threshold, and therefore is unlikely to result in detectable increases in peak flow and water yield. This percentage will decrease over the permit term as the rate of clear-cutting is reduced and recently harvested areas recover.

The degree to which increased flows would act independently and/or synergistically with increased suspended sediments and reduced in-stream wood to reduce habitat quality for Chinook salmon, coho salmon, and steelhead is unknown. Exposure to the increased flows is likely to cause fitness impacts in rearing juvenile salmonids that must expend more energy to remain in within the HCP Action Area. It may displace some juveniles from preferred habitat, including forcing premature downstream migration at times that are suboptimal for growth and survival. Increased flows can cause fitness impacts in migrating adults that must swim against the flow, and it may increase in-channel substrate movement and scour that injure or kill developing eggs and alevins in redds (Hicks *et al*. 1991; Hooper 1973). The annual numbers of individuals that would be affected by increased flows is unquantifiable with any degree of certainty. However, based on the relatively small amount of occupied habitat that may be affected, and the expectation that the density of the Covered Species within the HCP Action Area is low, the numbers of fish and eggs that would be annually affected by this stressor would comprise such small subsets of their respective cohorts, that their loss would cause no detectable population-level effects.

As described earlier, water drafting for road construction and fire protection would episodically cause very short-term and isolated minor decreases in in-stream flows. The magnitude of those withdrawals is not expected to cause any measurable effect on either of the mechanisms considered above that may cause changes in peak and base flows.

2.5.2.2. Water Temperature

Water temperature affects metabolism, behavior, and survival of both adults and juvenile fish, as well as other aquatic organisms that may be food sources. Carter (2005) compiled a literature review of the effects of temperature on steelhead, coho salmon, and Chinook salmon supporting TMDL establishment for water temperature in the Klamath River Basin. The introduction to Carter's (2005) review is excerpted here: "Temperature is one of the most important environmental influences on salmonid biology. Most aquatic organisms, including salmon and steelhead, are poikilotherms, meaning their temperature and metabolism are determined by the ambient temperature of water. Temperature, therefore, influences growth and feeding rates, metabolism, development of embryos and alevins, timing of life history events, such as upstream migration, spawning, freshwater rearing, and seaward migration, and the availability of food."

These effects can impact the organism directly (*e.g.*, altered metabolic demand), as well as indirectly by altering their habitat (*e.g.*, decreased dissolved oxygen or increased water chemistry reaction rates). Water temperatures can be affected by a number of factors, including air temperatures, elevation, depth, flow and velocity, and presence of riparian vegetation. Salmon populations are adapted to the specific, natural temperature ranges of their natal streams. The empirical evidence available demonstrates that altering these temperature regimes adversely affects all of the salmonid life stages. For example, high temperatures inhibit the upstream migration of adult salmon and increase the incidence of disease throughout a salmon population. Laboratory studies demonstrate that juvenile salmon respond to changes in stream temperature regimes with reduced development, reduced growth, reduced survival, and changes in the timing of life history phenomena (Beschta *et al*. 1987, Thomas *et al*. 1993). Further, the stressful impacts of water temperatures on salmonids are cumulative and positively correlated to the duration and severity of exposure. The longer the salmonid is exposed to thermal stress, the less chance it has for long-term survival (Ligon et al. 1999).

Salmon and steelhead require cool, well-oxygenated water within a relatively narrow range of temperatures. In general, juvenile and adult salmonids prefer water temperatures under 63º F (17º C). At temperature between about 64 and 72º F (18 and 22º C) ecological dominance transitions from salmonids to other species, and salmonids are typically eliminated from locations at temperatures above about 72 to 75º F (22 to 24°C) (Carter 2005). Tables 10 through 12 below outline the thermal tolerances for Chinook salmon, steelhead, and coho salmon respectively.

Table 10. Chinook Salmon Thermal Tolerances in Fresh Water. Source: Carter (2005).

Life Stage	Sub-Optimal Temperature	Optimal Temperature	Sub-Optimal Temperature	Lethal Temperature
Adult Migration and Holding	<10ºC	10-17°C	17-21°C	>21-24°C
Adult Spawning	<6ºC	6-13°C	13-18°C	>18°C

Life Stage	Sub-Optimal Temperature	Optimal Temperature	Sub-Optimal Temperature	Lethal Temperature
Egg and Larvae Incubation	<4°C	4-13°C	13-17°C	>17°C
Juvenile Rearing and Smolt Migration	<10°C	10-18°C	18-24°C	>24°C

Table 11. Steelhead Thermal Tolerances in Fresh Water. Source: Carter (2005).

Life Stage	Sub-Optimal Temperature	Optimal Temperature	Sub-Optimal Temperature	Lethal Temperature
Adult Migration and Holding	<10ºC	10-15°C	16-20°C	>21-24°C
Adult Spawning	<4ºC	4-13°C	13-18°C	>18°C
Egg and Larvae Incubation	<4°C	5-11°C	12-17°C	>17°C
Juvenile Rearing and Smolt Migration	<10°C	10-18°C	18-24°C	>24°C

Table 12. Coho Salmon Thermal Tolerances in Fresh Water. Source: Carter (2005).

Life Stage	Sub-Optimal Temperature	Optimal Temperature	Sub-Optimal Temperature	Lethal Temperature
Adult Migration and Holding	<10ºC	10-16.5°C	17-21°C	>21- 24°C
Adult Spawning	<4ºC	4-13°C	13-18°C	>18°C
Egg and Larvae Incubation	<4°C	4-10°C	11-14°C	>14°C
Juvenile Rearing and Smolt Migration	<10°C	10-18°C	18-22°C	>22-24°C

Timber Harvest Effects on Water Temperature

Tree removal within and adjacent to riparian areas in upper watersheds can elevated in-stream water temperatures of the adjacent streams. It can also influence water temperatures at a sub-reach or reach scale, and in some cases may affect water temperature at a watershed scale. The effect reduced riparian vegetation may have on in-stream temperature varies by stream size, season of the year, and the amount of lost vegetation. Water temperatures in small streams are strongly influenced by riparian forest conditions and canopy cover over the stream, especially during summer months. Conversely, the water temperature of large rivers is less affected by riparian vegetation adjacent to the river because most available solar radiation normally reaches the surface of the river, and diel temperature variations are reduced by stream depth and volume of flow (Everest and Reeves 2007).

The primary factors that influence stream shade are the height and density of riparian vegetation (Groom *et al.* 2011a) and the surrounding terrain, with riparian vegetation typically providing most of the shade (Allen *et al.* 2007; Allen 2008). Removing trees from riparian areas reduces the amount of shade, which can increase thermal loading to the adjacent streams (Moore and Wondzell 2005). No-cut buffers have been found to reduce stream shade impacts from forest thinning and logging actions. Although the exact relationship between no-cut buffer widths and stream shade impacts is difficult to predict, in general wider no-cut buffers result in lower levels of lost stream shade (Anderson *et al.* 2007; Park *et al*. 2008; Science Review Team 2008).

During studies of clearcutting, no-cut buffers between 66 and 99 feet wide (20 to 30 m) were insufficient to prevent substantial loss of shade (Brosofske *et al.* 1997; Groom *et al.* 2011b; Kiffney *et al.* 2003). Sweeney and Newbold (2014, p. 576) concluded that riparian buffer widths of 66 feet can increase stream temperatures by about 3.6°F (2°C) as compared to a fully forested watershed. Conversely, no-cut buffers that were 151 feet wide (46 m) caused very small effects on stream shade (Groom *et al.* 2011a; Science Team Review 2008), and the effects on shade and temperature were minimal to undetectable for no-cut buffer widths of 151 to 227 feet wide (46-69 m) (Anderson *et al.* 2007; Groom *et al*. 2011a and b; Science Team Review 2008). The reduced shade impacts that were observed for the wider no-cut buffers were likely due to the incapability of the trees outside of those buffers to cast shadows beyond the respective buffers' widths (Leinenbach 2011). Although these studies focused on clearcutting, the results demonstrate that trees as far as 150 feet away from a stream can to contribute to the stream's shade. In addition to width, increased canopy density within the no-cut buffer appeared to reduce shading impacts, as did increased residual tree density outside of the no-cut buffers (Leinenbach *et al*. 2013).

Therefore, post-harvest stream shade is highly correlated with the width of no-cut buffers. However, the relationship between no-cut buffers and in-stream temperatures is quite variable, and can be affected by site-specific factors (Caissie 2006). Complicating factors include riparian forest structure and species composition, topography and channel aspect, stream size, substrate type, and discharge. The density of riparian vegetation also affects shade and thermal loading to a stream because the penetration of solar radiation is positively correlated with the number and the size of the gaps in the canopy and between the branches and stems (Brazier and Brown 1973, DeWalle 2010). In some instances, such as narrow streams with dense, overhanging streamside vegetation, or in stands where tree shadows fall away from the stream (*i.e*. along the north sides of northern latitude streams with an east-west orientation), no-cut buffers as narrow as 30 feet can maintain stream shade (Brazier and Brown 1973). Additionally, inputs of cold water from the streambed, seepage areas along the stream bank, and tributaries can help cool an affected stream if they are sufficiently large relative to the subject stream's discharge (Wondzell 2012).

Some of the best available science is found in US EPA modeling used to evaluate the effects of thinning prescriptions on stream shade (US EPA 2013). The US EPA addressed the following riparian vegetation attributes when evaluating the effects of riparian management on stream shade conditions: 1) Total width of the riparian buffer management zone; 2) width of the no-harvest buffer; 3) density of the vegetation within the no-harvest buffer (expressed as canopy cover); 4) pre-harvest vegetation density within the outer "thinned" buffer; and 5) post-harvest vegetation density within the outer buffer.

For US EPA's modeling results, they referenced a BACI (before-after-control-impact) study on 33 streams exposed to riparian harvest (US EPA 2013). Results showed an increase in stream temperature for streams that had a shade loss of greater than 6 percent. Based on the BACI results, the US EPA developed a defensible shade loss Assimilative Capacity[4] that used a maximum of three percent shade loss of streams to add a margin of safety.

SPL&T's Sacramento River basin land base includes approximately 15 miles of riparian habitat bordering anadromous streams, and 619 miles of additional perennial stream habitat. SPL&T's Trinity River basin HCP Plan Area lands include approximately 61 miles of riparian habitat bordering anadromous or Class I streams, and 283 miles of additional perennial stream habitat. It is expected that all riparian habitat adjacent to these streams will be included in THPs during the permit term. In most situations, stream shade is mainly provided by vegetation in the WLPZ Core (see Section 1.3.1.1. above for WLPZ definitions).

The CFPRs include the following requirements for timber harvest within a WLPZ:

1. Retain a 30-foot Core no-harvest zone.
2. Retain an Inner Zone of 40 to 70 feet with 70 to 80 percent canopy.
3. Retain the largest 7 to 13 trees per acre.

The combination of these controls further limits the amount of vegetation providing stream shade that may be removed. Non-commercial vegetation bordering and covering meadows and wet areas will be retained and protected during timber operations unless explained and justified in the THP and approved by the CAL FIRE Director. Where less than 50 percent canopy cover exists before timber operations, only sanitation salvage will be used to protect stream features, such as water temperature, spawning and rearing habitat for salmonids, and vegetation structure diversity for fish and wildlife habitat.

As described above, substantial loss of shade in clear-cut systems has been observed with no-cut buffers ranging from 20 to 30 meters (66 to 99 feet). Therefore, we expect that SPI's adherence to the WLPZ restrictions identified above will continue to affect temperatures as lands bordering riparian habitat that are harvested, despite its intended protections. The WLPZ Core no-harvest zone will provide only about 1/3 of the shade needed to protect against increased instream temperatures. Therefore, timber harvest occurring within 100 feet of a stream would likely allow enough solar radiation to slightly increase the water temperatures in the adjacent streams, especially during the summer in stands where gap treatments abut buffers that are situated along the southern banks of east-west flowing streams. The amount of increase is uncertain. However, the information above supports the understanding that timber harvest within 100 to 150 feet of streams would cause detectable increases, harvest within 66 feet of streams may increase in-stream temperatures by as much as 3.6°F (2°C), and harvest within 30 feet of a stream would likely increase temperatures above that.

In addition, the required retention of 70 to 80 percent canopy cover in the Inner Zone will allow for a reduction in shade that could affect stream temperatures. As previously mentioned, the US EPA estimated that a reduction in shade of 6 percent was necessary to increase water temperatures. Within the WLPZ, up to 30 percent of the canopy could be removed from the Inner

[4] The Assimilative Capacity refers to the natural ability of waters to dilute and disperse wastes and pollution without harm to the aquatic environment.

Zone under an approved THP. This level of canopy reduction is expected to be rare, especially as harvest shifts from even-aged silviculture to thinning prescriptions through SPI's sustained yield plan (SPL&T 2020). However, in areas where timber harvest in the WLPZ Inner Zone reduces the canopy cover such that 6 percent or more of the shade is removed, elevated instream temperatures are likely to impact Covered Species. As harvest nears the 20-30 percent canopy cover reduction that could occur under an approved THP in the WLPZ, the expected reduction in shade would likely cause greater temperature increases.

In areas adjacent to anadromous fish habitat where the 30-foot buffer for WLPZs is applied, elevated instream temperatures are likely to adversely affect the Covered Species that are present. When those streams are in close upstream proximity to anadromous fish habitat, the increased instream temperatures may transfer downstream to occupied habitat. Increased stream temperatures resulting from timber harvest near intermittent streams is less certain because some or all of those streams may be dry during the summer when the effects of solar radiation would be greatest. However, intermittent streams that are wet during the summer would likely experience relatively high increases in water temperatures, which depending on their distance upstream from anadromous fish habitat, may elevate the instream temperatures in downstream habitat with fish present. Further, project-related elevated instream temperatures could continue for decades after timber harvest, until the riparian vegetation recovers.

The downstream extent of detectable elevated water temperatures that would be attributable to the Covered Activities is uncertain, and is likely to be spatially and temporally highly variable. The issue is complicated by the high levels of uncertainty about stream reach specifics such as, the amount of lost shade for exposed stream reaches, the existing temperatures and flow volumes in those stream reaches, and the temperatures and the flow volumes of downstream tributaries and receiving waters. In the absence of site-specific information, and/or information to the contrary, we estimate that elevated water temperatures that could be attributable to the project may extend as far as 2 miles downstream from any stream reach where timber harvest occurs within 30 feet of its banks. We acknowledge that this may slightly over-estimate the intensity of effects, but believe this estimate to be both reasonable and unlikely to underestimate the potential effects on Covered Species and critical habitats in the HCP Action Area.

Temperature-related effects will be greatest for those Covered Species that are present in the HCP Action Area during summer months. Central Valley spring-run Chinook salmon adults and yearlings, and rearing juvenile SONCC coho salmon, and juvenile KMP steelhead and CCV steelhead have the greatest likelihood of exposure to increased temperature from the Covered Activities. Adult winter-run Chinook salmon are also present during summer months, but are currently restricted to the Sacramento River and Battle Creek below Eagle Canyon Dam, and therefore are unlikely to be exposed to temperature increases resulting from the Covered Activities. In the event that winter-run Chinook salmon are reintroduced into historic habitat upstream of these areas, the likelihood of exposure to increased stream temperatures resulting from the Covered Activities is expected to increase.

Effects of Roads on Water Temperature

In addition to timber harvest, project-related roadwork would cause the removal of some trees and understory vegetation. Tree and understory removal may occur during maintenance work on existing roads, and is likely to occur during the planned construction of 30-50 miles of new roads during the first decade of the HCP and 15-30 miles of new road during the second decade. No new road construction is planned during the last three decades of the HCP. Some tree and understory removal is also likely to occur during the construction and/or reconstruction of turnarounds, and during clearing work done to provide safe passage of logging trucks and other heavy equipment. It is likely that at least some of the tree and understory removal would occur within 150 feet of streams. In the Sacramento River basin HCP Action Area, approximately 3.53 miles of project-related roads are within watersheds occupied by Covered Species or within the 300-feet corridor of anadromous fish habitat. In the Trinity River basin HCP Action Area, approximately 28.76 miles of project-related roads are within watersheds occupied by Covered Species or within the 300-feet corridor of anadromous fish habitat.

As with timber harvest, roadwork-related tree removal that is done adjacent to streams may decrease stream shade. Because roadwork-related tree removal would occur in relatively small and widely scattered areas, the magnitude of its effect on stream temperatures would likely be smaller than timber harvest. However, it may cause slight, localized increased in-stream temperatures that could be additive to the effects of timber harvest, especially in areas where timber harvest and roadwork tree removals overlap. As with timber harvest, temperature impacts from this work would continue for decades until the vegetation recovers.

Water Drafting Effects on Water Temperature

Water drafting may occur at road watercourse crossings throughout the HCP Action Area. Water drafting may reduce available habitat if the amount of water withdrawn is excessive. Because most roadwork would occur during the normal operating season (non-winter period months), those withdrawals would most likely occur during summer low-flow periods. Water drafting sites are selected to avoid disturbance to riparian systems. Where possible, existing drafting sites, storage tanks, and off-channel sources are used. Drafting sites are chosen in streams and pools where water is deep and flowing, as opposed to streams with low flow and small isolated pools. Pumping is terminated when the tank is full. Per the CFPRs [943.7(l)], in watersheds with listed anadromous salmonids, water drafting for timber operations shall:

1. Comply with F&GC Section 1600, *et seq*. Timber operations conducted under a Fish and Game Code Section 1600 Master Agreement for Timber Operations that includes water drafting may provide proof of such coverage for compliance with 14 CCR § 923.7(l).
2. Describe the water drafting site conditions and proposed water drafting activity in the plan.
    a. A general description of the conditions and proposed water drafting;
    b. The Watercourse classification;
    c. The drafting parameters including the months the site is proposed for use; estimated total volume needed per day; estimated maximum instantaneous drafting rate and filling time; and disclosure of other water drafting activities in the same watershed;
    d. The estimated drainage area (acres) above the point of diversion;
    e. The estimated unimpeded streamflow, pumping rate, and drafting duration;

f. A discussion of the effects on aquatic habitat downstream from the drafting site(s) of single pumping operations, or multiple pumping operations at the same location, and at other locations in the same watershed;
g. A discussion of proposed alternatives and measures to prevent adverse effects to fish and wildlife resources, such as reducing hose Diameter; using gravity-fed tanks instead of truck pumping; reducing the instantaneous or daily intake at one location; describing allowances for recharge time; using other dust palliatives; and drafting water at alternative sites; and
h. The methods that will be used to measure source streamflow prior to the water drafting operation and the conditions that will trigger streamflow to be measured during the operation.

Additionally, bypass flows for Class I watercourses shall be provided in volume sufficient to avoid dewatering the watercourse and maintain aquatic life downstream, and shall conform to the following standard:

1. Bypass flows in the source stream during drafting shall be at least 2 cfs.
2. Diversion rate shall not exceed 10 percent of the surface flow.
3. Pool volume reduction shall not exceed 10 percent.

Before commencing any water drafting operation, the RPF and the Water Drafting Operator shall conduct a pre-operations field review to discuss the water drafting measures in the plan and/or Lake or Streambed Alteration Agreement (F&GC Section 1600).

Water drafting would cause periodic temporarily reduced instream flows downstream from the withdrawal points. Reduced flows could increase the affected stream's susceptibility to solar-induced temperature increases, or reduce the stream's ability to cool downstream reaches that are exposed to the sun. The intensity of any flow reduction would depend largely on the existing stream flow, the withdrawal rate and volume, and the duration of the withdrawal. When withdrawn water is a large portion of stream flow, shallow riffles and pools are likely to result from water withdrawal, leading to the temporary loss of margin habitat and instream cover.

SPI typically uses 4,000-gallon water trucks for water drafting operations. The requirements described above ensure that the maximum pump rates in Class I streams will not exceed 5.8 gallons per second. At maximum speed, a drafting event would last about 11.5 minutes. Given the expectation that water withdrawals would be relatively small due to adherence to the requirements outlined above (*i.e.*, limits for maximum diversion rates and pool volume reductions), and both spatially and temporally separated, detectable flow reductions would be brief (about 15 minutes at most), quickly lost with downstream movement from the site, and of a magnitude too low to cause any detectable effect on instream temperatures.

Expected Effects to Covered Species: During the summer, when project-related elevated instream temperatures are most likely to occur, migrating adult Chinook salmon are likely to be present within the HCP Action Area. In addition, rearing stream-type juvenile Chinook salmon (*e.g.*, spring-run Chinook salmon), rearing juvenile coho salmon, and rearing juvenile steelhead may be present within portions of the HCP Action Area year-round. As described in the

Environmental Baseline, summer instream temperatures in the Sacramento River basin HCP Action Area can already exceed 64.4°F (18°C). This temperature exceeds the threshold for decreased migratory fitness in adult salmonids (Carter 2005). It is also above the thresholds for sharply decreased salmon and steelhead egg survival, and it exceeds the ideal temperatures for optimal freshwater rearing of juvenile Chinook salmon, coho salmon, and steelhead. In the Trinity River basin HCP Action Area, mainstem water temperatures during the summer months in the Upper Trinity River are usually cool downstream to the vicinity of Douglas City. However, temperatures can be problematic during drought years when storage in Trinity Reservoir is low, tributary flows are low, and air temperatures are typically high for long durations. Downstream of Douglas City, daily average mainstem water temperatures during the summer months are higher than the published range for juvenile coho salmon rearing, and some smaller tributary streams may be subject to water temperatures increasing to levels stressful for rearing coho salmon during this period (NMFS 2014b).

Project-related tree loss is likely to cause slight but detectable temperature increases in watersheds occupied by anadromous salmonids where existing temperatures can already exceed thresholds for adverse effects. Therefore, project-related elevated instream temperature would adversely affect the Covered Species, and would likely continue to do so for decades until the vegetation recovers. For all Covered Species, exposure to project-related elevated water temperatures is likely to reduce adult migratory fitness, which may also reduce spawning success (Carter 2005). Rearing juveniles may experience elevated stress, reduced growth, and increased susceptibility to disease that could reduce their likelihood of long-term survival (Marine 1992; Marine and Cech 2004; McCullough et al. 2001; Reeves *et al*. 1987). Exposed eggs and alevin may also experience reduced fitness and increased mortality (Jager 2011). The annual numbers of individuals of the Covered Species that may be adversely affected by project-related elevated temperature is unquantifiable with any degree of certainty. However, the HCP Action Area is only sparsely populated by the Covered Species at any given time due to differences in freshwater residence timing. Furthermore, the temperature effects associated with the Covered Activities are expected to overlap with a very small amount of the occupied habitat within the HCP Action Area, and detectable effects are not expected to extend more than 2 miles downstream from the impacted reaches. Therefore, the numbers of affected fish would comprise such small subsets of their respective cohorts, that their loss is unlikely to cause detectable population-level effects.

2.5.2.3. Suspended Sediment

Increased instream suspended sediment is likely to adversely affect the Covered Species. The proposed Covered Activities that are most likely to affect suspended sediment levels are timber harvest and roads. Suspended sediments in small streams is often highly variable, being strongly influenced by the underlying geology of a site. Ground disturbance and subsequent erosion associated with timber harvesting, road work, and road use (timber hauling) can cause increased sediment transport to streams (Beschta 1978; Furniss *et al*. 1991; Gomi *et al*. 2005; Haupt 1959; Megahan 1987; McClelland *et al*. 1997; Robison *et al*. 1999; Swanson and Dryness 1975; Swanston and Swanson 1976). The increased sediments can degrade water quality and aquatic habitat conditions at multiple scales, including up to the watershed scale. The effects increase with increased road area and length of unbuffered stream reaches in headwater streams, and may persist for several years to decades following harvest (Gomi *et al*. 2005).

Two sources of sediment delivery to channels are expected from the Covered Activities, chronic and episodic. Chronic sediment delivery is that which occurs frequently, as a result of precipitation events that produce runoff, or snowmelt. Sediment from chronic sources is delivered during all storms with intensity great enough to initiate surface flow. Input of chronic sediment can be expected throughout the rainy season, and from occasional summer thundershowers. Episodic sediment delivery occurs infrequently, as the result of large storm events. These events can trigger mass wasting events and produce floods large enough to cause failures of channel crossings. Runoff following wildfire can also be considered episodic.

Research into the causes of crossing failures (Furniss *et al.* 1998) indicates that failures are typically caused by woody debris obstructing culvert inlets, coupled with flood flows. Failures are less often caused by exceedance of flow capacity. The amount of sediment delivered by these crossing failures is difficult to predict, due to the variation in the size of crossing fills and the extent of the failure. As crossings are improved, better design features, such as larger pipes, tapered or winged inlets, or replacement of culverts with low water crossings, are incorporated into reconstruction. As a result, the number of crossings at risk to failure are expected to decline over time. Mass wasting (*i.e.,* landslides) is another principal mechanism for the delivery of episodic sediment to stream channels. Once in the stream channel, the quantity and rate of sediment supply is a dominant factor in the distribution and quality of habitat for Pacific salmonids (Reeves *et al*. 1995). Excessive rates of sediment supply are expected to impact habitat through increased levels of fine sediment in the streambed, widened stream channels, filled pools, and, in the case of extremely high sediment yields, braided channels (*e.g.,* Dietrich *et al.* 1989).

Sediment delivered from road crossings and road surfaces are the primary source of potential chronic sediment in both the Sacramento River basin and Trinity River basin HCP Action Area watersheds. The planning watersheds in the Sacramento River basin HCP Action Area are not prone to mass wasting, and therefore road watercourse crossing failures represent the primary risk of episodic sediment delivery. The planning watersheds in the Trinity River basin HCP Action Area are generally more prone to mass wasting. Thus, wasting events and road watercourse crossing failures represent the primary risks of episodic sediment delivery in this basin.

Covered Species occur within 31 planning watersheds in the Trinity River basin, three of which are considered high risk for landslides and would have the highest likelihood to produce sources of episodic sediment. Fourteen of the 31 planning watersheds are considered moderate-high risk (see Table E-3, Appendix E of the HCP/SHA). One of the three high-risk (Upper Rush Creek) and two of the 14 moderate-high risk (Maxwell Creek and Little Browns Creek) planning watersheds are within the known or suspected SONCC coho salmon geographic range. In the SHA Action Area, none of the planning watersheds are considered high risk for landslides, but 10 considered moderate-high and would have the highest likelihood to produce sources of episodic sediment (see Table E-4, Appendix E of the HCP/SHA). Although the Covered Species are not present in the SHA Plan Area, episodic sediment resulting from landslides or mass wasting has the potential to extend downstream into occupied habitat.

Timber Harvest Effects on Suspended Sediment

The potential for sediment delivery from timber harvest activities strongly depends on the interaction between the location of the activity relative to a waterbody and the erosion potential of the activity (Croke and Hairsine 2006). The location of the activity is important, because eroded sediment from a disturbed site can rapidly settle as it discharges onto an undisturbed forest floor. The farther an activity is from a watercourse, the more likely it will be that eroded material will deposit before it reaches the water and causes a water-quality impact. The ability of the undisturbed forest floor to filter sediment is a fundamental concept used in forestry-related BMPs, and the CFPRs rely heavily on riparian buffer strips to prevent sediment delivery from timber-harvest activities. Hence, the likelihood of sediment delivery generally decreases as distance from the watercourse increases. Although the CFPRs and other timber harvest BMPs are designed to reduce the amount of erosion and delivery to watercourses, BMPs cannot prevent all erosion resulting from timber harvest (Keppeler *et al.* 2008).

Sediment delivery to streams typically begins as overland sheet flow. Conduits such as skid trails, roads, ditches, rills, and/or gullies increase the probability of delivery by channelizing the flow (Bilby *et al*. 1989; Croke and Mocker 2001), particularly if riparian buffer strips are not left between disturbed areas and stream channels (Gomi *et al*. 2005; Rashin *et al*. 2006). Timber felling and yarding disturbs soils and increases the potential for sediment transport to stream channels. Logging alone does not appear to increase surface erosion significantly (Likens *et al*. 1970, Megahan *et al*. 1995). However, the use of heavy machinery to transport cut logs causes soil compaction, leading to increased surface erosion and increased fine sediment delivery to streams (Williamson and Neilson 2000). Yarding activities can disturb soils when the trees are dragged across the ground (Hassan *et al*. 2005; Rashin *et al*. 2006). Yarding practices that limit the damage to shrub and herbaceous ground cover, and reduce the exposure of bare soil can reduce sediment transport to streams. Full suspension skyline yarding is very effective because the logs are suspended above the ground throughout much or all of the yarding process. Lifting the heavy end of trees being yarded and protecting skid trails with slash can also reduce soil impacts.

Living tree roots help stabilize soil. Cutting trees kills the roots, which increases the probability of slope failure as those roots decompose, particularly on steep slopes (Robison *et al*. 1999; Swanston and Swanson 1976). Depending on the intensity of the failure and its proximity to streams, slope failure can deliver large quantities of sediment to stream networks. The occurrence probability is related to the harvest type and intensity, soil properties, geology, unit slope, and precipitation level. When large areas are clear-cut, the slope will become less stable over time as the tree roots decompose and their effectiveness in stabilizing the soils decreases. This effect may be reduced and eventually offset in areas where enough trees are left scattered across the stand, because the remaining trees are likely to experience rapid growth from decreased competition and their increased root mass would improve their ability to stabilize the soils.

The amount of skid trails and landings will increase slightly in the HCP Action Area over the course of the permit period, with more area subject to harvest as treatments move from clearcutting to selection and thinning prescriptions. Assuming that sediment delivery from skid trails and landings is correlated with the amount of area harvested, we expect a slight increase in sediment from this source.

Several studies document the importance of streamside buffer strips to reduce sediment delivery, and show that their effectiveness increases with the presence herbaceous vegetation and slash (Belt *et al*. 1992), and with increased width. Vegetated buffers of 40 to 100 feet wide are very effective against sediment transport (Burroughs and King 1989, Corbett and Lynch 1985, Gomi *et al*. 2005). Lakel *et al*. (2010) report that buffer widths of as little as 25 feet can reduce sediment transport to streams, and Rashin *et al*. (2006) concluded that a 33-foot wide vegetated buffer is likely to prevent sediment delivery to streams from about 95 percent of harvest-related erosion features. SPI has proposed several measures to minimize fine sediment production from harvest units in the HCP Action Area. Riparian buffer widths of 30 feet and associated streamside slopes will filter a large portion if not all of fine sediment originating from harvest units. Based on the information presented above, we expect that the 30-foot wide WLZP no-cut buffer that SPI will implement would likely be sufficient to prevent most timber harvest-related sediment transport to streams within the HCP Action Area, such that sediment transport to fish-bearing streams is expected to be undetectable.

Effect of Roads on Suspended Sediment

Sediment delivery to streams from the erosion of unpaved roads, cut-banks, and ditches is well-documented (Gucinski *et al*. 2001; Croke and Mockler 2001; Johnson and Bestcha 1980; Madej 2001; Montogomery 1994; Reid *et al*.1981), ranging from chronic input of small amounts of fine sediments to catastrophic mass failures of roads during large storms (Gucinski *et al*. 2001). A road's design and placement on the landscape heavily influence its potential for sediment delivery to adjacent streams (Gucinski *et al*. 2001). Sediment delivery from surface erosion typically occurs through direct connections such as ditches, rills, or gullies (Bilby *et al*. 1989; Croke and Mockler 2001). Erosion rates can vary greatly, based primarily on surface material, traffic levels, storm intensity, and road slope (Bilby *et al*. 1989; MacDonald *et al*. 2001; Reid *et al*. 1981; Ziegler *et al*. 2001). Roads may increase episodic sediment delivery (*i.e*., landslides and crossing failures) through altered hillslope hydrology, destabilization of toe slopes and removal of vegetation that provides slope stability. The effects of roads on landslide rates will be a function of road location and drainage design. The impact of crossing failures on fish depends on the timing of the flows causing the event.

SPI analyzed THPs and other records for lands within the Sacramento River basin and Trinity River basin HCP Action Area to evaluate and characterize historic forest road conditions and failures, and to estimate potential future road failures and sediment delivery trends. Trends were based on the past 21 years and used the 100-year flood event of 1997 as a benchmark. The analysis suggests a trend of fewer road watercourse crossing and road drainage failures, and nearly no events resulting in watercourse diversion. Watercourse and drainage failures occurring during this period were all within areas burned by wildfire and then subject to rain-on-snow events. Collectively, these trends suggest some failure events will continue to occur over the permit term, including large events on rare occasions. Those large events are most likely to occur where landscapes are burned by wildfire, then subject to rain-on-snow weather conditions. In the Sacramento River basin HCP Action Area, 19 planning watersheds had greater than 1 square mile burned by wildfire during the last decade (2007-2018). In the Trinity River basin HCP Action Area, only two watersheds had greater than 1 square mile burned by wildfire during the last decade (2007-2018). While episodic sediment material is typical of all the planning watersheds in the HCP Action Area, the Trinity River basin has the highest propensity for mass wasting due to topography, parent material, and soil types. However, the risk of episodic sediment associated with large areas burned by wildfires is greatest in the Sacramento River basin.

During flood flows that cause crossing failures, critical dips prevent flow from draining down the road, and reduces erosion from gullying of road surfaces and fills. Studies of sediment effects during culvert (*i.e*., crossing) construction determined that increased sediment accumulation within the streambed was measurable (relative to control levels within) at a range of 358 to 1,442 meters downstream of the culvert (Lachance *et al*. 2008). This indicates that crossing failures and crossing-related sediment effects may extend up to a mile (approximately 1610 meters) downstream. SPI has constructed critical dips at all crossings with diversion potential. As a result, material delivered to channels during crossing failures should be limited to sediment in the fill. Generally, culverts over 30 inches in diameter have rock armoring to stabilize the fill and minimize the risk of failure. Therefore, we can make assumptions for existing culverts that are either 18 or 24 inches in diameter that may not be armored, in order to determine the amount of fill covering those crossings that may extend downstream in the event of a failure. Assuming an average crossing length of 10 feet for installation of a 24-inch-diameter culvert with a 14-foot roadway, plus 3-foot fill base in each side (20-foot total width), and a height of two feet (generally the height of fill over the culvert is similar to the height of the culvert), a crossing would have a fill volume of about six cubic yards. Assuming 50 percent of the fill volume would be delivered during failure, about three cubic yards of material would be delivered from each crossing with an 18-or 24-inch culvert installation that failed but did not divert the watercourse channel.

Road densities on SPL&T lands in the Sacramento River basin HCP Action Area are relatively high (see Appendix D in the HCP/SHA) and average 5.26 road miles per square mile. Project-related roads cross streams at over 3,450 locations in the Sacramento River basin HCP Action Area. However, only four cross streams occupied by anadromous salmonids. Approximately 3.53 miles of project-related roads are within watersheds occupied by Covered Species or within the 300-feet corridor of anadromous fish habitat. SPI has conducted READI Model surveys of SPL&T roads in 50 of the 78 Sacramento River basin planning watersheds and these surveys indicate that the percentage of connected roads varies from 0 to 40 percent. Of the 50 planning watersheds that have been surveyed, 20 include road-related sediment production delivered to streams at levels greater than 10 percent, and six out of those 20 watersheds are occupied by Covered Species. This amount of connected surface and road watercourse crossings can be expected to contribute at least moderate amounts of sediment to stream channels, until road improvements are implemented using the READI Model.

Road density on SPL&T in the Trinity River basin HCP Action Area is also relatively high (see Appendix D in the HCP/SHA) and average 5.64 road miles per square mile. Roads cross streams at over 2,200 locations, but only 29 cross anadromous streams. Approximately 28.76 miles of project-related roads are within watersheds occupied by Covered Species or within the 300-feet corridor of anadromous fish habitat. SPI has conducted READI surveys of SPL&T roads in 26 of the 31 Trinity River basin planning watersheds and these surveys indicate that the percentage of connected roads varies from 0 to 44 percent. Of the 26 planning watersheds that have been surveyed, 18 include road-related sediment production delivered to streams at levels greater than 10 percent, and 15 out of those 18 watersheds are occupied by Covered Species in the HCP Action Area. This amount of connected surface and road watercourse crossings can be expected to contribute at least moderate amounts of sediment to stream channels until road improvements commence using the READI Model. Additionally, the Trinity River basin HCP Action Area lies within less stable geologic landforms than the Sacramento River basin. Greater chronic sediment levels can be expected in the Trinity River basin HCP planning watersheds with greater landslide risk.

We also expect periodic short-term increases in fine sediment as a result of road construction, upgrading, and decommissioning throughout the HCP Action Area. As previously noted, SPI anticipates approximately 3-5 miles of new road construction in the HCP Action Area annually during the first decade of the permit period, 1.5-3 miles during the following decade, then no new road construction during the final three decades. Many of the new roads will be temporary roads that are removed after completion of harvest operations, or located on ridge tops where sediment delivery hazards are negligible. In the event that roads are proposed across potentially unstable areas, the services of a qualified geologist or engineer are required for construction in these areas. The CFPRs require identification, disclosure, and review by geologist professionals and protection measure implementation when operations are proposed on unstable areas, inner gorges or headwall swales. This additional oversight required by the CFPRs will allow for modification of the proposed timber operations to minimize instability and are expected to substantially reduce the hazard of any roads constructed across potentially unstable features. Based on CFPRs trends, current design standards and considerations will continue to advance and apply to future road reconstruction actions.

In general, once mobilized, fine sediments tend to stay suspended for long distances within the relatively fast flowing waters of upper watershed streams. However, they eventually settle to the streambed in areas where flows are sufficiently slow, or they may be diluted by the influx of additional water sources. Conversely, the influx of water from a tributary with high sediment loading may increase the suspended sediment concentration within a given stream. The downstream extent to which elevated suspended sediments that would be attributable to the Covered Activities is uncertain, and is likely to be highly variable, both spatially and temporally. The issue is complicated by high levels of uncertainty about road and stream reach specifics such as roadbed conditions, traffic type and volumes, the distance between the road and the stream, the existence of water control structures, and the type and density of vegetation that may separate the road from the stream. It is further complicated by variability in the amounts of precipitation that would mobilize the sediments and the adjacent stream's volume and flow rates. Without site- and storm-specific information, and/or information to the contrary, we estimate that elevated suspended sediments that could be attributable to the project may extend as far as 2 miles downstream from any stream reach that is within 300 feet of any project-related road. We acknowledge that this may slightly over-estimate the intensity of effects, but believe this estimate to be both reasonable and unlikely to underestimate the potential effects on Covered Species and critical habitats in the HCP Action Area.

We expect sediment-related impacts to Covered Species resulting from connected road surfaces to be greatest during the initial years (five years) following permit issuance, until READI Model fieldwork is completed and road improvements begin to occur as each watershed is entered as part of a proposed THP. Sediment delivery from roads would be reduced most during the first entries, as sites with the greatest potential to deliver sediment become treated. Once treated and regularly maintained, a trend to less sediment delivery will continue over the permit term. As a result, additional road lengths would be disconnected (reduced from current connectivity of 0 to 44 percent down to 0 to 15 percent over the permit term), and the efficiency and durability of road watercourse crossings would be improved so that their risk of failure is reduced. These changes to the road system would result in less sediment delivery (and flow) from road surfaces, and less sediment delivery from road watercourse crossings.

Expected Effects to Covered Species: Clean water is one of the most important ecological requirements for Chinook salmon, coho salmon, and steelhead (NMFS 2014a, 2014b). Increased sediment delivery (especially fine sediment) affects Covered Species in multiple ways. Chronic delivery of sediment, typically fine sediment, can have several different impacts, both short-term on individual salmonids, and via more long-term means such as effects on prey base. The impact of episodic sediment delivery (*e.g*., mass wasting and road watercourse crossing failures) on fish and habitat depends on the timing of the flows causing the event.

The majority of sediment transported from harvest will occur the first year or two following harvest or site preparation, and will continue to a lesser extent until revegetation of the site occurs, effectively protecting the soil from rainfall impact, and sheet erosion. The existing number of road crossings in HCP Action Area have the potential to contribute a limited amount of sediment to streams occupied by the Covered Species. Furthermore, unstable lands in the Trinity River basin HCP Action Area may be subject to mass wasting events, which have the potential to contribute large amounts of sediment to streams occupied by the Covered Species. We expect that the Covered Species present in those planning watersheds with greater than 10 percent road-related sediment delivery to streams will have the greatest exposure to chronic sediment-related impacts.

Therefore, exposure to project-related elevated suspended sediment and substrate embeddedness is reasonably certain to adversely affect juvenile and adult Chinook salmon, coho salmon, and steelhead that occupy the HCP Action Area. Exposure is most likely to occur annually over several months during the wet season, which overlaps with spawning, egg incubation, fry emergence, and rearing by stream-type juveniles. Exposure to elevated suspended sediment would likely include behavioral disturbances and possible injury, while substrate embeddedness may reduce spawning success and could reduce available forage for juveniles (Newcombe and MacDonald 1991).

Suspended sediments are often measured by the opacity it causes (turbidity) and/or by its concentration (total suspended sediments (TSS)). Turbidity is typically expressed in NTU, and TSS is typically expressed in mg/L. Depending on the particle sizes, NTU values roughly equal the TSS values (*i.e*. 10 NTU = ~ 10 mg/L TSS, and 1,000 NTU = ~ 1,000 mg/L TSS) (Campbell Scientific Inc. 2008; Ellison *et al*. 2010). Therefore, the two units of measure can be easily compared. Water quality is considered adversely affected by suspended sediments when turbidity is increased by 20 NTU for a period of 4 hours or more (Berg and Northcote 1985; Robertson *et al*. 2006). The effects on fish exposed to suspended sediments are somewhat species and size dependent. In general, severity typically increases with sediment concentration and duration of exposure, and decreases with the increasing size of the fish.

Bjornn and Reiser (1991) report that adult and larger juvenile salmonids appear to be little affected by the high concentrations of suspended sediments that may be experienced during storm and snowmelt runoff episodes. However, empirical data from numerous studies report the onset of minor physiological stress in juvenile and adult salmon after one hour of continuous exposure to suspended sediment concentration levels between about 1,100 and 3,000 mg/l, or to three hours of exposure to 400 mg/l, and seven hours of exposure to concentration levels as low as 55 mg/l (Newcombe and Jensen 1996). The authors reported that serious non-lethal effects such as major physiological stress and reduced growth were reported for seven hours of continuous exposure to 400 mg/l and 24 hours of continuous exposures to concentration levels as low as about 150 mg/l.

No specific information is available to describe the intensity and duration of the turbidity plumes that are likely to be caused by the proposed Covered Activities. However, elevated turbidity in the HCP Action Area resulting from the Covered Activities is very likely to periodically exceed the lower thresholds identified by Newcombe and Jensen (1996), and occasionally also exceed higher thresholds. Further, the sediments would increase substrate embeddedness in areas where they settle out of the water. Again, no specific information is available to describe the intensity of the substrate embeddedness that is likely to be caused by the Covered Activities. The distance of sediment travel, and the locations where sediments would settle out and accumulate would vary, based largely on the relationship between stream morphology and instream flows that would be driven by the intensity of storm events. Embeddedness would likely be relatively high in stream reaches where flows tend to slow downstream of input points. Depending on the intensity of subsequent storm events, sediments may continue to accumulate in certain areas, or become remobilized and move farther downstream. Therefore, sediments that enter intermittent and perennial streams upstream from habitat occupied by the Covered Species, may eventually, if not immediately reach that habitat.

Behavioral Disturbance: Most exposed individuals would likely first respond to increased suspended sediments by attempted avoidance of the turbidity plume. For juveniles, the avoidance behavior may cause abandonment of preferred shelter and forage resources. Displaced juveniles may experience decreased growth and fitness and reduced likelihood of survival due to increased energetic costs caused by foraging in suboptimal habitat and increase intra-species competition. Displaced individuals may also experience increased exposure to predators. Juveniles that remain within the area of increased turbidity may experience reduced feeding efficiency due to reduced visibility. Depending on the intensity and duration of the elevated turbidity, the exposure could cause decreased growth and fitness and reduced likelihood of survival in some individuals.

Injury: Prolonged exposure to relatively low levels of suspended sediments can cause physiological stress in fish that may reduce growth rates and increase the susceptibility to disease in exposed individuals. Exposure to high levels of suspended sediment can cause gill irritation or abrasion that can reduce respiratory efficiency or lead to infection. Compromised gill function would reduce fitness and may increase mortality. At very high levels, suspended sediments can clog gills, which may cause direct mortality. Although it is not likely that suspended sediment concentrations would reach levels sufficient to kill or permanently injure exposed individuals, some rearing and migrating juveniles are likely to experience some level of reduced fitness that may reduce their likelihood of survival.

Reduced Spawning Success: Sediment-free rocks and gravel are critically important habitat for salmon and steelhead spawning. Salmon and steelhead eggs and alevins depend on a steady supply of well-oxygenated water flowing through the interstitial spaces between sediment-free gravels during the months-long period between spawning and the emergence of the fry from those gravels. Suspended sediments are likely to settle into the interstitial spaces between rocks and gravel when they eventually settle out of the water. High levels of sediment settling onto existing salmonid redds (nests), has the potential to fill-in the interstitial spaces between the gravel and smother the eggs or alevin within those redds. If sedimentation concentrations and/or persistence are high enough, the gravels may become embedded enough that the spawning habitat may be unavailable for future generations of returning adults.

Reduced Forage: Small aquatic invertebrates, that are important forage resources for juvenile salmonids, live in the well-oxygenated interstitial spaces between the rocks and gravel. Gravel embeddedness is likely to kill aquatic invertebrates in the areas where suspended sediments settle out of the water, and reduce forage availability within the affected reach. Reduced forage availability is likely to increase competition, and may reduce growth and likelihood of survival for some of the individuals that rear in the impacted reaches. Over time, gravel embeddedness may significantly reduce the affected reach's ability to support rearing juvenile salmonids.

It is most likely that the effects on adult salmonids that would be exposed to elevated suspended sediments resulting from Covered Activities would be limited to relatively mild behavioral effects such as avoidance of the plume and mild gill flaring (coughing) that would affect the fitness of the exposed individuals. Given their small size and relatively high sensitivity to the stressors described above, some of the rearing and migrating juveniles that would be exposed to project-related elevated suspended sediments are likely to experience behavioral and physiological effects that would reduce their overall fitness and may reduce their likelihood of survival. Additionally, it is reasonably likely, that some eggs and interstitial juveniles of both species may be injured or killed by sedimentation of gravels.

The annual numbers of individuals of the Covered Species that would be impacted by suspended sediments and substrate embeddedness is unquantifiable with any degree of certainty. However, given the relatively small amount of occupied habitat that would be affected, and the expectation that the density of the Covered Species within the HCP Action Area is low, the numbers of fish that would be annually affected by this stressor would comprise such small subsets of their respective cohorts, that their loss would cause no detectable population-level effects.

2.5.2.4. Large Woody Debris

Reduced instream LWD recruitment due to the Covered Activities is likely to adversely affect the Covered Species. Instream wood (tree trunks and root wads) enhances the habitat quality for salmonids. Riparian trees that die and fall into streams and/or their floodplains and wetlands influence stream channel complexity and stability. They help retain sediments, and create pools, undercut banks, and off-channel habitat. They deflect and slow stream flows and increase hydraulic complexity. They also stabilize stream channels, improve productivity, and provide cover for fish (Bilby and Bisson 1998; Bisson *et al.* 1987; Gregory et al. 1987; Hicks *et al.* 1991; Murphy 1995; Ralph *et al.* 1994).

Streamside LWD recruitment to streams tends to be relatively even throughout a drainage network, whereas episodic landslides tend to create large concentrations of wood at tributary junctions. Streamside-derived wood can provide the largest key pieces to streams, and contribute to gravel storage that converts bedrock reaches to alluvial reaches, creates smaller, more numerous pools, and increases habitat complexity (Bigelow *et al.* 2007; Montgomery *et al.* 1996). LWD in episodic landslides also contributes to habitat complexity and ecological productivity (Bigelow *et al.* 2007). It also reduces the speed and run-out distance of debris flows on valley floors (Lancaster *et al*. 2003). Both types of LWD delivery are necessary for functioning and productive stream ecosystems.

Coarse sediment retention by LWD is also important, because it helps to create and maintain alluvial aquifers that moderate stream temperatures through hyporheic exchange. In addition, sediment storage in upstream reaches reduces the downstream transport of fine sediments that can embed gravels and smother redds. LWD and other obstructions attenuate peak flows, which reduces the movement of spawning substrate and bed scour that can destroy redds.

Empirical data and modeling studies suggest that streamside riparian LWD input rates vary by stand type and age, but rates decline exponentially with distance from the stream (Gregory *et al.* 2003; McDade *et al.* 1990; Van Sickle and Gregory 1990). Studies indicate that about 95 percent of instream LWD from streamside sources typically comes from distances within about 150 feet of the stream. Shorter distances may occur in young, short stands, while longer distances may occur in older and taller stands (Spies *et al.* 2013). Studies suggest that the 30-foot WLZP no-cut buffer would protect only about 40 to 50 percent of the existing LWD recruitment (McDade *et al.* 1990; Spies *et al.* 2013). Although SPI's sustained yield plan may accelerate the growth of large diameter trees over the long term (Spies *et al.* 2013), it is likely to reduce LWD recruitment to HCP and SHA Action Area streams for the next 20 years or so.

The HCP describes several activities that influence the supply of woody debris to streams. These activities include: (1) riparian management, including delineation of WLPZs and harvest activities within WLPZs; (2) harvest on existing unstable ground and potentially unstable areas (*i.e.*, inner gorges and headwall swales); and (3) road construction and maintenance. Non-commercial vegetation bordering and covering meadows and wet areas are retained and protected during timber operations, unless explained and justified in the THP and approved by the CAL FIRE Director. Where less than 50 percent canopy cover exists before timber operations, only sanitation salvage (harvest of dead or decaying timber resources) will be used to protect stream features. These features include water temperature, streambed and flow modification by LWD, filtration of organic and inorganic material, upslope stability, bank and channel stability, spawning and rearing habitat for salmonids, and vegetation structure diversity for fish and wildlife habitat. LWD recruitment for instream habitat is provided by retaining Core, Inner and Outer Zone tree and canopy requirements (described in Section 1.3.1.1) in the HCP Action Area and maintaining at least two live conifers (at least 16-inch dbh and 50 feet tall) within 50 feet of Class I and II watercourses (described in Section 1.3.1.2) in the SHA Action Area.

As previously mentioned, the effect of removing trees on hillslopes that are prone to mass wasting can have a substantial influence on the supply of LWD to streams. We note that while most of these unstable areas will have trees on them, they will be typically smaller in size (*i.e.*, approximate age since past harvest). Therefore, we expect that much of the vegetation derived from these areas following harvest or landslides will be composed largely of smaller pieces with limited ability to provide instream function (Bilby and Ward 1989, Fox 1994). However, over time, it is expected that many of the trees that are retained will attain an age and size that will provide significant function if delivered to streams in the HCP Action Area. We expect that implementation of the HCP/SHA will provide greater assurances that a larger number of trees will be retained over the long term in potentially unstable areas and supplied to streams during active slides.

The reduced LWD recruitment to streams within the HCP Action Area is likely to sufficiently reduce habitat quality for rearing juvenile salmonids, such that some individuals would experience fitness impacts that may reduce their likelihood of survival. The reduced LWD recruitment is also likely to reduce spawning habitat quality sufficiently enough to reduce the spawning success for some adults, and/or to cause the loss of some eggs and alevin. The annual numbers of individuals that would be affected by reduced LWD recruitment is unquantifiable with any degree of certainty. However, based on the relatively small amount of occupied habitat that may be affected, and the expectation that the density of the Covered Species within the HCP Action Area is very low, the numbers of fish and eggs that would be annually affected by this stressor would comprise such small subsets of their respective cohorts, that their loss would cause no detectable population-level effects.

Pool Frequency and Quality: Reduced pool frequency and quality due to the Covered Activities is likely to adversely affect the Covered Species. Pools are important habitat features for juvenile and adult salmonids because they often provide deep cool water that act as thermal refugia during periods of high instream temperatures. They also often provide pockets of reduced flow velocity that can provide shelter during high flow events.

Reduced LWD recruitment would negatively affect hydrological functions involved with pool formation, as well as with the retention of sediments. Increased input of fine sediments would act synergistically with reduced instream LWD, and would likely reduce pool depths due to in-filling. In areas where excessive sediment aggradation occurs, the stream channels could become wider and shallower. NMFS believes that these effects would be manifested across the watershed over several years as increased sediment loading continues to enter the streams, and the removed trees that may have eventually recruited to the streams would fail to enter the water to replace the current instream LWD that is likely to migrate downstream over time.

The resulting reduction in pool frequency and quality within the HCP Action Area is likely to sufficiently reduce habitat quality for rearing juveniles, such that some individuals would experience fitness impacts that may reduce their likelihood of survival. The reduced pool frequency and quality may also sufficiently reduce habitat quality for migrating adults such that some individuals may experience reduced spawning success. The annual numbers of individuals that would be affected by reduced pool frequency and quality is unquantifiable with any degree of certainty. However, based on the relatively small amount of occupied habitat that may be affected, and the expectation that the density of Covered Species within the HCP Action Area is very low, the numbers of fish that would be annually affected by this stressor would comprise such small subsets of their respective cohorts, that their loss would cause no detectable population-level effects.

2.5.2.5. Chemicals and Nutrients

Exposure to project-related chemicals and nutrients is likely to adversely affect Covered Species. Most of the Covered Activities, particularly timber harvest, road work, and timber hauling, involve the use of heavy equipment near streams. Many of the fuels, lubricants, and other fluids used by that equipment are petroleum-based fluids that contain Polycyclic Aromatic Hydrocarbons (PAHs) and other substances that are known to be injurious to fish. Under standards in the CFPRs, machinery may be maintained and fueled within the THP area, and fuel may also be stored in the HCP Action Area. Maintenance, fueling, and fuel storage must be conducted outside WLPZs. Petroleum products and cleaning agents must be disposed of in proper dumps or water treatment facilities. SPI is committed to avoiding and minimizing environmental impacts of such activities (SPL&T 2020).

Although SPI proposes measures intended to reduce the risk and intensity of discharges and spills, those measures would not completely eliminate the risk. Therefore, it is likely that some contaminants would be leaked or spilled onto forest roads and landings by log trucks and other equipment, and onto the forest floor by the saws and other equipment used to cut and yard trees. Although direct discharge to the streams is relatively unlikely, toxic fluids are likely to enter the streams when the dusts and sediments that have absorbed the myriad drips and small spills are eventually carried to streams by runoff during the wet season.

Salmon and steelhead can uptake contaminants directly through their gills, and through dietary exposure (Karrow *et al*. 1999; Lee and Dobbs 1972; McCain *et al*. 1990; Meador *et al*. 2006; Neff 1982; Varanasi *et al*. 1993). Many of the pollutants that may enter the water column due to Covered Activities can cause effects in exposed fish that range from avoidance of an affected area, to reduced growth, altered immune function, and immediate mortality in exposed individuals. The intensity of effects depends largely on the pollutant, its concentration, and/or the duration of exposure (Brette *et al*. 2014; Feist *et a*l. 2011; Gobel *et al*. 2007; Incardona *et al.* 2004, 2005, and 2006; Mcintyre *et al.* 2012; Meadore *et al.* 2006; Sandahl *et al*. 2007; Spromberg *et al.* 2015). It is likely that some juvenile salmon and/or steelhead will be directly exposed to petroleum-based pollutants, and/or contaminated prey resources, at concentrations capable of causing reduced growth, increased susceptibility to infection, and increased mortality, as a result of the Covered Activities.

Timber harvest can cause a release of carbon, nitrogen, phosphorus, and sulfur through burning of slash and decomposition that may also reach streams through erosion and runoff (Vitousek 1983). Riparian buffers as small as 62 feet wide can decrease nutrient flow to streams by 48 to

95 percent (Jordan *et al.* 1993; Lowrance *et al.* 1984; Snyder *et al*. 1995). Based on this information, the planned 30-foot WLPZ no-cut buffer will likely be inadequate to capture all project-related nutrient flow, and a small increase in nutrient flow to the streams is likely to occur. While some nutrient increases may adversely affect the Covered Species, some timber harvest related nutrients provide benefits for anadromous salmonids.

Allochthonous inputs (nutrients derived from outside the aquatic system typically through leaf and needle [*i.e.*, detrital] inputs) can serve as important sources of nutrients in streams occupied by salmonids. Leaves and needles, along with other biological material falling into streams from riparian vegetation, supply nutrients and food for aquatic organisms (Gregory *et al.* 1991; Richardson 1992). Alder (*Alnus* sp.) fixes atmospheric nitrogen and is one of the most important sources of detrital inputs to lower order streams. The organisms in the base of the food chain that rely on those inputs are ultimately the food base that juvenile salmonids consume when rearing and migrating to the ocean. Studies indicate that nutrients in streams from a variety of sources increase in the first few years following logging (Hicks *et al.* 1991), elevating nutrient levels and increasing food production. Where additional light is provided to the stream, increases in primary and secondary productivity may occur and provide greater food availability for fish, enabling increases in individual juvenile salmonid growth, but effects on overall salmonid production have not been detected related to these increases (Hicks *et al.* 1991).

The CFPRs require increasing conservation of streamside vegetation during timber harvest operations, so we expect that detrital inputs are likely to increase over time as riparian vegetation is retained in the HCP Action Area. Tree retention standards and riparian buffer requirements for WLPZs will allow for the continued input of detrital material (leaf/needle debris) that deliver nutrients to streams within the HCP Action Area. This retention of riparian vegetation will also serve to filter out contaminants that may be delivered to streams from the use of heavy equipment during timber harvest. The annual numbers of individuals that would be affected by exposure to chemical and nutrients is unquantifiable with any degree of certainty. However, based on the expected infrequency and small volumes of discharge, the relatively small amount of occupied habitat that may be affected, and the expectation that the density of the Covered Species within the HCP Action Area is low, the numbers of fish that would be annually affected by this stressor would comprise such small subsets of their respective cohorts, that their loss would cause no detectable population-level effects.

2.5.2.6. Entrainment

Watercourse crossings within anadromous fish habitat will occasionally be used as water drafting sites during forestland management activities. Water drafting involves the pumping of stream flow into a water truck, which is then applied to road surfaces for dust abatement and to maintain road surfaces. During water drafting, small salmon and steelhead may be entrained in the hose or impinged against the surface of the pump screen. Entrainment or impingement could result in injury or mortality. Adult salmonids are unlikely to be affected due to restrictions associated with water drafting near spawning habitat and the ability of adult salmonids to avoid areas where water drafting is occurring. Most drafting occurs in summer and early fall during periods when Covered Species are least likely to be present in the HCP Action Area.

During water drafting, SPI will implement several measures that are designed to avoid impacts to Covered Species. Water drafting sites are selected to avoid disturbance to riparian systems. Where possible, existing drafting sites, storage tanks, and off-channel sources are used. In all watersheds, all intakes will be screened and operated to prevent impingement of juvenile fish against the screen. Per the CFPRs [943.7(l)], the following requirements apply to screens and water drafting on Class I waters:

1. Openings in perforated plate or woven wire mesh screens shall not exceed 3/32 inch (2.38 millimeters). Slot openings in wedge wire screens shall not exceed 1/16 inch (1.75 millimeters).
2. The total (unobstructed) surface area of the screen shall be at least 2.5 square feet.
3. The drafting operator shall regularly inspect, clean, and maintain screens to ensure proper operation whenever water is drafted.
4. The approach velocity (water moving through the screen) shall not exceed 0.3 foot/second.
5. The diversion rate shall not exceed 350 gallons per minute.

The licensed timber operator (or the water drafting operator) will implement the measures described above during water drafting, per the CFPRs. CDFW's 1600 Agreement standards will also apply to water drafting activities. SPI is required to obtain a Section 1600 Agreement from the CDFW for any forest management activities that divert or obstruct the natural flow of a river, stream, or lake; substantially change or use material from the bed, channel, or bank of any river, stream, or lake; or deposit debris, waste, or other materials that could pass into any river, stream, or lake (F&GC 1600 *et seq*.). CDFW can recommend additional minimization measures that may be incorporated into the Section 1600 Agreement and become enforceable requirements if agreed to by the applicant. Such measures may include timing restrictions, erosion control BMPs, and design criteria for water crossing structures to protect water quality and fish life. For emergency projects that require immediate repair, the landowner is required to apply for a Section 1600 permit from CDFW within 14 days of emergency repairs.

Water drafting within ASP watersheds also includes implementing NMFS Water Drafting Guidelines (NMFS 2001), which are intended to reduce potential impacts further. The screening criteria discussed above prevents entrainment into the pump, and the required velocities for pumping minimize the potential for impingement.

The CFPRs and the NMFS Water Drafting Guidelines require that the water drafting operator keep a log each time that water is drafted. The Water Drafting Log records:

- Water Drafting Operators name
- Date of water drafting
- Screen condition
- Total pumping time, including start time and end time
- Diversion/pump rate
- Total volume of water diverted

Water Drafting Logs are filed with CAL FIRE at the end of seasonal operations and are maintained with the plan record.

In the HCP Action Area, the small number of watercourse crossings that may be used during water drafting indicates that exposure to these activities will be rare. In the event that juvenile salmonids are exposed, the screening criteria and pumping limitations described above will reduce the potential for harm, injury, or death. Thus, we expect that protective measures to be implemented by SPI during water drafting in the HCP Action Area will minimize impacts to Covered Species, such that the numbers of fish that would be annually affected by this stressor would comprise such small subsets of their respective cohorts, that their loss would cause no detectable population-level effects.

2.5.2.1. Fish Passage

Natural and artificial barriers can delay the upstream passage and increase energetic costs to migration for salmonids. Impediments physically block access to upstream holding and spawning habitats, alter downstream habitat (by disrupting water velocity, temperature, and sediment transport) and eliminate the spatial segregation of spawning habitat that historically existed. This can create cascading effects of fragmented habitat, constrained species distributions, isolated genetic pools, increased competition for spawning sites, and favoring generalist over specialist life histories which poses a particular risk to endemic species (Liermann *et al*. 2012; Poff *et al*. 2007).

Passage impediments/barriers typically are manmade structures that constrain connectivity and fragment access between essential habitats. Barriers physically block access to upstream historic holding and spawning habitats and eliminate spatial segregation of spawning habitats, which historically existed above the barrier, and may cause spatial competition among adults. Effects of the action that contribute to passage impediments/barriers are likely to result in a probable change in fitness by reducing salmon and steelhead adult reproductive success prior to spawning and reducing Chinook and steelhead salmon egg survival through redd superimposition. Passage impediments and barriers may affect juvenile rearing and outmigration life stages of salmon and steelhead along their migration routes between the ocean and natal areas. Impediments change the routing and travel rates of fish passing these sites, which may increase competition among individuals and expose fish to higher predation in distinct migration routes. Effects that contribute to passage impediments/barriers are likely to result in a probable change in fitness by reducing juvenile salmon and steelhead growth and survival.

Road watercourse crossings are accomplished by constructing a variety of structures. Typically, these structures are culverts, followed in frequency by fords and bridges. Bridges usually do not alter stream morphology and do not obstruct passage of aquatic organisms. Fords typically affect short lengths of the stream bottom and therefore do not obstruct passage (SPL&T 2020). Many culverted crossings are barriers to different life stages of salmonids. Passage problems are associated with confined flow areas that accelerate velocity, and the length and slope of culverts, which exceed the sustained and burst swimming capabilities of fish, especially young fish. Culverts may also have inlets not placed at stream grade that present jump distances exceeding capabilities of fish.

In the event that a road watercourse crossing failure or a mass wasting event occurs and blocks fish passage, Covered Species may be temporarily affected, until remediation occurs. The duration may vary depending on the source of the fish passage barrier. Road watercourse crossing failures can be repaired quickly (hours to days), whereas habitat blockage due to mass wasting events may take longer (days to weeks), before remediation (either through natural processes or repairs) occurs. However, these events are expected to be rare and unlikely to occur in HCP Action Area due to the additional protection measures that are required through the CFPRs when activities are proposed within unstable areas. Mass wasting risk generally originates from inner gorge streamside destabilization due to over-steepened slopes adjacent to watercourses or concave headwall swales located in the steepest, highest reaches of a watershed. Inner gorges and headwall swales are characterized in the CFPRs as areas where additional expertise from a professional geologist may be required if harvest or road building activities are proposed. The CFPRs require identification, disclosure, and review by geologist professionals and the implementation of protection measures when operations are proposed on unstable areas, inner gorges or headwall swales. These measures are expected to reduce the likelihood of mass wasting events as a result of the Covered Activities.

Road watercourse crossings are kept to a minimum, and existing crossing locations are used when possible. If a new watercourse crossing is required, it will be prepared using a structure, such as a bridge, culvert, or temporary log culvert. Any in-water work necessary to construct road watercourse crossings is conducted during in-water work periods specified in applicable CFPRs (see Section 2.5.2.8. *Physical Disturbance of Habitat*). The HCP's discussion regarding crossing facilities on watercourses supporting fish indicates that SPI will ensure unrestricted passage for all life stages of anadromous salmonids that may be present. Within a WLPZ, temporary crossings will be removed before the winter period, unless explained and justified in the winter operating plan and approved by the Director of CAL FIRE. Tractor roads are not constructed or used in watercourses and other wet areas, except at prepared tractor road watercourse crossings, crossings over dry watercourses, and at new and existing tractor road watercourse crossings as part of the Fish and Game Code process (F&GC § 1600 *et seq*.).

There are currently no impassable crossings in anadromous stream habitat on streams in the Sacramento River basin HCP Plan Area. Four stream crossings occur in anadromous stream reaches in the Sacramento River basin HCP Plan Area: one bridge, one culvert, and two fords located in the Deadhorse Creek and Taylor Gulch planning watersheds (see Table 5 above). These streams occur in the Antelope Creek and Cottonwood Creek watersheds, respectively. Twenty-nine stream crossings occur in anadromous stream reaches in the Trinity River basin HCP Plan Area: 14 bridges, 8 culverts, and 6 fords located in 17 planning watersheds (see Table 6 above). These streams occur in the Lower, South Fork, and Middle Trinity River Hydrologic Areas.

Should Covered Activities impair fish passage, adult and juvenile salmonids are likely to be adversely affected through altered migration behavior and reduced survival and productivity. However, as previously mentioned, the number of new road watercourse crossings will be minimized to reduce environmental impacts. Crossing facilities on fish-bearing watercourses are designed to allow for unrestricted passage of all life stages of anadromous salmonids and unrestricted water passage. Therefore, we expect that the Covered Activities are unlikely to result in impediments to fish passage within the HCP Action Area or reduce habitat connectivity during the permit period.

2.5.2.2. Physical Disturbance of Habitat

Physical disturbance of instream habitat is likely to adversely affect Covered Species. Covered Activities that may involve instream habitat disturbance include road reconstruction and new road construction associated with THPs. In most cases, these activities are conducted to upgrade the crossing structure where the crossing may fail and need replacement, while in other cases the crossing may need replacement because it has aged and is subject to failure. Road construction and road reconstruction activities include the use of heavy equipment to remove existing fill and to construct or place new structures.

Work involving the presence of equipment or vehicles in the active stream channel when Covered Species are present is likely to result in injury or death of some individuals. SPI will avoid or reduce that risk by limiting the timing of instream work to avoid vulnerable life stages of anadromous salmonids, including migration, spawning and rearing. Reconstruction activities will occur during low flow periods when Covered Species are least likely to be present. SPI will adhere to the CFPRs during instream work, which limit the extent of instream activity that may occur under an approved THP. The CFPRs require that reconstruction activities conducted in flowing streams have a dewatering (*i.e.*, isolation) plan in place prior to beginning instream activities. This is also required through the CDFW 1600 Agreement process.

If dewatering is required to conduct instream activities, a plastic pipe will be used to collect water above the proposed construction site. The water will be routed around the site into the same channel below the proposed construction site. Dewatering of the isolated work areas will dry out the substrate in that area, reducing the risk of exposure of streams to sediment and chemical contaminants resulting from construction activities. However, it is also important to note that any macro-invertebrates residing in the isolated work areas will likely die as the area dries out. This results in a short-term reduction of available prey for juvenile salmonids. Work isolations will also temporarily decrease spatial availability within the river, and reduce available aquatic habitats.

If work area isolation/dewatering is necessary, any juvenile salmon or steelhead present in the work area will be captured and released up or downstream of the work area. It is unlikely that any adult fish, including Chinook salmon, coho salmon, and steelhead will be affected by this procedure because the proposed action includes implementing these activities during recognized in-water work windows when adults are unlikely to be present and, if any are present, their size allows them to easily escape from the containment area.

Although instream construction activities will occur during low flow periods in order to avoid impacts to Covered Species, salmonids that are present during summer months (*i.e.,* juvenile spring-run Chinook salmon, juvenile coho salmon, and juvenile steelhead) have the greatest likelihood of exposure to these activities. Covered Species with shorter freshwater residence times (*i.e.,* fall-run Chinook salmon) are not typically present in the HCP Action Area during low flow periods, and are therefore unlikely to be exposed to instream activities. Although winter-run Chinook salmon adults spawn during the summer months, they are not currently present in HCP

Plan Area watersheds, and the extent of instream work effects are not expected to extend downstream where adult winter-run Chinook salmon spawning occurs.

Capturing and handling fish causes them stress, however most will typically recover rapidly from the process, and therefore the overall effects of the procedure are generally short-lived (Portz 2007). In rare cases, some fish may be injured or die from capture and handling during dewatering. The primary contributing factors to stress and death from handling are differences in water temperature between the river where the fish are captured and wherever the fish are held, dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical trauma. Stress on fish increases rapidly from handling if the water temperature exceeds 64°F or dissolved oxygen is below saturation.

Effects to Covered Species resulting from physical alteration of instream habitat in the HCP Action Area are expected to occur in areas where occupied habitat intersects with road watercourse crossings. Currently, four crossing locations occur in the Sacramento River basin HCP Action Area in the Deadhorse Creek and Taylor Gulch planning watersheds. These planning watersheds occur in Antelope Creek and Beegum/Cottonwood Creek, respectively (Table 10). Reconstruction activities at these locations will be infrequent during the permit period (two to three times per decade) and would be necessary following storm events causing extensive damage to these structures. In the Trinity River basin HCP Action Area, 29 road watercourse crossings occur in 17 planning watersheds in the Lower, South Fork, and Middle Trinity River HAs. Two of the 29 crossings occur in a planning watershed potentially occupied by SONCC coho salmon (Little Browns Creek), both of which are bridges (Table 9). Reconstruction activities at these locations will be infrequent during the permit period (one to two times per decade) and would be necessary following storm events causing extensive damage to these structures.

The annual numbers of individuals that would be affected by dewatering activities associated with instream construction is unquantifiable with any degree of certainty. However, based on the relatively small amount of occupied habitat that may be affected, the infrequency of instream construction activities, and the expectation that the density of Covered Species within the HCP Action Area is very low, the numbers of fish that would be annually affected by this stressor would comprise such small subsets of their respective cohorts, that their loss would cause no detectable population-level effects.

2.5.2.3. Effects of Other Activities

We considered, under the ESA, whether or not the proposed action would cause any other activities that would have consequences on the species and their critical habitat included in the opinion, and determined that it would cause the use and application of chemicals during forestland management activities. The application of forest chemicals is not a Covered Activity in the HCP/SHA; however, some herbicide use is a reasonably foreseeable outcome of even-aged timber harvesting. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur.

2.5.2.3.1. Chemical Use

Herbicides are primarily used by SPI to temporarily delay the growth of brush and weeds that compete with conifers for nutrients and sunlight while conifers are young. The application of forest chemicals is not a Covered Activity in the HCP/SHA; however, some herbicide use is a reasonably foreseeable outcome of even-aged timber harvesting. Both direct effects from exposure and indirect effects from habitat alteration or changes in primary and secondary production may occur within the HCP Action Area. Therefore, potential effects of herbicide applications are reasonably foreseeable during the permit period.

SPI forest chemical application is regulated by several federal, state, and local agencies and their use is conducted under applicable laws. Each chemical used by SPI has been tested and researched by the Department of Pesticide Regulations (DPR). The DPR regulatory process serves as a CEQA equivalent program and includes use of the US EPA label and additional label restrictions if necessary. Herbicide use requires a formal recommendation by a licensed Pest Control Advisor and application by a licensed Pest Control Operator. The County Agricultural Commissioner also participates in the DPR CEQA functional equivalent program. The CFPRs and chemical labels provide regulations regarding buffers for aquatic habitats and other conditions during application.

A review of the application methods, transport, and fate of the various herbicides commonly used during forestland management (NMFS 2007) indicates that the chance of these chemicals entering a fish-bearing watercourse is low. Further, toxicology data indicate that the exposure levels expected under forest application would not be sufficient to cause adverse effects to salmonids. However, we note that mixtures of the various compounds may be having greater effects on salmonids and their habitat than that considered for the compounds individually (Lydy *et al*. 2004). For instance, the adjuvants used during aerial application of these chemicals may be cause for concern. Despite the lack of information on the toxicology of these adjuvants and the uncertainties surrounding mixtures of these compounds, existing information for the surfactant R-11 indicates that aerial application of these substances may cause sub-lethal effects with consequent mortality of salmonids where streamside buffers are narrow and aerial drift occurs.

While we expect that the risk to salmonids is exceedingly low in any given year, when considered over the 50-year term of the ITP, isolated incidences of aerial drift and exposure may occur. Given the low concentrations of compound needed to induce a sub-lethal response, the likelihood exists, where aerial applications occur adjacent to fish-bearing streams, that individual salmonids may experience reductions in growth rates or other sub-lethal effects as a result of effects arising from the presence of adjuvants in streams. As previously mentioned, we consider this a low likelihood of occurring given that the application site must be near a watercourse with salmonids present, and we presume that SPI will comply with any R-11 use restrictions that are imposed from future assessments of the impacts of this compound on listed species. Chemical application is under the jurisdiction of several Federal, state, and local agencies and their use is expected to be conducted under applicable laws. By following all chemical labels and other regulations regarding the application methods, transport, and fate of the various herbicides, the chance of these chemicals entering a fish-bearing watercourse is very low. Furthermore, the likelihood of Covered Species being present near a treatment site at the time of chemical application is unlikely. Therefore, we expect that the likelihood of exposure to chemicals applied during timber harvest activities and potential effects to Covered Species and their habitat to be discountable, as it is very unlikely to occur.

2.5.2.4. Effects to Designated Critical Habitat

This assessment considers the intensity of expected effects in terms of the change they would cause in affected Primary Biological Features (PBFs) from their baseline conditions, and the severity of each effect, considered in terms of the time required to recover from the effect. Ephemeral effects are those that are likely to last for hours or days, short-term effects would likely last for weeks, and long-term effects are likely to last for months, years or decades.

Designated critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, CCV steelhead, and SONCC coho salmon occurs within the HCP Action Area. Because the PBFs for each species are similar, impacts to critical habitat are described collectively and are not separated by species. The expected effects on those PBFs from the Covered Activities, including full application of the conservation measures and BMPs, would be limited to the impacts on freshwater PBFs, as described below.

1. *Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.*

Water Quantity: The Covered Activities would cause long-term minor adverse effects on water quantity. Timber harvest, roads and roadwork would increase the ECA sufficiently to cause relatively small and localized increases in water yield and peak flows during the winter months. Increased flows would be undetectable beyond the HCP Action Area, but may persist for up to 20 years in a planning watershed after harvest.

Water drafting during the normal operating season (non-winter months) would cause very small, episodic, and very brief temporary decreases in water quantity that would be undetectable within yards downstream of the drafting site.

Water Quality: The Covered Activities would cause long-term minor adverse effects on water quality. Timber harvest, roads, and roadwork would cause slightly increased summer water temperatures that can already exceed 64.4°F (18°C) in some watersheds within the HCP Action Area. SPI will follow the CFPR WLPZ requirements which include maintaining 70 percent canopy cover within the riparian buffer, maintaining an average diameter of 24 inches for overstory trees, and maintaining a core area of 30 feet on each side of a fish-bearing stream. While these requirements are intended to be protective of Covered Species, we still anticipate localized temperature increases at the site of timber harvest. Timber harvest, roads, and hauling would cause slightly increased input of fine sediments, and equipment leaks and spills would introduce low levels of petrochemicals into stream waters. Detectable effects are not expected to exceed 2 miles downstream of locations where harvest or roads are within 150 feet of streams, but may persist for up to 20 years in the affected planning watershed. Road improvements will commence in year-4 of the permit term (once READI Model fieldwork and data analysis is complete) and will continue throughout the permit period until reaching the 85 to 90 percent disconnection goal for SPL&T roads. This conservation measure will reduce fine sediment inputs to streams and reduce overall impacts to water quality.

Substrate: The Covered Activities would cause long-term minor adverse effects on substrate. Increased flows, combined with reduced LWD delivery to streams may increase substrate movement and scour. Project-related sediment increases may cause localized low-level substrate in-filling and embedment. Some of these effects may extend up to 2 miles downstream from locations where timber harvest or roads are within 150 feet of streams and could persist for up to 20 years in the affected planning watershed after being entered as part of a THP. Road-related sediment delivery will be reduced using the READI Model, with improvements commencing as early as year-4 of the permit term. While the number or roads that will be improved and/or disconnected in a given year is unknown, SPI will conduct road improvements by giving the highest priority to locations that would provide the greatest conservation benefit based on the following criteria. In the Trinity River basin HCP/SHA Plan Areas, SPI will give highest priority to implementing road improvements on unstable lands based on the landslide risk assessment results and watersheds occupied by Covered Species. Improvements in the Sacramento River basin HCP/SHA Plan Areas will be prioritized using the NMFS Recovery Plan guidelines (NMFS 2014a). Core and reintroduction classifications, beginning with Core 1 and Core 2 watersheds, followed by Primary and Candidate classifications.

2. *Freshwater rearing sites with:*
    a. *Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility.*
    b. *Water quality and forage supporting juvenile development.*
    c. *Natural cover, such as shade, submerged and overhanging large wood, logjams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.*

Floodplain Connectivity: The Covered Activities would cause long-term minor adverse effects on floodplain connectivity. Although new road construction is planned during the first two decades of the permit-term, no new roads will be constructed in designated critical habitat. However, activities to improve or maintain existing roads and crossing infrastructure could occur in critical habitat. The roads that would be maintained and used as part of the proposed action could prevent natural channel migration past them where they border and/or cross streams. Streambank armoring that protects those roads locks the physical conditions at the sites in a simplified state with reduced edge habitat features such as undercut banks and alcoves. It also prevents the formation of off-channel habitat at those locations. The altered hydrology at the site may also impact bank habitat forming processes within the nearest bends in the affected streams. Reduced LWD recruitment due to the planned riparian thinning would also cause some deleterious effects on bank habitat forming processes and flood plain connectivity. The effects from reduced wood recruitment are likely to persist for up to 20 years in a planning watershed after being entered and harvested as part of a THP. Road-related impacts would persist for the life of the roads, most of which are considered permanent. However, as previously stated, the READI Model will be used to identify and prioritize locations of road and drainage improvement projects. These improvements will commence in year-4 following permit issuance and are expected to reduce the frequency and magnitude of road-related impacts over the permit term.

Forage: The Covered Activities would cause long-term minor adverse effects on forage. Increased suspended sediment input would cause minor reductions in the production of aquatic macroinvertebrate prey organisms. Conversely, increased solar radiation reaching streams, and concurrent increased streamside understory vegetation, may increase the availability of macroinvertebrate prey organisms and nutrients (through leaf/needle detrital input) in some areas. Detectable effects would likely be minor and largely limited to instream areas immediately adjacent to sites where roads or timber harvest are within 150 feet of the stream, and no more than 2 miles downstream. However, the effects would persist for decades.

Natural Cover: The Covered Activities would cause long-term minor adverse effects on natural cover. The maintenance of roadside bank armoring would permanently prevent the formation of edge habitat features such as undercut banks along their lengths. Reduced LWD recruitment would slightly reduce the availability of instream wood, and the removal of bankside riparian vegetation in some areas would remove overhanging vegetation and in-stream leaf litter that can provide in-water cover. These effects would persist for decades. However, SPI's adherence to the CFPR WLPZ requirements that limit the amount of riparian vegetation and overstory canopy cover that can be removed during timber harvest are expected to reduce impacts to natural cover.

Water Quantity: Same as above.

Water Quality: Same as above.

3. *Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover, such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks, supporting juvenile and adult mobility and survival.*

Free of Obstruction and Excessive Predation: The Covered Activities would cause long-term minor adverse effects on obstruction and predation. Increased suspended sediments and increased summer water temperatures may delay or alter migration for some adults. Increased instream flows during the winter may prematurely displace some rearing juveniles. The forced early migration would, in effect, obstruct their continued rearing within the affected area. The maintenance of roadside bank armoring, especially if riprap is used, would provide conditions that are preferred by predatory species such as sculpins and trout, which would increase the risk of predation for juvenile salmonids. These effects would persist for decades.

Water Quantity: Same as above.

Water Quality: Same as above.

Natural Cover: Same as above.

4. *Estuarine Areas* – None in the Action Area.

5. *Nearshore Marine Areas* – None in the Action Area.

6. *Offshore Marine Areas* – None in the Action Area.

2.5.2.5. Return to Elevated Baseline (SHA)

In exchange for actions contributing to the recovery of Covered Species on non-federal lands, SPL&T will receive assurances from NMFS in the form of an ESP including the SHA. If SPL&T fulfills the conditions of the SHA, NMFS will not require any additional or different management activities by SPI on SHA covered lands during the permit term without SPI's consent. In addition, at the end of the agreement period, SPI may return the SHA Plan Area to the Elevated Baseline Conditions described in Section 1.3.9 *Elevated Baseline Conditions (SHA)*.

The Elevated Baseline in the SHA Plan Area will support NMFS' ESA-listed salmonid species reintroduction efforts. SPI will use the READI Model to identify locations of road and drainage improvement projects. Once implemented, these improvements become permanent features in the SHA Plan Area, regardless of current NMFS reintroduction efforts, resulting in improved, or Elevated Baseline Conditions.

The ESP does not authorize actions that would cause habitat conditions for the Covered Species to go below the agreed upon Elevated Baseline Conditions as described in the SHA. Any take that occurs as a result of a reduction in the habitat quality and/or quantity established as the Present or Elevated Baseline Conditions on the SPL&T lands described in the SHA is not authorized. The Elevated Baseline Conditions described in the SHA (*e.g.*, READI Model implementation and support of NMFS reintroduction efforts) are all conditions that are suitable and would not constitute take; they represent clear long-term improved conditions for Covered Species. Therefore, NMFS does not anticipate take associated with returning to the Elevated Baseline Conditions. Designated critical habitat will remain improved in all cases as a result of implementing the READI Model in the SHA Plan Area.

2.6. Cumulative Effects

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

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

The cumulative effects analysis conducted for this HCP/SHA considers SPI's previously described management context and land ownership patterns in the HCP and SHA Action Areas. Timber Harvest and associated activities are regulated under a functional equivalent program that was approved by the California Secretary of Resources in 1976. Under the CEQA process, this means that a formal Environmental Impact Report and related analysis is replaced by the entirety of the functional equivalent program. The approved functional equivalent program includes the California Forest Practice Act, CFPRs, the BOF rule making process, THP documents, a multi-disciplinary Review Team (Review Team), a pre-harvest inspection by the Review Team, the public comment period, and if necessary, the CAL FIRE Official Response to issues raised. The BOF rule making process includes public participation and comment periods. The BOF also conducts a CEQA analysis for each rule making effort.

Each Review Team has standing members of CAL FIRE, CDFW, and the California RWQCB; additionally, as local circumstances dictate, the Review Team can also include the California Geologic Survey, U.S. Forest Service, National Park Service, California State Parks, and local Counties. All review team members can raise issues. The landowner and CALFIRE as lead agency must address all issues deemed potentially significant adverse impacts. This functional equivalent program represents over 42 years of continual advancement in the process by all participating parties and entities.

SPI conducts all forestland management activities in full compliance with the CFPRs, which set prescriptive standards for natural resource protection minimization measures for all privately-and state-owned timberland management activities in California. The CFPRs set even higher standards for activities in ASP watersheds; SPI lands in the HCP Action Area are presently considered ASP watersheds. Each THP prepared under the CFPRs includes multi-agency, multidisciplinary administrative and field review, and public participation. Resource agency approvals include post-project assessment to assure compliance with all appropriate CFPRs protection measures. In particular, the process has required that each THP must include a complete cumulative impacts analysis, which is available for public review and comment. As a result of this functional equivalent program, CALFIRE cannot approve a project that causes a significant environmental impact.

The cumulative effects of additional actions on State, tribal, local, or private lands that are reasonably certain to occur in the HCP/SHA Action Areas during the permit period are summarized below.

2.6.1. Timberland Management

Approximately 104,074 acres, or 19 percent, of the other (*i.e.*, non-SPL&T) private lands in the Sacramento River basin HCP Action Area consist of commercial timberlands. In the Trinity River basin HCP Action Area, approximately 70,960 acres, or 8 percent, of the other private lands in the Trinity River basin HCP Action Area consist of commercial timberlands.

Timberland management activities on those lands including timber harvest, yarding, loading, hauling, site preparation, planting, and vegetation management are expected to continue during the permit period. These activities may potentially affect Covered Species and their habitat. However, activities on these lands are subject to the CFPRs, including the ASP rules where applicable, and the potential effects, including cumulative effects, are addressed and mitigated to insignificant levels by each proposed THP and other programmatic agreements.

2.6.2. Wildfire Suppression on Non-federal Lands

Wildfire is likely to occur in the HCP/SHA Action Area watersheds during the permit term. Depending on size, severity, and location, fires could have effects ranging from beneficial (increased water yield, improved riparian condition, reduced fuel loadings) to negative (increased sediment loading, increased water temperatures). Wildfire suppression may include the removal or modification of vegetation due to firebreak construction or setting backfires as fire control measures. An undetermined amount of potential Covered Species habitat may be removed or modified by this activity. Post-fire rehabilitation is performed by the state or federal incident lead agency per their guidelines. This HCP/SHA includes mitigation measures to minimize potential impacts post-fire, including road watercourse crossing upgrades and other relevant BMPs.

2.6.3. Roads

Numerous private, county, and state roads occur in the HCP/SHA Action Areas. The amount of existing road maintenance and new road construction cannot be determined; however, maintenance and new construction are expected to continue similar to current levels. Standard and project-specific aquatic resource protection measures are expected to continue and maintain trends for higher road construction, reconstruction, and maintenance standards compared to historical standards. Continued improvement of environmental conditions on private and state lands related to roads throughout the HCP/SHA Action Areas is expected during the permit period.

Increased sediment from timber harvest and related road management is addressed in the evaluation of the Covered Activities, as SPI is responsible for most timber harvest in the HCP Action Area watersheds. Potential impacts from roads on other private timberlands are subject to the CFPRs, including the ASP rules where applicable, and all potential project effects, including cumulative effects, are addressed and mitigated to insignificant levels. Road conditions on SPL&T lands are expected to continue improving during the permit period by implementing the READI Model and implementing road and drainage improvements.

2.6.4. Mining

Limited gravel and hard rock mining and quarrying, and associated gravel processing, occurs in the HCP Action Area. SPI assumes these activities will continue during the permit period. The potential effects of mining on aquatic resources in the HCP Action Area depend on the type, size, location, and distance from aquatic habitats. Instream gravel mining can impact sedimentation, erosion, streambank and streambed stability, and substrate. Surface mining may cause soil compaction and loss of vegetative cover. Mining activities may also affect riparian vegetation. Because potential effects of quarries and rock mines depend on numerous variables, the effects of mining within the HCP Action Area to Covered Species and their habitats are unknown. All mining activities, however, are regulated by the State of California under SMARA and additional local and county regulations. This regulatory framework mandates that the impacts from these activities be mitigated to insignificant levels.

2.6.5. Agricultural Activities

Agricultural activities (predominantly grazing) occur on many of the private lands in the Sacramento River basin HCP Action Area. Upward trends in values of dairy-related agricultural products (*e.g.*, milk, cows and calves, pasture, and hay) in the Sierra Nevada and Cascade Range foothills is expected to continue as human populations continue to increase. The agricultural industry in the HCP Action Area is expected to continue throughout the permit period. Potential impacts on water quality are expected to be regulated under applicable laws. Additional potential impacts to Covered Species and habitat, including riparian vegetation, decreased bank stability, loss of overstory shade, increased sediment inputs, and elevated bacteria levels are expected to continue.

Activities in the Trinity River basin HCP Action Area includes similar agricultural practices, but at smaller scales. These lands also include significant landowner participation in California's legal cannabis program. Potential impacts to Covered Species and their habitat include effects to water quality, stream flow, diversions, riparian vegetation, and sedimentation. These farming operations are regulated by several state and local agencies including the Bureau of Cannabis Control, California Department of Food and Agriculture, California Department of Public Health, CDFW, California RWQCB, and Trinity County. These activities are expected to continue during the permit period and anticipates the proportion of illegal cannabis to continue decreasing as legal growing and the regulatory framework become more established.

2.6.6. Residential Development and Infrastructure

The Sacramento River basin HCP Action Area is characterized by rural residential and small community developments. This type of development pattern is expected to remain during the permit period; however, it is reasonable to assume continued development and development pressure will persist as growth in the greater populated regions located primarily downslope (westerly) of the Sacramento River basin HCP Action Area continues. The Trinity River basin HCP Action Area is much less populated and remote than the Sacramento River basin. Development in this region includes several small primary communities and scattered rural residential development. SPI also expects this development pattern to continue, with more growth likely centered near small communities.

Potential impacts to Covered Species and habitats from development and associated utility and road infrastructure include riparian habitat loss, changes to stream channel morphology, altered watershed hydrology (increased storm runoff), increased sediment loading, pollutants, and water temperature. Potential impacts on Covered Species and their habitats, including water quality, will be regulated by State and local CEQA requirements. The anticipated impacts to Covered Species and their habitats from continued residential development are expected to be sustained and locally intense, but are not expected to increase substantially over current levels due to the existing regulatory framework and associated conservation, minimization, and mitigation measures.

2.6.7. Recreation

Recreation in the HCP/SHA Action Areas consists of mainly dispersed activities, such as hunting, fishing, and camping. SPI allows dispersed, non-motorized recreation on SPL&T lands, with seasonal closures for high fire risk and adverse weather conditions. Potential impacts to Covered Species and their habitats from these activities include localized effects on turbidity, water quality, streambanks, riparian vegetation, and spawning redds wherever human use is concentrated and these resources occur.

All hunting and fishing in the HCP/SHA Action Areas is regulated by CDFW rules. Currently, all the watersheds in the HCP Action Area in the Sacramento River basin are closed to salmon and steelhead fishing. Many tributary streams in the Trinity River basin are subject to similar restrictions. Other fishing in the HCP Action Area is subject to various closures and seasonal restrictions per the CDFW regulations. Potential impact levels to Covered Species within the HCP Action Area are unknown, but given limited legal public access, are likely very low and expected to remain at current levels.

2.6.8. Water Withdrawals

Flows in most HCP Action Area Sacramento River basin watersheds are impacted by diversions downstream of SPL&T ownership. An unknown number of permanent and temporary water withdrawal facilities exist within the action area, most of which are associated with agricultural lands. Due to the anticipated development and continued agricultural use in the Sacramento River basin HCP Action Area, the number of diversions and amount of water diverted is expected to increase. Potential impacts to Covered Species and their habitat include entrapment and impingement of younger life stages, localized dewatering of stream reaches, elevated stream temperature, and depleted flows.

Watersheds in the Trinity River basin HCP Action Area above and below SPL&T ownership are also likely impacted by diversions, primarily for agricultural purposes. The number of diversions is expected to increase during the permit period, though at a smaller individual scale. All water diversions are expected to be conducted under applicable laws, including the State Water Rights, CDFW regulations, CRWQCB regulations, and other local or county regulations. Current and future salmonid restoration activities to restore flows, especially during critical fish passage periods could result in improved conditions.

2.7. Integration and Synthesis

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

As described in more detail above in Section 2.4, climate change is likely to increasingly affect the abundance and distribution of the ESA-listed species considered in the Opinion. It is also likely to increasingly affect the PBFs of designated critical habitats. The exact effects of climate change are both uncertain, and unlikely to be spatially homogeneous. However, climate change is reasonably likely to cause reduced instream flows in some systems, and may impact water quality through elevated in-stream water temperatures and reduced DO, as well as by causing more frequent and more intense flooding events.

Climate change may also impact coastal waters through elevated surface water temperature, increased and variable acidity, increasing storm frequency and magnitude, and rising sea levels. The adaptive ability of listed-species is uncertain, but likely reduced due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. The proposed action will cause direct and indirect effects on the Covered Species and critical habitats considered in the Opinion well into the foreseeable future. However, the Covered Activities' effects on water quality, substrate, and the biological environment are expected to be of such a small scale that no detectable effects on Covered Species through synergistic interactions with the impacts of climate change are expected.

2.7.1. Covered Species and Critical Habitat

A general theme across the HCP Action Area is widespread habitat degradation due to past land management activities. Intensive land and stream manipulation during the past century (*e.g.,* logging, agricultural/livestock development, mining, urbanization, and river dams/diversion) has modified and eliminated much of the historic anadromous fish habitat in the Sacramento River and Trinity River basins. The conditions and associated metrics for watersheds where SPL&T ownership overlaps with anadromous stream habitat are summarized in Table 5 and Table 6 above.

In the Sacramento River basin, manmade barriers blocking access to historical habitat, passage impediments and flow fluctuations from hydropower operations, and loss of rearing habitat (NMFS 2014a) continue to affect the Covered Species. Agricultural diversions and diversion dams, warm water temperatures, manmade barriers blocking access to historical habitat, entrainment from diversions, and loss of channel connectivity represent potential limiting factors in the Northern Sierra Nevada diversity group; while warm water temperatures, limited spawning habitat availability, loss of rearing habitat, and manmade barriers blocking access to historical habitat are limiting factors in the Northwestern California diversity group.

In the Trinity River basin, factors such as sedimentation from increased land sliding and a general decrease of instream LWD under past forest practices due to removal or previous harvest in areas that are likely to recruit wood to channels, are considered to be limiting for the Covered Species. Current forest practices represent an improvement over past forest practices, thus, we assume that baseline conditions are improving at an unknown rate. Current riparian stands in many locations are dominated by hardwoods or conifers that are too small to provide functional LWD to adjacent watercourses. Timber harvest and road construction on unstable slopes have increased mass wasting (landslides) and caused a broad-scale simplification of salmonid habitat. This has resulted in degraded spawning habitat. In many locations, pool frequency is reduced, pool depth is diminished and overall complexity of habitat units is decreased, limiting the amount of juvenile rearing habitat available.

Salmonid populations in the HCP Action Area have responded similarly to that seen at the ESU and DPS-level. Existing data suggest long-term declines in abundance, productivity and spatial structure continuing up to the present. Hatchery influences also present an ongoing threat to the diversity of populations in the HCP Action Area. The changes in habitat described above have reduced juvenile survival rates through decreased fry emergence rates, lack of summer and winter rearing habitat. For salmonids, the status of critical habitat in the environmental baseline has many PBFs that are impaired, to the extent of limiting the availability (and accessibility) of high-quality habitat.

Covered Species will be affected over time by cumulative effects, some positive – as recovery plan implementation and regulatory revisions increase habitat protections and restoration, and some negative – as climate change and unregulated or difficult to regulate sources of environmental degradation persist or increase. Overall, to the degree that habitat trends are negative, as described below, effects on viability parameters of each species are also likely to be negative. In this context, we consider the effects of the proposed action's effect on individuals of the listed species at the population scale.

Sacramento River winter-run Chinook salmon: The Sacramento River winter-run Chinook salmon ESU consists of only one population that is confined to the Sacramento River in California. According to the NMFS 2016 5-year Status Review (NMFS 2016a), the extinction risk for winter-run Chinook salmon has increased from moderate risk to high risk of extinction since the 2007 and 2010 assessments. Critical habitat for Sacramento River winter-run Chinook salmon extends from the Sacramento River at Keswick Dam to Chipps Island at the westward margin of the Sacramento-San Joaquin Delta. Although the current conditions of PBFs for SR winter-run critical habitat in the Sacramento River are significantly limited and degraded, the habitat remaining is considered highly valuable.

Currently, Sacramento River winter-run Chinook salmon do not use the HCP Action Area for any life history stage. Natural spawning is restricted to the Sacramento River downstream of the Keswick Dam (NMFS 2014a) and Battle Creek below Eagle Canyon Dam. Both areas are downstream of the HCP Action Area. As such, the HCP Action Area overlaps with a very small amount of habitat that is upstream of where Sacramento River winter-run Chinook salmon occur.

The Covered Activities would cause a combination of impacts that would slightly reduce the functional levels of habitat features within small stream sections across the HCP/SHA Action Areas. The effects would last over the 50-year life of the HCP/SHA and could persist in planning watersheds for up to 20-years after being entered as part of a THP. Both individually and collectively, those impacts would annually cause altered behaviors, reduced fitness, and mortality in very low numbers of juveniles and eggs, and may slightly reduce the migratory fitness and spawning success for very low numbers of adults. However, it is unlikely that many of the adverse effects described above would extend far enough downstream to impact winter-run Chinook salmon.

The annual number of individuals that are likely to be injured or killed by the exposure to Covered Activity-related stressors is unknown. However, the overlap with occupied habitat is minimal, and in locations where the density of Sacramento River winter-run Chinook salmon is very low. Therefore, the numbers of fish and eggs that would be annually affected by the Covered Activities would represent a very small fraction of any annual cohort, and their loss would have no detectable effect on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for this ESU. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

Central Valley spring-run Chinook salmon: The Central Valley spring-run Chinook salmon ESU includes all naturally spawned populations of spring-run Chinook salmon in the Sacramento River and its tributaries in California, including the Feather River, as well as the Feather River Hatchery spring-run Chinook program. The NMFS 2016 5-Year Status Review re-evaluated the status of Central Valley spring-run Chinook salmon and concluded that the species should remain listed as threatened (NMFS 2016b). Recent declines of many of the independent and dependent populations, high pre-spawn and egg mortality during the 2012 to 2016 drought, and uncertain juvenile survival during the drought are likely increasing the ESU's extinction risk. Critical habitat for Central Valley spring-run Chinook salmon includes stream reaches of the Feather, Yuba and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, as well as portions of the northern Delta. Although the current conditions of PBFs for spring-run Chinook salmon critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.

Due to the presence of large dams in major river systems limiting habitat access throughout the Central Valley, the largest Central Valley spring-run Chinook salmon ESU populations in the HCP Action Area are currently limited to Butte, Mill and Deer Creeks (Williams *et al.* 2016). Small populations also occur in Antelope, Battle, Big Chico, Clear, Cottonwood, and Cow Creeks (Williams *et al.* 2016).

SPL&T ownership overlaps Central Valley spring-run Chinook salmon in the following watersheds: Antelope, Cottonwood, Cow, Deer, and Mill Creeks. There are 11 planning watersheds present that include approximately 15.33 stream miles subject to anadromy. As such, the HCP Action Area overlaps with a very small amount occupied habitat, near its extreme upstream end where the density of Central Valley spring-run Chinook salmon is low.

The Covered Activities would cause a combination of impacts that would slightly reduce the functional levels of habitat features within small stream sections across the HCP/SHA Action Areas. The effects would last over the 50-year life of the HCP/SHA and could persist in planning watersheds for up to 20-years after being entered as part of a THP. Both individually and collectively, those impacts would annually cause altered behaviors, reduced fitness, and mortality in very low numbers of juveniles and eggs, and may slightly reduce the migratory fitness and spawning success for very low numbers of adults. However, the frequency and magnitude of effects are expected to slowly diminish over the permit terms as harvest practices are improved through SPI's sustained yield plan. Furthermore, road-related impacts will be reduced through SPI's use of their READI Model, with improvements commencing as early as year-4 following permit issuance, once the READI Model fieldwork is complete.

The annual number of individuals that are likely to be injured or killed by the exposure to Covered Activity-related stressors is unknown. However, the overlap with occupied habitat would be small, and in locations where the density of Central Valley spring-run Chinook salmon is low. The effects will be spatially and temporally separated as each planning watershed is entered as part of a THP and will likely only affect a small number of fish at any one time. Therefore, the numbers of fish and eggs that would be annually affected by the Covered Activities would represent a very small fraction of any annual cohort, and their loss would have no detectable effect on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for this ESU. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

Southern Oregon/Northern California Coast coho salmon: The SONCC coho salmon ESU is currently considered likely to become endangered within the foreseeable future in all or a significant portion of its range (Williams *et al.* 2016). Williams *et al.* (2016) found that there has been no trend toward recovery of SONCC coho salmon since their listing in 1997. While some improvements in factors affecting population units in the action area have improved habitat in some areas (*e.g.*, Trinity River restoration, improvements in hatchery practices), populations in the action area overall have not trended toward recovery. Currently accessible salmonid habitat throughout the action area has been severely degraded. Intensive land and stream manipulation during the past century (*e.g.*, logging, agricultural/livestock development, mining, urbanization, unscreened diversions, and impoundments) has modified and eliminated much of the historic anadromous fish habitat in the Trinity Basin. Although the current conditions of salmonid habitat are significantly degraded, the remaining habitat for spawning and egg incubation, migratory corridors, and rearing is considered to have high intrinsic value for the conservation of the species.

Of the seven diversity strata, only the Interior Trinity diversity strata overlaps with the SPL&T HCP Action Area. The Interior Trinity diversity strata includes the Lower Trinity River, South Fork Trinity River, and Upper Trinity River populations (NMFS 2014b). SPL&T lands within the SONCC coho salmon range included in the HCP Plan Area include approximately 13.2 stream miles occurring in 13 planning watersheds in the Lower and Middle Trinity River populations. These areas represent approximately 13 percent of all SONCC coho habitat in the Lower and Middle Trinity River populations. As such, the HCP Action Area overlaps with a very small amount occupied habitat within only one of the seven diversity strata identified for the ESU.

The Covered Activities would cause a combination of impacts that would slightly reduce the functional levels of habitat features within small stream sections across the HCP/SHA Action Areas. The effects would last over the 50-year life of the HCP/SHA and could persist in planning watersheds for up to 20-years after being entered as part of a THP. Both individually and collectively, those impacts would annually cause altered behaviors, reduced fitness, and mortality in very low numbers of juveniles and eggs, and may slightly reduce the migratory fitness and spawning success for very low numbers of adults. However, the frequency and magnitude of effects are expected to slowly diminish over the permit terms as harvest practices are improved through SPI's sustained yield plan. Furthermore, road-related impacts will be reduced through SPI's use of their READI Model, with improvements commencing as early as year-4 following permit issuance, once the READI Model fieldwork is complete.

The annual number of individuals that are likely to be injured or killed by the exposure to Covered Activity-related stressors is unknown. However, the overlap with occupied habitat would be very small, and in locations where the density of SONCC coho salmon is very low. The effects will be spatially and temporally separated as each planning watershed is entered as part of a THP and will likely only affect a small number of fish at any one time. Therefore, the numbers of fish and eggs that would be annually affected by the Covered Activities would represent a very small fraction of any annual cohort, and their loss would have no detectable effect on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for this ESU. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

California Central Valley steelhead: According to the NMFS 5-year species status review (NMFS 2016a), the status of CCV steelhead appears to have remained unchanged since the 2011 status review that concluded that the DPS was in danger of becoming endangered. Most CCV steelhead populations are very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. Critical habitat for CCV steelhead includes the stream reaches in the Sacramento River and its tributaries, as well as reaches of the San Joaquin River and its tributaries. Although the current conditions of PBFs for CCV steelhead critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.

Within the HCP Action Area, CCV steelhead are found in most accessible tributaries of the Sacramento River basin, including but not limited to Antelope, Battle, Big Chico, Butte, Clear, Cottonwood, Cow, Deer, and Mill Creeks. Many of those tributaries include upper reaches within SPL&T ownership.

SPL&T ownership overlaps with CCV steelhead in the following watersheds: Antelope, Cottonwood, Cow, Deer, and Mill Creeks. There are 11 planning watersheds present that include approximately 15.33 stream miles subject to anadromy. As such, the HCP Action Area overlaps with a very small amount occupied habitat, especially when compared to the range of the CCV steelhead DPS.

The Covered Activities would cause a combination of impacts that would slightly reduce the functional levels of habitat features within small stream sections across the HCP/SHA Action Areas. The effects would last over the 50-year life of the HCP/SHA and could persist in planning watersheds for up to 20-years after being entered as part of a THP. Both individually and collectively, those impacts would annually cause altered behaviors, reduced fitness, and mortality in very low numbers of juveniles and eggs, and may slightly reduce the migratory fitness and spawning success for very low numbers of adults. However, the frequency and magnitude of effects are expected to slowly diminish over the permit terms as harvest practices are improved through SPI's sustained yield plan. Furthermore, road-related impacts will be reduced through SPI's use of their READI Model, with improvements commencing as early as year-4 following permit issuance, once the READI Model fieldwork is complete.

The annual number of individuals that are likely to be injured or killed by the exposure to Covered Activity-related stressors is unknown. However, the overlap with occupied habitat would be very small, and in locations where the density of CCV steelhead is very low. The effects will be spatially and temporally separated as each planning watershed is entered as part of a THP and will likely only affect a small number of fish at any one time. Therefore, the numbers of fish and eggs that would be annually affected by the Covered Activities would represent a very small fraction of any annual cohort, and their loss would have no detectable effect on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for this DPS. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

Central Valley fall- and late fall-run Chinook salmon: There is very limited data on the status of Central Valley late fall-run Chinook salmon, and recent surveys indicate that the species currently only occurs in the Sacramento River basin. CDFW's Grand Tab (CDFW Grand Tab dated 5/7/2019) compilation of escapement estimates for late fall-run Chinook salmon in the Sacramento River watershed generally indicates a declining trend. It is uncertain if Central Valley late fall-run Chinook salmon would be ESA listed in the next 50 years.

Central Valley fall-run Chinook salmon are the most ubiquitous in the Central Valley rivers. Based on CDFW's Grand Tab (CDFW Grand Tab dated 5/7/2019) compilation of escapement for estimates for Central Valley fall-run Chinook salmon, the status of the species in the Sacramento and San Joaquin watersheds seems to decline and rebound based on water year types, and is heavily influenced by hatchery productions throughout the Central Valley. Recent trends for the Sacramento River populations show a decline in recent years as result of drought years (*i.e.* 2014 and 2015). The past five years have seen a declining trend for escapement in the Sacramento River watershed (excluding hatchery escapement abundances). In the San Joaquin River watershed, Central Valley fall-run Chinook salmon escapement estimates have remained relatively stable, and general trends show an increase in escapement estimates into the San Joaquin tributaries (excluding hatchery escapement). It is uncertain if Central Valley fall-run Chinook salmon would be ESA listed in the next 50 years.

In general, Central Valley fall-run and late fall-run Chinook salmon have limited spawning range within the HCP Plan Area. At present, fall-and late fall-run Chinook salmon spawn in the Sacramento River up to the Keswick Dam (not in the HCP Plan Area). They also spawn in Battle Creek, Bear Creek, Cottonwood Creek, Cow Creek, Clear Creek, Deer Creek, and Mill Creek watersheds (SHN Consulting Engineers 2001; Heiman and Knecht 2010; CDFW 2014a, 2014b; CDFW 2015b, 2015c). Although the reaches of Cottonwood, Cow, Clear, Deer, and Mill Creeks that are within the HCP Plan Area are above areas where fall and late-fall Chinook salmon spawn, the effects of the Covered Activities, especially effects to water quality, may extend downstream of the covered lands into habitat used for spawning and rearing.

SPL&T ownership overlaps Central Valley fall-run Chinook salmon in the following watersheds: Antelope, Cottonwood, Cow, Deer, and Mill Creeks. There are 11 planning watersheds present that include approximately 15.33 stream miles subject to anadromy. Central Valley fall-run Chinook salmon typically utilize the lower reaches of available spawning habitat and are less likely to be exposed to the effects of the Covered Activities. As such, the HCP Action Area overlaps with a very small amount occupied habitat, near its extreme upstream end where the density of Central Valley fall-run Chinook salmon is very low. This is especially true when compared to the range of the Central Valley fall- and late fall-run Chinook salmon ESU.

The Covered Activities would cause a combination of impacts that would slightly reduce the functional levels of habitat features within small stream sections across the HCP/SHA Action Areas. The effects would last over the 50-year life of the HCP/SHA and could persist in planning watersheds for up to 20-years after being entered as part of a THP. Both individually and collectively, those impacts would annually cause altered behaviors, reduced fitness, and mortality in very low numbers of juveniles and eggs, and may slightly reduce the migratory fitness and spawning success for very low numbers of adults. However, the frequency and magnitude of effects are expected to slowly diminish over the permit terms as harvest practices are improved through SPI's sustained yield plan. Furthermore, road-related impacts will be reduced through SPI's use of their READI Model, with improvements commencing as early as year-4 following permit issuance, once the READI Model fieldwork is complete.

The annual number of individuals that are likely to be injured or killed by the exposure to Covered Activity-related stressors is unknown. However, the overlap with occupied habitat would be very small, and in locations where the density of Central Valley fall- and late fall-run Chinook salmon is very low. The effects will be spatially and temporally separated as each planning watershed is entered as part of a THP and will likely only affect a small number of fish at any one time. Therefore, the numbers of fish and eggs that would be annually affected by the Covered Activities would represent a very small fraction of any annual cohort, and their loss would have no detectable effect on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for this ESU. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this species.

Upper Klamath/Trinity Rivers Chinook salmon: The UKTR Chinook salmon ESU is genetically distinguishable from other California Chinook ESUs (Waples *et al.* 2004). Although fall-run and spring-run Chinook salmon are both part of this ESU, the two runs are treated as separate taxa due to the distinctive adaptive life histories characterized by each group. UKTR spring-run Chinook are considered a Species of Special Concern by CDFW (2015). Genetic risk from low populations and interaction with Trinity River Hatchery fish, climate change impacts, and anthropogenic threats affect UKTR spring-run Chinook salmon and make them vulnerable. UKTR fall-run Chinook are not in immediate danger of extinction, although their numbers have declined in recent decades.

The Covered Activities are more likely to affect the spring-run Chinook salmon life history type of the UKTR ESU due to the summertime holding period exhibited by adults prior to spawning. The UKTR fall-run Chinook salmon exhibits an "ocean-type" life history strategy, where Chinook salmon juveniles which spend less than a year in fresh water before migrating to the ocean. This shorter freshwater residence time coupled with the ability to utilize lower-elevation reaches for adult spawning and juvenile rearing reduces the likelihood of exposure to any impacts resulting from the Covered Activities.

SPL&T lands within the UKTR Chinook salmon ESU range included in the HCP Plan Area contain approximately 60.6 stream miles occurring in 31 planning watersheds in the Lower Trinity, Middle Trinity, and South Fork Trinity River population areas. These streams represent approximately 14 percent of all UKTR Chinook salmon habitat in the Lower, Middle, and South Fork Trinity River populations. As such, the HCP Action Area overlaps with a small amount of occupied habitat, near its extreme upstream end where the density of UKTR Chinook salmon is expected to be low.

The Covered Activities would cause a combination of impacts that would slightly reduce the functional levels of habitat features within small stream sections across the HCP/SHA Action Areas. The effects would last over the 50-year life of the HCP/SHA and could persist in planning watersheds for up to 20-years after being entered as part of a THP. Both individually and collectively, those impacts would annually cause altered behaviors, reduced fitness, and mortality in very low numbers of juveniles and eggs, and may slightly reduce the migratory fitness and spawning success for very low numbers of adults. However, the frequency and magnitude of effects are expected to slowly diminish over the term of the permits as harvest practices are improved through SPI's sustained yield plan and road-related impacts are reduced by SPI's use of their READI Model.

The annual number of individuals that are likely to be injured or killed by the exposure to Covered Activity-related stressors is unknown. However, the overlap with occupied habitat would be very small, and in locations where the density of UKTR Chinook salmon is very low. The effects will be spatially and temporally separated as each planning watershed is entered as part of a THP and will likely only affect a small number of fish at any one time. Therefore, the numbers of fish and eggs that would be annually affected by the Covered Activities would represent a very small fraction of any annual cohort, and their loss would have no detectable effect on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for this ESU. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this species.

Klamath Mountains Province steelhead: The KMP steelhead DPS is listed as a species of high concern by CDFW and appears to be undergoing a long-term decline (Moyle *et al.* 2015). Stream-maturing forms (mostly summer steelhead) are more limited in distribution and face a higher likelihood of near-term extinction than ocean-maturing forms (winter steelhead). Major factors likely contributing to the decline of KMP steelhead include: 1) dams, 2) diversions, 3) logging, and 4) agriculture. The original KMP steelhead ESU (now DPS) was first determined to be "not warranted" for listing under the federal ESA by NMFS in March 1998. A final decision was reached on April 4, 2001, and the listing of KMP steelhead ESU under the ESA was again determined to be not warranted.

For the purposes of the HCP, the geographic extent of the KMP steelhead DPS is assumed to include all Class I streams as defined in the CFPRs in all planning watersheds within the HCP Action Area. This area includes all streams considered currently accessible and otherwise restorable for anadromous salmonids (*i.e*., Covered Species). Collectively, Covered Species on SPL&T lands in the Trinity River Basin occur in 31 planning watersheds included in the Lower, Middle Trinity, and South Fork Trinity River population areas. SPL&T lands in these planning watersheds include approximately 60.6 stream miles within the KMP steelhead DPS range and represent approximately 14 percent of all KMP steelhead DPS habitat in the Lower, Middle, and South Fork Trinity River populations. As such, the HCP Action Area overlaps with a small amount occupied habitat, especially when compared to the range of the KMP steelhead DPS.

The Covered Activities would cause a combination of impacts that would slightly reduce the functional levels of habitat features within small stream sections across the HCP/SHA Action Areas. The effects would last over the 50-year life of the HCP/SHA and could persist in planning watersheds for up to 20-years after being entered as part of a THP. Both individually and collectively, those impacts would annually cause altered behaviors, reduced fitness, and mortality in very low numbers of juveniles and eggs, and may slightly reduce the migratory fitness and spawning success for very low numbers of adults. However, the frequency and magnitude of effects are expected to slowly diminish over the permit terms as harvest practices are improved through SPI's sustained yield plan. Furthermore, road-related impacts will be reduced through SPI's use of their READI Model, with improvements commencing as early as year-4 following permit issuance, once the READI Model fieldwork is complete.

The annual number of individuals that are likely to be injured or killed by the exposure to Covered Activity-related stressors is unknown. However, the overlap with occupied habitat would be very small, and in locations where the density of KMP steelhead is very low. The effects will be spatially and temporally separated as each planning watershed is entered as part of a THP and will likely only affect a small number of fish at any one time. Therefore, the numbers of fish and eggs that would be annually affected by the Covered Activities would represent a very small fraction of any annual cohort, and their loss would have no detectable effect on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for this DPS. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this species.

Taking into account the magnitude and duration of the adverse effects associated with the Covered Activities and the significant beneficial effects associated with the implementation of the HCP/SHA, in addition to the environmental baseline, cumulative effects, and status of the Covered Species and designated critical habitat, the proposed action is not expected to: (1) appreciably reduce the likelihood of both the survival and recovery of the listed or non-listed species in the wild by reducing their numbers, reproduction, or distribution.

Critical Habitat for Chinook Salmon Coho Salmon, and Steelhead: As described above at Section 2.5, the proposed action is likely to adversely affect designated critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, CCV steelhead, and SONCC coho salmon. Past and ongoing land and water use practices have degraded salmonid critical habitat throughout the Sacramento River and Trinity River basins. Hydropower and water management activities have reduced or eliminated access to significant portions of historic spawning habitat. Timber harvest, agriculture, industry, urbanization, and shoreline development have adversely altered floodplain and stream morphology in many watersheds, diminished the availability and quality of estuarine and nearshore marine habitats, and reduced water quality across the region.

Global climate change is expected to increase instream water temperatures and alter stream flows, possibly exacerbating impacts on baseline conditions in freshwater habitats across the region. Rising sea levels are expected to increase coastal erosion and alter the composition of nearshore habitats, which could further reduce the availability and quality of estuarine habitats. Increased ocean acidification may also reduce the quality of estuarine habitats. In the future, non-federal land and water use practices and climate change are likely to increase. The intensity of those influences on salmonid habitats is uncertain, as is the degree to which those impacts may be tempered by adoption of more environmentally acceptable land use practices, by the implementation of non-federal plans that are intended to benefit salmonids, and by efforts to address the effects of climate change.

The PBFs of salmonid critical habitat that would be affected by the Covered Activities are freshwater spawning sites, rearing sites, and migration corridors free of obstruction and excessive predation. As described above, the Covered Activities would cause long-term minor adverse effects on water quality, substrate, floodplain connectivity, forage, natural cover, and freedom from obstruction and excessive predation within approximately 2 miles (or less) of locations where timber harvest or roads are within 150 feet of streams.

Based on the best available information, the scale of the proposed action's effects, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to measurably reduce the quality or functionality of the freshwater PBFs from their current levels. Therefore, the critical habitat would maintain its current level of functionality, and retain its current ability for PBFs to become functionally established, to serve the intended conservation role for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, CCV steelhead, and SONCC coho salmon.

2.8. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, CCV steelhead, SONCC coho salmon or destroy or adversely modify their designated critical habitats.

Additionally, after reviewing and analyzing the current status of the currently non-listed species, the environmental baseline, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, if the ESUs/DPS were to be listed during the ITP/ESP period, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of Central Valley fall- and late fall-run Chinook salmon, UKTR Chinook salmon, or KMP steelhead. No critical habitat has been designated or proposed for these species, however, if critical habitat is designated in the HCP and/or SHA Action Areas in the future, the proposed action is not likely to destroy or adversely modify designated critical habitat. If critical habitat is designated for these species in the future, we expect that the PBFs for those species will similar, if not the same as those identified for the ESA-listed species considered in this biological opinion. Therefore, the analysis of effects to designated critical habitat and the conclusion reached for ESA-listed species would also apply to the non-listed

Covered Species, should they become listed in the future and a critical habitat designation is made.

2.9. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement (ITS).

The ESA and its regulations require that HCPs specify the impact that will likely result from the taking (ESA Section 10(a)(2)(A)(i), 50 CFR 222.307(b)(5)(i)). While take happens to individuals, the impact of taking occurs at the population and species level.

Central Valley late-fall/fall-run Chinook salmon (designated as species of concern by NMFS), UKTR Chinook salmon (currently petitioned for listing as threatened or endangered under the ESA), and KMP steelhead (no current regulatory status) are included as a Covered Species in the HCP/SHA and in this biological opinion. Currently, none of these species are listed under the ESA. As such, there are no take prohibitions under the ESA for these species at the time of writing this biological opinion. The ITS and permits shall become effective for Central Valley late-fall/fall-run Chinook salmon, UKTR Chinook salmon, and KMP steelhead if and when they become listed under the ESA during the terms of this opinion and the permits.

The SHA Plan Area includes all SPL&T lands in planning watersheds outside the current limits of anadromy, in which salmonid reintroductions are proposed. These watersheds are within historically occupied habitat and above currently impassable barriers to anadromy. SPL&T proposes to support ESA-listed salmonid reintroduction in watersheds with SPL&T ownership above several man-made barriers in the Trinity River and Sacramento River basins, consistent with reintroduction efforts proposed by NMFS.

The Elevated Baseline Conditions are Baseline Conditions that are improved as a result of implementing the Beneficial Management Activities described in the SHA (see Section 1.3.8 above). SPL&T and NMFS have agreed that the Elevated Baseline Conditions are the improved riparian and habitat conditions resulting from the proposed forest road improvements (*i.e.*, READI Model implementation) and the support of ESA-listed species reintroduction efforts proposed by NMFS.

The Amount or Extent of Take associated with Covered Activities described below will apply to Covered Species that are present in the SHA Action Area, once ESA-listed salmonids are reintroduced to historically occupied habitat within watersheds on SPL&T lands. Any take that occurs as a result of a reduction in the habitat quality and/or quantity established as the Present or Elevated Baseline Conditions on the SPL&T lands described in the SHA is not authorized.

2.9.1. Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

- Take in the form of harm to Covered Species from exposure to the following habitat-related impacts resulting from Covered Activities: increased suspended sediment and increased instream temperature.
- Take in the form of harm, injury, or death to Covered Species resulting from the following Covered Activities: water drafting and instream construction requiring capture, handling, and release of Covered Species during stream dewatering.

NMFS cannot precisely quantify or track the amount or number of individuals that are expected to occupy habitat within the HCP and SHA Action Areas each year, or be incidentally taken per species and per watershed as a result of the Covered Activities. The natural variability in salmonid population parameters (*e.g.*, abundance, productivity, *etc.*) make it impractical to attribute or determine the numbers of individuals taken as a result of the Covered Activities given their scale, both temporally and spatially, and the indirect and cumulative nature of their effects on salmonids. For example:

1. It can be difficult to separate the impact on the species arising from human-induced habitat modification from the impact on the species arising from naturally-occurring, and often stochastic, watershed processes that form a wide distribution of habitat conditions;
2. Salmonids possess complex life histories, with multiple life stages that rely on a broad range of habitat conditions, both spatially and temporally;
3. Salmonids exhibit high natural mortality rates in the wild, and it is exceedingly difficult to first detect distinct instances of mortality, and then attribute mortality to specific actions affecting habitat conditions; and
4. Habitat conditions vary over time and space due to natural and human-induced factors, and it is difficult to predict where and when salmonids may experience such habitat conditions and whether those conditions will lead to take. The timing and specific location of events causing potential impacts are unknown, there is no practicable way to observe or count the number of fishes affected.

The distribution and abundance of Covered Species that occur within the HCP Action Area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics. We expect that similar processes will affect the abundance and distribution of ESA-listed salmonids that are reintroduced into historic habitat within the SHA Action Area. These biotic and environmental processes interact in ways that may be random or directional, and may operate across far broader temporal and spatial scales than are affected by the Covered Activities. Therefore, the distribution and abundance of fish within the HCP and SHA Action Areas cannot be attributed entirely to habitat conditions. As such, NMFS cannot precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by the Covered Activities. Additionally, NMFS knows of no device or practicable technique that would yield reliable counts of individuals that experience these impacts. However, it is possible to estimate the extent of incidental take by designating ecological surrogates, which are those elements of the project that are expected to result in incidental take. Ecological surrogates are more predictable and/or measurable and monitoring those surrogates will determine the extent to which incidental take is occurring.

2.9.1.1. Habitat-Based Ecological Surrogates and Associated Incidental Take

A surrogate monitoring strategy has been developed to evaluate water temperature and turbidity levels, as described below. The surrogate monitoring strategy includes two management response levels based on the values established for each of the surrogate indicators. A "green level" response threshold will be used when average surrogate indicator values are within the lower 50 percent of the surrogate indicator range. The green level represents surrogate values within the exceedance threshold, but otherwise requiring no immediate management actions. A "red level" response threshold will be used when average surrogate values are within the upper 50 percent of the surrogate indicator range for a consecutive three-year period. When the red level threshold is reached, SPI and NMFS will confer to identify possible adaptive management actions to address the condition. SPI will implement the agreed upon adaptive management actions to address the condition as soon as practicable. Red level management response investigations will include all review of all practicable information potentially influencing surrogate monitoring levels. This information includes, but is not limited to, air and water temperature correlations, planning watershed size and hydrologic regime, water year, SPI Covered Activities, disturbance events in applicable planning watersheds, and activities on other lands potentially influencing surrogate levels.

2.9.1.1.1. Water Temperature

The water temperature surrogate for indicating whether SPI exceeds exempted levels of incidental take is based on mean weekly maximum water temperatures (MWMT). A MWMT of 16.5°C is the level at which water temperature is considered fully protective for Chinook salmon, coho salmon, and steelhead (Carter 2005, Dunsmoor and Huntington 2006). Elevated MWMT levels between 16.5°C and 20.5°C in medium to high water years, or 16.5°C and 21.5°C in low water years, represent authorized incidental take levels. If MWMT levels occur above 20.5°C (21.5°C in low water years) at any time in any year for a three-year contiguous period, then authorized incidental take has been exceeded. This potential increase would be determined from exceedances beyond these levels in MWMT as measured at one of the five monitoring stations (Upper San Antonio Creek, Judd Creek, Hazel Creek, and the two new stations to be located in the Trinity River basin). Once established and SPI has five years of monitoring data, these thresholds will be further refined with NMFS for the Trinity Basin portion of the HCP/SHA.

The procedures for monitoring the water temperature ecological surrogate would include:

1. Hourly monitoring of water temperature at the monitoring locations defined in the monitoring plan. High, medium, and low water years will be determined from the most recent 10 years of SPI's 20 permanent weather station rainfall data.

2. Data assessment relative to the surrogate level on a monthly basis.
3. Establishing the appropriate management response threshold level using the monitoring data, as described below:
    a. A Green Level response threshold occurs when MWMT levels are between 16.5°C and 18.5°C (19.5°C in low water years); no immediate management actions are required.
    b. The Red Level response threshold occurs when MWMT levels are between 18.5°C and 20.5°C (21.5°C in low water years). If values within this range occur at any time in any year for a three-year contiguous period, SPI and NMFS will confer to identify possible adaptive management actions to address the issue. SPI will implement the agreed upon adaptive management actions to address the condition as soon as practicable.
    c. MWMT levels above 20.5°C (21.5°C in low water years) at any time, in any year for a three-year contiguous period, represent take exceedance. SPI will notify NMFS as soon as possible, but no later than two business days upon determining that the authorized level of incidental take has been exceeded.
4. Development of an annual report summarizing monitoring results during this time period, including discussion of each monitoring procedure, as applicable.

2.9.1.1.2. Turbidity

The turbidity level surrogate indicates whether the exempted level of incidental take is exceeded is based on the NTU level described by Sigler *et al.* (1984). Turbidity levels as little as 25 NTUs can cause growth reductions in steelhead and coho salmon. However, Sigler *et al.* (1984) also noted that these fish could survive turbidity levels up to 77 NTU. Therefore, NMFS considers this the range for determining potential effects and authorized take. Turbidity levels within the range of 64 to 77 NTUs for a continuous 14-day period would be considered within the exempted incidental take levels. If turbidity levels greater than 77 NTU occur for a continuous 14-day period or if turbidity levels within the range of 64 to 77 NTU occur for a contiguous period longer than 14 days (see Section 1.3.4.1 *Effectiveness Monitoring*), then exempted incidental take has been exceeded. This potential increase would be determined through measurements at one of the five monitoring stations (Upper San Antonio Creek, Judd Creek, Hazel Creek, and the two new stations to be located in the Trinity River basin). Once established and SPI has five years of monitoring data, these thresholds will be further refined with NMFS for the Trinity Basin portion of the HCP/SHA.

The procedures for monitoring the turbidity ecological surrogate would include:

1. Monitoring turbidity levels at locations defined in the monitoring plan.
2. Data assessment relative to the surrogate level on a monthly basis.
3. Establishing the appropriate management response threshold level using the monitoring data, as described below:
    a. A Green Level response threshold occurs when NTU levels are between 25 and 64; no immediate management actions are required.

   b. The Red Level response threshold occurs if NTU levels are between 64 and 77 for a continuous 14-day period. If values within this range occur at any time in any year for a three-year contiguous period, SPI and NMFS will confer to identify possible adaptive management actions to address the issue. SPI will implement the agreed upon adaptive management actions to address the condition as soon as practicable.
   c. Turbidity levels greater than 77 NTU for a continuous 14-day period or turbidity levels within the range of 64 to 77 NTU for a contiguous period longer than 14 days represents take exceedance. SPI will notify NMFS as soon as possible, but no later than two business days upon determining that the authorized level of incidental take has been exceeded.
4. Development of an annual report summarizing monitoring results during this time period, including discussion of each monitoring procedure, as applicable.

Table 13. Surrogate Indicator Monitoring Measures for Turbidity and Temperature

Monitoring Measures	Watershed Processes	Habitat Elements	Range of Surrogate Indicators for Authorized Take
Temperature monitoring	Stream temperature at designated monitoring locations	Water quality	• **Increases in MWMT[1] from 16.5°C to 20.5°C (21.5°C in low water years).** *Green Level response threshold = 16.5°C-18.5°C (19.5°C in low water years). *Red Level[2] response threshold = 18.5°C-20.5°C (21.5°C in low water years). • **MWMT levels above 20.5°C (21.5°C in low water years) represent take exceedance.**
Turbidity monitoring	Light refraction and penetration at designated monitoring locations.	Water quality	• **Increases in turbidity at designated monitoring stations from 25 to 77 NTU for a continuous 14-day period.** *Green Level response threshold = 25 NTU-64 NTU. *Red Level[3] response threshold = 64 NTU-77 NTU. • **Turbidity levels greater than 77 NTU for a continuous 14-day period represent take exceedance.**

[1]MWMT = mean weekly maximum water temperature.

[2]The Red Level response threshold occurs when MWMT levels are between 18.5°C and 20.5°C. If values within this range occur at any time in any year for a three-year contiguous period, SPI and NMFS will confer to identify possible adaptive management measures to address the condition.
[3] The Red Level response threshold occurs if NTU levels are between 64 and 77 for a continuous 14-day period. If values within this range occur, SPI and NMFS will confer to identify possible adaptive management measures to address the condition.

2.9.1.2. Ecological Surrogates for Other Covered Activities and Associated Incidental Take

2.9.1.2.1. Water Drafting

In the HCP and SHA Action Areas, the small number of watercourse crossings that may be used during water drafting indicates that exposure of Covered Species to these activities will be rare. The timing of water drafting would generally occur outside of peak migration timing for listed salmonids, minimizing the likelihood and numbers of fish exposed. The analysis of the effects of the Covered Activities anticipates that water drafting will be conducted in a manner that ensures continued compliance with the CFPRs [943.7(l)], NMFS Water Drafting Guidelines (NMFS 2001), and the Section 1600 Lake and Streambed Alteration Agreement required by CDFW (F&GC 1600 *et seq*.). These requirements are primarily for the protection of juvenile anadromous salmonids, in waters where they are known to exist. In the event that juvenile salmonids are exposed to water drafting, adherence to the requirements described above will reduce the potential for harm, injury, or death.

Therefore, the most appropriate threshold for the extent of incidental take that is expected to occur during water drafting is to use the following requirements/specifications.

All intakes are screened in a manner that is intended to avoid impingement of juvenile fish against the screen. The following requirements apply to screens and water drafting on Class I waters:

1. Openings in perforated plate or woven wire mesh screens do not exceed 3/32 inch (2.38 millimeters). Slot openings in wedge wire screens do not exceed 1/16 inch (1.75 millimeters).
2. The screen surface has at least 2.5 square feet of openings submerged in water.
3. The drafting operator regularly inspects, cleans, and maintains screens to ensure proper operation whenever water is drafted.
4. The approach velocity (water moving through the screen) does not exceed 0.3 feet/second.
5. The diversion rate does not exceed 350 gallons per minute.

Bypass flows for Class I watercourses are provided in volumes sufficient to avoid dewatering the watercourse and maintain aquatic life downstream, and conform to the following standards:

1. Bypass flows in the source stream during drafting are at least 2 cfs.
2. Diversion rate does not exceed 10 percent of the surface flow.
3. Pool volume reduction does not exceed 10 percent.

During water drafting activities, small salmon and steelhead may be impinged against the surface of the pump screen. Water drafting can also disrupt habitat utilization and may cause fish behavioral modifications leading to harm as described below. NMFS anticipates annual incidental take will be limited to the following forms:

- Harm, injury, or death to juvenile salmon and steelhead from impingement during water drafting. Water drafting may affect the behavior of Covered Species, including migration delay and displacement from the water drafting site, resulting in reduced fitness.

The measures described above, per the CFPRs and the CDFW 1600 Agreement, must be implemented by the water drafting operator during water drafting activities. In ASP watersheds, these standards also include implementing NMFS Water Drafting Guidelines. Water Drafting Logs are to be filed with CAL FIRE at the end of seasonal operations and are maintained with the plan record. The Water Drafting Logs from ASP watersheds for the previous seasonal operations must be provided with annual reports that are submitted to NMFS, to verify that incidental take has not been exceeded.

If the specific parameters described above are not followed during water drafting activities that are conducted in watersheds occupied by Covered Species (*e.g*., ASP watersheds), then incidental take will be exceeded.

2.9.1.2.2. Instream Work during Road Reconstruction

Covered Activities that may involve instream habitat disturbance include road reconstruction and new road construction associated with THPs. SPI anticipates approximately 3-5 miles of new road construction in the HCP and SHA Plan Areas annually during the first decade of the permit period, 1.5-3 miles during the following decade, then no new road construction during the final three decades. SPI will not construct any new roads in the currently identified WLPZ on anadromous stream reaches during the permit term. In most cases, instream construction will occur in order to upgrade an existing crossing structure where the crossing may fail or need replacement, while in other cases the crossing may need replacement because it has aged and is subject to failure. Reconstruction activities will occur during low flow periods when Covered Species are least likely to be present and will adhere to CFPRs limiting the extent of instream activity. The CFPRs require that road reconstruction activities that will occur in flowing water must have a Dewatering Plan in place prior to commencing instream work. Stream dewatering prior to road reconstruction activities may require the capture, handling, and relocation of Covered Species when they are present.

Effects to Covered Species resulting from physical alteration of instream habitat in the HCP and SHA Action Areas are expected to occur in areas where occupied habitat intersects with road watercourse crossings. Thus, the most appropriate threshold for the extent of incidental take that is expected to occur as a result of stream dewatering and the capture, handling, and release of Covered Species is the number of road watercourse crossings that occur within habitat that is occupied by Covered Species and the frequency of instream work that will occur during crossing reconstruction.

Stream dewatering and the capture and handling of fish may cause behavioral modifications and result in increased stress, as described below. NMFS anticipates annual incidental take will be limited to the following forms:

- Harm, injury, or death to Covered Species from stream dewatering and handling during relocation activities. The primary contributing factors to stress and injury from handling are differences in water temperature between the river where the fish are captured and wherever the fish are held, dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical trauma.

Currently, four crossing locations occur in the Sacramento River basin HCP Action Area. Reconstruction activities at these locations will be infrequent during the permit period and would be necessary following storm events causing extensive damage to these structures. There is uncertainty regarding the frequency of storm events that would cause extensive damage requiring road reconstruction activities over the permit-term, due to climate change and other variables. NMFS anticipates that instream work resulting in stream dewatering and fish handling will occur at each of the four road watercourse crossings in the Sacramento River basin HCP Action Area up to six times per decade. If stream dewatering and fish handling occurs during road reconstruction activities at any of the four road watercourse crossings in the Sacramento River basin HCP Action Area, more than six times per decade, then incidental take will be exceeded.

In the Trinity River basin HCP Action Area, 29 road watercourse crossings are present in watersheds occupied by Covered Species. Reconstruction activities at these locations will be infrequent during the permit period and would be necessary following storm events causing extensive damage to these structures. Similar to the Sacramento River basin HCP Action Area, there is uncertainty regarding the frequency of storm events that would cause extensive damage requiring road reconstruction activities over the permit-term, due to climate change and other variables. NMFS anticipates that instream work resulting in stream dewatering and fish handling will occur at each of the 29 road watercourse crossings in the Trinity River basin HCP Action Area up to four times per decade. If stream dewatering and fish handling occurs during road reconstruction activities at any of the 29 road watercourse crossings in the Trinity River basin HCP Action Area, more than four times per decade, then incidental take will be exceeded.

The number of stream crossings is substantially higher in the SHA Action Area, ranging from 650 stream crossings within the McCloud River HU, to 2,067 within the Yuba River HU (see Table 7 above). Covered Species are not currently present in the SHA Action Area. However, NMFS expects that they could be present at some point over the 50-year term of the permits, in the event that ESA-listed salmonids are successfully reintroduced into historic habitat within the SHA Action Area. While the number of stream crossings is high in the SHA Action Area, we expect the frequency of road reconstruction activities over the permit term to be comparable to the levels outlined for the HCP Action Area above. Therefore, when Covered Species are present in the SHA Action Area, NMFS anticipates that instream work resulting in stream dewatering and fish handling will occur at each of the road watercourse crossings up to four times per decade. If stream dewatering and fish handling occurs during road reconstruction activities at any of the road watercourse crossings in SHA Action Area, more than four times per decade, then incidental take will be exceeded.

During fish capture, handling, and relocation activities, we expect the total incidental mortality to be equal to or less than three percent of the total number of all fish that are captured, handled, and released. If incidental mortality greater than three percent occurs, then incidental take will be exceeded.

2.9.2. Effect of the Take

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

2.9.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" are-discretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). The following reasonable and prudent measures (RPMs) and associated Terms and Conditions will be incorporated into the ITP issued to SPL&T for the HCP/SHA.

1. Minimize the extent of incidental take to the maximum extent practicable from exposure to Covered Activities.
2. Conduct monitoring and reporting to confirm that the take exemption for the Covered Activities is not exceeded.

2.9.4. Terms and Conditions

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

To implement RPM Number 1, "Minimize the extent of incidental take from exposure to Covered Activities," SPL&T shall adhere to the following:

1. All conservation measures described in the final HCP/SHA (Section 6, Page 188 in SPL&T, 2020), together with the associated Section 10(a)(1)(B) ITP and Section 10(a)(1)(A) ESP issued with respect to the HCP/SHA, are hereby incorporated by reference as terms and conditions within this ITS. Such terms and conditions are nondiscretionary and must be undertaken for the exemptions under Section 10(a)(1)(B) and Section 7(o)(2) of the ESA to apply. If SPL&T fails to adhere to these terms and conditions, the protective coverage of the Section 10(a)(1)(B) permit and Section 7(o)(2) may lapse. The amount or extent of incidental take anticipated with implementation of the proposed HCP is described in Section 2.9.1 of this biological opinion and incorporated as a term and condition in NMFS' accompanying Section 10(a)(1)(B) permit. The associated reporting requirements and provisions for disposition of dead or

injured animals are as described in the HCP and its accompanying section 10(a)(1)(B) ITP.

To implement RPM Number 2, "Conduct monitoring and reporting to confirm that the take exemption for the Covered Activities is not exceeded," SPL&T shall ensure that:

1. Data assessment relative to the temperature and turbidity habitat-based ecological surrogate levels identified in Table 13 shall occur on a monthly basis to verify that incidental take has not been exceeded.
2. As part of the annual reports that are submitted to NMFS for the previous water year (October 1 through September 30), the following information shall be provided:
    a. Copies of all completed Water Drafting Logs for ASP watersheds filed with CAL FIRE at the end of seasonal operations.
    b. A summary of the instream work conducted during road construction or road reconstruction within ASP watersheds, including documentation of any stream dewatering, and fish capture, handling, and relocation activities.
    c. A summary of the THP Completion Reports submitted to CAL FIRE, including any responses received from CAL FIRE.
    d. A summary of any third-party audits through certification by the SFI.
    e. A summary of any Covered Activities conducted by SPI that are not subject to THP approval by CAL FIRE or other CEQA Review processes. The summary should include a description of the Covered Activity, the timing, and the location.

Yearly evaluation of the ITP by the NMFS West Coast Region will include re-analyses of all data, a reassessment of the take levels, and a written response to the sufficiency of the submitted annual reports within 60 days.

2.10. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). NMFS has not identified any additional conservation recommendations beyond those contained in the HCP/SHA.

2.11. Reinitiation of Consultation

This concludes formal consultation for Sierra Pacific Industries Forestland Management Program Habitat Conservation Plan and Safe Harbor Agreement.

As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion, or (4) a new species is listed or critical habitat designated [that is not considered in this opinion] that may be affected by the action.

3. Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

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

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

3.1. Essential Fish Habitat Affected by the Project

The proposed action (*i.e.*, Covered Activities) for this consultation is described in the Introduction section of this document. The HCP and SHA Action Areas are described in Section 2.3 of this document. The HCP Action Area includes areas designated as EFH for various life history stages of Pacific Coast salmon in the Sacramento and Trinity River basins.

- Habitat Areas of Particular Concern (HAPCs) for Pacific Coast salmon are: complex channel and floodplain habitat, spawning habitat, thermal refugia, estuaries, and submerged aquatic vegetation (see descriptions of salmon HAPCs in Appendix A to the Pacific Coast Salmon FMP (PMFC 2014).

The HAPCs for complex channel and floodplain habitat, spawning habitat, and thermal refugia are expected to be either directly or indirectly adversely affected by the Covered Activities. These HAPCs are currently degraded within the HCP Action Area due to numerous instream structures for water diversion and flood control, as well as from extensive agricultural land use and timber harvest activities in the upper portion of the HCP/SHA Action Areas.

3.2. Adverse Effects on Essential Fish Habitat

The ESA portion of this document (Sections 1 and 2) describes the adverse effects of the proposed action on ESA-listed species and critical habitats, and is relevant to the effects on EFH for Pacific Coast Salmon. Based on the analysis of effects presented in Section 2.5, the proposed action will cause small-scale, long-term adverse effects on EFH for Pacific salmon through direct or indirect physical and chemical alteration of the water and substrate. It would also alter habitat conditions at the sites in a manner that slightly alters migratory behaviors and reduces natural cover and forage resources for juvenile salmonids. It may also increase the risk of predation.

3.3. Essential Fish Habitat Conservation Recommendations

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

1. SPL&T shall follow Term and Condition #1 above (Section 2.9.4) in the ESA portion of this document to offset adverse effects to EFH from Forest Management Activities.

3.4. Statutory Response Requirement

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

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

3.5. Supplemental Consultation

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

4. Data Quality Act Documentation and Pre-Dissemination Review

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

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are NMFS and SPL&T. Other interested users could include USFWS and CDFW. The document will be available within two weeks at the NOAA Library Institutional Repository (https://repository.library.noaa.gov/welcome). The format and naming adheres to conventional standards for style.

4.2. Integrity

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

4.3. Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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