DRAFT ENVIRONMENTAL ASSESSMENT

Environmental Assessment to Analyze Impacts of NOAA's National Marine Fisheries Service Determination that the Confederated Tribes of the Colville Reservation Tribal Resource Management Plan Meets the Endangered Species Act Tribal § 4(d) Rule

Okanogan River Weir
(Source: Colville Tribes Fish & Wildlife News, Volume 15, September 2014)

Prepared by the
National Marine Fisheries Service, West Coast Region

December 2016

Cover Sheet
Draft Environmental Assessment

Title of Environmental Review:	Environmental Assessment to Analyze Impacts of NOAA's National Marine Fisheries Service Determination that the Confederated Tribes of the Colville Reservation Tribal Resource Management Plan (TRMP) Meets the Endangered Species Act Tribal § 4(d) Rule
Distinct Population Segments:	Upper Columbia River Spring Chinook Salmon ESU Upper Columbia River Steelhead DPS
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Legal Mandate:	Endangered Species Act of 1973, as amended and implemented – 50 CFR Part 223
Location of Proposed Activities:	Mainstem Columbia River and Okanogan Basin, Washington
Activity Considered:	The proposed TRMP includes all Tribal fishery, hatchery, research, monitoring and evaluation, kelt reconditioning, and fish predator control activities in the Okanogan Basin and a portion of the Columbia River.

Glossary of Key Terms

- Abundance: The number of fish in a given group.
- Acclimation: Rearing juvenile fish in the water of a particular stream before their release into that stream to increase likelihood of them returning to the natal stream.
- Adipose fin: A small fleshy fin with no rays, located between the dorsal and caudal fins of salmon and steelhead. The adipose fin is often "clipped" on hatchery-origin fish so they can be differentiated from natural-origin fish. See "Marking".
- Anadromous: Fish that hatch and rear in freshwater, migrate to the ocean to grow and mature, and return to freshwater to spawn.
- Analysis area: The geographic extent that is being evaluated for each resource. For some resources (e.g., socioeconomics), the analysis area can differ from the project area.
- Broodstock: A group of sexually mature individuals that is used for breeding purposes as the source for a subsequent generation.
- Bycatch: An organism that is caught unintentionally while catching certain target fish species.
- Coded wire tag: See "Tagging."
- Conservation hatchery program: An artificial production program that produces fish to aid in the prevention of extinction, increase the abundance of natural spawners, or to provide fish for reintroductions.
- Critical Habitat: Area within or outside the geographical area occupied by the listed species, at the time it is listed, which are essential to the conservation of the species and may require special management considerations or protections.
- Density-dependence: A phenomenon that occurs when the number of fish in a given area changes the population's growth rate. One type of ecological interactions.
- Dewatering: A water withdrawal that diverts the entire flow of a stream or river to another location.
- Disease: A deviation or interruption of the normal structure or function of any part of the body that is manifested by a characteristic set of signs; many fish displaying the same clinical signs could be considered a disease outbreak.
- Dissolved oxygen (DO): The amount of oxygen that is dissolved in a particular body of water. The amount of DO can be an important indicator of the condition of the water body.
- Distinct population segment (DPS): See "Species."
- Diversity: For purposes of this document, diversity is the amount and type of variability in fish characteristics, usually measured in life-history characteristics or molecular genetic markers.
- Domestication: See "hatchery-influenced selection."
- Ecological interactions: For purposes of this document, ecological interactions are when hatchery fish prey on or compete-with natural origin fish for resources (e., space, food), transmit pathogens, or have redd superimposition.
- Endangered species: See "Species."
- Endangered Species Act (ESA): A United States law that provides for the conservation of endangered and threatened species of fish, wildlife, and plants.
- Escapement: Adult salmon and steelhead that survive fisheries to potentially become spanwers.
- Evolutionarily significant unit (ESU): See "species."
- Ex-vessel value: The price received for a product "at the dock."

- Fecundity: The reproductive capacity of an individual.
- First Nation: A term referring to the aboriginal people located in what is now Canada.
- Fish screen: A fish screen is used to prevent entrainment of salmonids into water diversions or intakes at hatchery facilities.
- Fitness: As used in this document, the ability of a group of fish (e.g., populations) to survive and reproduce.
- Fry: Juvenile salmon and steelhead that have absorbed their egg sac and are in an early free-swimming, foraging life stage.
- Genetic diversity: See "Diversity."
- Gross economic value: For the purposes of this document, gross economic value is a metric used to measure the monetary value to commercial or recreational fishers of catching salmon. The gross economic value of salmon caught by commercial fishers is considered equivalent to the ex-vessel value of the harvest. For recreational fisheries, gross economic value is considered equivalent to the anglers' total willingness to pay for salmon fishing, including out-of-pocket trip expenditures plus any surplus value to anglers over and above these expenditures.
- Habitat: The physical, biological, and chemical characteristics of a specific unit of the environment occupied by a specific plant or animal.
- Hatchery Genetic Management Plan (HGMP): A technical document submitted to NMFS from applicants (mainly hatchery funders and operators) that outlines the supportive breeding, rearing, maintenance, and associated monitoring and evaluations that occur for a particular hatchery program.
- Hatchery-influenced selection: A genetic change in a population's characteristics that results from differences between the environments experienced by hatchery-origin and natural-origin fish. The effect will occur directly to fish being reared in a hatchery, but indirectly to natural-origin fish through spawning with hatchery-origin fish.
- Hatchery-origin spawners (HOS): Hatchery-origin fish spawning naturally.
- Hatchery program: A program that artificially propagates fish. Most hatchery programs for salmon and steelhead spawn adults in captivity, raise the resulting progeny for a few months or longer, and then release the fish into the natural environment where they will mature. Distinction should be made between "program" (the actual set of activities carried out to achieve objectives for the given group of fish) and "HGMP" (the written plan describing the program) since the program causes the effects considered in the analysis, while the HGMP contains the description of such program.
- Hydropower: Electrical power generation through use of gravitational force of falling water at dams.
- Incidental: Unintentional, but not unexpected.
- Integrated hatchery program: A hatchery program that includes natural-origin adults in the program broodstock.
- Isolated (segregated) hatchery program: A hatchery program that incorporates only hatchery-origin fish only into the broodstock.
- Jack: Early maturing (precocious) salmon or steelhead; most are males.
- Kelt: Salmonids that spawn more than once before dying (e.g., steelhead).
- Life history: Developmental characteristics of an organism throughout its lifetime (e.g., age at length, age at maturity, fecundity, run timing , life stage specific mortality)
- Mainstem: The principal channel of a drainage system into which other smaller streams or rivers flow.

- Marking: The process that allows hatchery-origin fish to be distinguished from natural-origin fish (e.g., adipose fin-clipping, tagging (see "Tagging")).
- Masking: The presence of hatchery-origin fish that is indistinguishable from natural-origin fish in the natural population causing imprecision or bias in assessing the status of natural-origin population.
- National Pollutant Discharge Elimination System (NPDES): A provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by the Environmental Protection Agency, a state, or, where delegated, a tribal government on an Indian reservation.
- Native fish: Fish that are endemic to or limited to a specific region.
- Natural-origin spawners (NOS): Natural-origin fish spawning naturally.
- Net economic value: Net economic value for commercial fisheries is the gross economic value received by vessel operators and fish processors minus costs (including wages), operational expenses (such as fuel and equipment), and fixed costs (such as insurance and depreciation).
- Net pen: A fish enclosure used in aquatic areas.
- Nonindigenous fish: A fish species that is occurring outside its native range. May also be referred to as invasive or non-native species.
- Outbreeding: Gene flow from one population to another.
- Outmigration: The downstream migration of salmon and steelhead toward the ocean (i.e., emigration).
- Pathogen: An infectious microorganism that can cause disease (e.g., virus, bacteria, fungus) in its host.
- Parts per million (ppm): The number of "parts" by weight of a substance per million parts of water. This unit is commonly used to represent pollutant concentrations.
- pH: A measure of the relative acidity or alkalinity of a solution, expressed on scale from 0 to 14, with the neutral point at 7.0. Acid solutions have pH values lower than 7.0, and basic (i.e., alkaline) solutions have pH values higher than 7.0.
- pHOS: The proportion of naturally spawning salmon or steelhead that are of hatchery-origin.
- PIT tag: Stands for Passive Integrative Transponder. See "Tagging."
- pNOB: The proportion of a hatchery program's broodstock that is made up of natural-origin fish.
- Polychlorinated biphenyls (PCBs): A group of synthetic, toxic industrial chemical compounds that are chemically inert and not biodegradable; they were historically used in making paint and electrical transformers.
- Population: A group of animals of the same species that spawn in a particular locality at a particular season and does not interbreed substantially with individuals from any other group.
- Precocious males: See "Jack."
- Preferred alternative: The "agency's preferred alternative" is the alternative which the agency believes would fulfill its statutory mission and responsibilities, giving consideration to economic, environmental, technical and other factors...It is identified so that agencies and the public can understand the lead agency's orientation.
- Primary constituent elements: Biological and physical features that are essential to the conservation of species.
- Productivity: The rate at which a population is able to reproduce offspring.
- Project area: Geographic area where the proposed action will take place. For some resources (e.g., socioeconomics), the analysis area can differ from the project area.

- Proportionate natural influence (PNI): Metric used to indicate the genetic influence of hatchery programs on the naturally reproducing part of the population. The concept applies to both integrated and isolated programs. In populations affected by integrated programs,

$$PNI \approx pNOB(pNOB + pHOS)$$

- Proportion of hatchery-origin spawners (pHOS): See "pHOS."
- Recovery: Defined in the ESA as the process by which the decline of an endangered or threatened species is stopped or reversed, or threats to its survival neutralized so that its long-term survival in the wild can be ensured, and it can be removed from the list of threatened and endangered species.
- Recovery plan: A recovery plan is prepared for each species listed under the Endangered Species Act. A recovery plan identifies recovery objectives and how to meet these objectives for federally listed species. Recovery plans are considered central organizing tools for guiding each species' recovery process.
- Redd: A spawning nest that is built by salmon and steelhead in the gravel of streams or the shoreline of lakes.
- Redd superimposition: When a salmon spawns on top of another salmon's redd.
- Reference area: A reference area is used in an environmental justice analysis. It is the area used as a benchmark of comparison when identifying whether a target population has a minority or low-income population that may be subject to disproportionate environmental or economic effects.
- Resident fish: Fish that live in freshwater throughout their life cycle.
- Residuals: Hatchery-origin fish that out-migrate slowly, if at all, after they are released. Residualism occurs when such fish remain near their natal stream rather than out-migrate as most of their counterparts do.
- Run: The migration of salmon or steelhead from the ocean to fresh water to spawn. Defined by the season they return as adults to the mouths of their home rivers.
- Run size: The number of adult salmon or steelhead (i.e., harvest plus escapement) returning to their natal areas.
- Salmonids: Fish of the family Salmonidae, which includes salmon and steelhead.
- Scoping: An early and open process for determining the extent and variety of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).
- Segregated program: See "Isolated program."
- Selection: The process by which the environmental or genetic influences determine which types of organism survive or reproduce better than others.
- Selective fisheries: Fisheries that target specific fish or fish runs; often target hatchery-origin fish.
- Smolts: Juvenile salmonids that are ready to leave their natal stream and to head downriver toward the ocean.
- Smoltification: Physiological changes anadromous salmonids undergo in freshwater allow them to live in saltwater.
- Spatial structure: Geographic distribution of individuals in a population and the processes or conditions that generate that distribution.
- Spawning: The eggs and sperm released or deposited into the water by fish.
- Species:
    - Biological definition: A group of living organisms consisting of individuals capable of exchanging genes or interbreeding.

    - ESA definition: A species under the ESA includes any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature.
    - Endangered species: As defined by Section 3 of the ESA, an endangered species means any species which is in danger of extinction throughout all or significant portion of its range.
    - Threatened species: As defined by Section 4 of the ESA, a threatened species means any species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
    - Evolutionarily Significant Unit (ESU): A concept NMFS uses to identify distinct population segments of Pacific salmon under the ESA (see Distinct Population Segment). An ESU is a population or group of populations of Pacific salmon that 1) is substantially reproductively isolated from other populations, and 2) contributes substantially to the evolutionary legacy of the biological species
    - Distinct Population Segment (DPS): The ESA considers a DPS of vertebrates to be a "species" (see "ESA definition" of species above).
- Stepping stone program: For the purposes of this document, a stepping stone program is a program that utilizes hatchery-origin fish from an integrated program component as broodstock for an isolated program component to minimize the potential genetic divergence between the hatchery-origin and natural-origin fish.
- Stock: For the purposes of this document, a stock is a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season.
- Stray (Straying): For purposes of this document, straying refers to fish found in non-natal areas.
- Subyearling: Juvenile salmon less than one year of age.
- Supplementation: Release of fish into the natural environment to increase the abundance of naturally reproducing fish populations.
- Tagging: A method used to study the biology, movement, and migration of animals.
    - Coded wire tag: Used to distinguish between hatchery and natural-origin fish through the presence of an internal tag in hatchery-origin fish. Presence of tag can be confirmed with a wand using non-lethal methods. The origin of of the hatchery fish (i.e., which hatchery it came from) can be confirmed through lethal methods.
    - PIT tag: Used to monitor movement and habitat usage of fish when the fish passes by a transponder.
- Target area: A target area is used in an environmental justice analysis. It is the geographical study area that is potentially affected by EIS alternatives. The target area is compared to a reference area (a benchmark) to determine if there is a substantially larger minority or low-income population within the target area.
- Threatened species: See "Species."
- Tributary: A stream or river that flows into a larger stream or river.
- Turbidity: The amount of solid particles that are suspended in water and that cause light rays shining through the water to scatter.
- Viable salmonid population (VSP): A population of Pacific salmon or steelhead that has a negligible risk of extinction over a 100-year timeframe, measured by four criteria: abundance, productivity, diversity, and spatial structure.
- Volitional: A term used to describe the method of passively releasing fish that allows fish to voluntarily leave hatchery facilities when the fish are ready.

- Water intake screen: See “Fish screen.”
- Watershed: An area of land where all of the water that is under it or drains off of it goes into the same place.
- Weir: A structure placed across a stream, permanently or seasonally, to regulate the upstream migration of adult salmon or steelhead.
- Yearling: Juvenile salmon or steelhead that emigrate to the ocean after one year of freshwater rearing.

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1. Purpose Of And Need For The Proposed Action

1.1. Background

NOAA's National Marine Fisheries Service (NMFS) is the Federal agency responsible for protecting salmon and steelhead listed as either threatened or endangered under the Endangered Species Act (ESA). The law strictly prohibits the "take" of an endangered species (including harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect; or to attempt any of these). However, when a species is listed as "threatened" the Federal government issues regulations, pursuant to Section 4(d) of the ESA, that are "necessary and advisable for the conservations of the species." In other words, a threatened species may have the same take protections as an endangered species or the application of those protections may be limited as long as the take occurs as the result of a program that adequately protects the listed species and its habitat. The species covered by this draft Environmental Assessment are Upper Columbia River Spring Chinook Salmon (endangered) and Upper Columbia River Steelhead (threatened). For these species NMFS issued a final rule in July of 2000 creating a section 4(d) limitation on the Tribal Resource Management Plan allowing implementation of the plan as long as it would not appreciably reduce the likelihood of survival and recovery of the listed species. This draft Environment Assessment analyzes the impacts of the of NMFS' determination that the Confederated Tribes of the Colville Reservation Tribal Resource Management Plan satisfies the ESA Tribal 4 (d) rule.

An application prepared by the Confederated Tribes of the Colville Reservation (CTCR) for a TRMP (CTCR 2014a; CTCR 2014b) was received in February 2014 and deemed sufficient by NMFS in 2014 (Jones 2014). Through National Environmental Policy Act (NEPA) analysis, NMFS considers how its pending actions may affect the natural and physical environment and the relationship of people with that environment. The NEPA analysis provides an opportunity to consider, for example, how the action may affect conservation of non-listed species and socioeconomic objectives that seek to balance conservation with wise use of affected resources.

Three other recent NEPA analyses have been conducted that may help inform analysis of this TRMP. In 2014, NMFS completed a Final Environmental Impact Statement (FEIS) to inform Columbia River Basin hatchery operations and funding of the Mitchell Act hatchery programs (Mitchell Act FEIS) (NMFS 2014c). The Mitchell Act (16 U.S.C. 755-757; 52 Stat. 345) allows NMFS to distribute appropriated funds to support research, improve fish passage, screen diversions, and build and operate over 20 salmon and steelhead hatchery facilities in Oregon, Washington, and Idaho. While actions in the TRMP are not funded by the Mitchell Act, the comprehensive FEIS evaluation of likely effects of hatchery production in the Columbia River Basin helps to inform the site-specific analyses within this EA. The FEIS has been incorporated by reference into this EA. The FEIS is useful in understanding the affected environment and the environmental impacts in this project area and to inform the analyses in this EA. Thus, this document references the FEIS, when useful information on the appropriate and relevant analyses discussed in the FEIS is pertinent.

Also in 2014, NMFS completed an Environmental Assessment (EA) for the reintroduction of a 10(j) non-essential experimental population of spring Chinook salmon into the Okanogan Basin

(Okanogan 10(j) EA). Thus, much of the information in the affected environment section of the 10(j) EA is applicable to this EA on the CTCR TRMP. In 2009, the Bonneville Power Administration completed an FEIS on the construction of Chief Joseph (CJ) Hatchery and operation of two hatchery programs: summer/fall Chinook salmon and spring Chinook salmon (CJ Hatchery FEIS) (BPA et al. 2009). Because the operation of these two programs has not changed substantially since their 2009 NEPA evaluation, and because the resources analyzed are identical to those we consider in this analysis, little further analysis of these two programs is needed. The information contained within these NEPA documents has also been incorporated by reference into this EA.

1.2. Description of the Proposed Action

The TRMP that is subject of the proposed action includes fisheries; hatcheries; research, monitoring, and evaluation (RM&E); kelt reconditioning; and predator control activities in the Okanogan Basin and portions of the mainstem Columbia River. Activities are summarized in Table 1 and are further detailed in Subsection 2.2, Alternative 2 (Proposed Action) – Make a Determination that the TRMP Meets the Requirements of the Tribal 4(d) Rule.

Table 1. Proposed activities included in the TRMP. CJ = Chief Joseph.

Activity Category	Specific Activity	Target Species	Activity Location[1]
Fishery	Non-selective fishery	summer/fall Chinook and sockeye	CJ Dam tailrace, Okanogan River
	Selective fisheries	spring and summer/fall Chinook and steelhead	Okanogan River, Columbia River including the CJ Dam tailrace
	Resident fisheries	Largemouth and smallmouth bass; burbot; walleye; whitefish; crappie; catfish; perch; sunfish; trout	Okanogan and Columbia Rivers
Hatchery	Broodstock collection	Spring and summer/fall Chinook; steelhead	Okanogan and Columbia Rivers
	Adult management	summer/fall Chinook; steelhead	Okanogan and Columbia Rivers
		Spring Chinook	Columbia River
	Juvenile rearing	Spring and summer/fall Chinook	CJ Hatchery
	Juvenile acclimation and release	Spring Chinook	CJ Hatchery
		Summer/fall Chinook	CJ Hatchery and Okanogan subbasin
		Steelhead	Okanogan subbasin
Research, Monitoring and Evaluation	Adult and juvenile salmon and steelhead	spring and summer/fall Chinook; steelhead	Okanogan and Columbia Rivers
	Evaluate sturgeon in Wells pool	Sturgeon	Wells pool

Activity Category	Specific Activity	Target Species	Activity Location[1]
Predator Control	Predator fish capture and removal	Walleye; Smallmouth bass; Pikeminnow Northern Pike	Okanogan and Columbia Rivers
Steelhead Conservation	Kelt Reconditioning	Steelhead	Okanogan Basin

[1]None of the activities in the Columbia River extend downstream of Wells Pool.

The specific activities in the Proposed Action are described in greater detail in Section 2.2, the Proposed Action Alternative (Alternative 2). These activities include Fisheries (Section 2.2.1), Hatchery Activities like broodstock collection and juvenile releases (Section 2.2.2), RM&E activities (Section 2.2.3), Predator Control (Section 2.2.4), and Kelt Reconditioning (Section 2.2.5).

The specific activity should describe the number of juvenile and adult fish involved, the location of the activities, and any other activities that result in effects (e.g., all adult and juvenile management strategies that we typically care about as far as reducing impacts).
In our analysis of the affected environment in Section 3, we also consider the potential interaction of the proposed action with other plans, regulations, agreements, treaties, laws, and Secretarial and Executive Orders as they may also affect hatchery operations in the Upper Columbia River Basin. The plans, regulations, agreements, treaties, laws, and Secretarial and Executive Orders we identified as pertinent are:

- Clean Water Act (Section 3.1)
- Executive Order 12898 (Section 3.6)
- *U.S. v. Oregon* (Section 3.7)
- *Antoine v. Washington* (Section 3.7)
- Secretarial Order 3206 (Section 3.7)
- The Federal Trust Responsibility (Section 3.7)
- Pacific Salmon Treaty (Section 3.2.7)
- Hatchery and Fishery Reform Policy (Section 3.2)
- Recovery Plan for Upper Columbia Spring Chinook Salmon and Steelhead (Section 3.2)
- Wilderness Act (Section 3.4)
- Marine Mammal Protection Act (Section 3.4)

1.3. Purpose of and Need for the Action

The purpose of this EA is to analyze the activities described in the TRMP submitted by the CTCR to ensure that they meet requirements under ESA 4(d) and not appreciably reduce the likelihood of survival and recover for Upper Columbia River Spring Chinook salmon and Upper Columbia River steelhead.

NMFS objectives for the Proposed Action are to:

- Determine as to whether the plans meet the criteria under the 4(d) Rule
- Meet NMFS' tribal trust responsibilities

The applicant's objectives for the Proposed Action are to:

- Implement activities in the Columbia River mainstem and Okanogan Basin for tracking the status of ESA-listed fish populations and the effects of the hatchery programs
- Contribute to the recovery of the Okanogan steelhead population through implementation of a conservation hatchery program
- Implement GPUD's mitigation obligation for a 100,000 steelhead smolt release within the Okanogan Basin
- Fulfill Federally protected reserved fishing rights for salmon and steelhead populations within the Columbia River mainstem and Okanogan Basin by supporting tribal commercial, recreational, and tribal ceremonial and subsistence fisheries when consistent with conservation objectives
- Use the TRMP as an overview document for all CTCR fisheries-related activities in the U.S. portion of the anadromous zone of the Columbia River mainstem above Wells Dam and the Okanogan Basin
- Provide fishing opportunities for citizens of Washington State within the Columbia River mainstem and Okanogan subbasin
- Assist the Bonneville Power Administration with meeting obligations under the Pacific Northwest Power Planning and Conservation Act of 1980 to protect, mitigate, and enhance fish and wildlife affected by the development, operation, and management of federal hydroelectric facilities on the Columbia River and its tributaries.

1.4. Project Area and Analysis Area

The project area for the proposed CTCR TRMP includes the Upper Columbia River just above Wells Dam (i.e., Wells pool) north to, and including, the Okanogan River Basin within Washington State (Figure 1; Figure 2). The majority of activities described in the TRMP would occur within the bounds of the Colville Reservation and North Half (Figure 2). The North Half is bounded to the east by the Columbia River/Lake Roosevelt, the north by the 49th parallel, the west by the Okanogan River and Lake Osoyoos, and the south by the current Colville Reservation northern boundary line. Some fish and habitat monitoring activities may occur beyond these geographic boundaries such as at Wells Dam, Moses Columbia Reserve, Washington State lands, and British Columbia.

The analysis area is the geographic extent that is being evaluated for a particular resource. For some resources, the analysis area may be larger than the action area, since some of the effects of the alternatives may occur outside the action area. The analysis area for each resource is described in Chapter 3, Affected Environment.

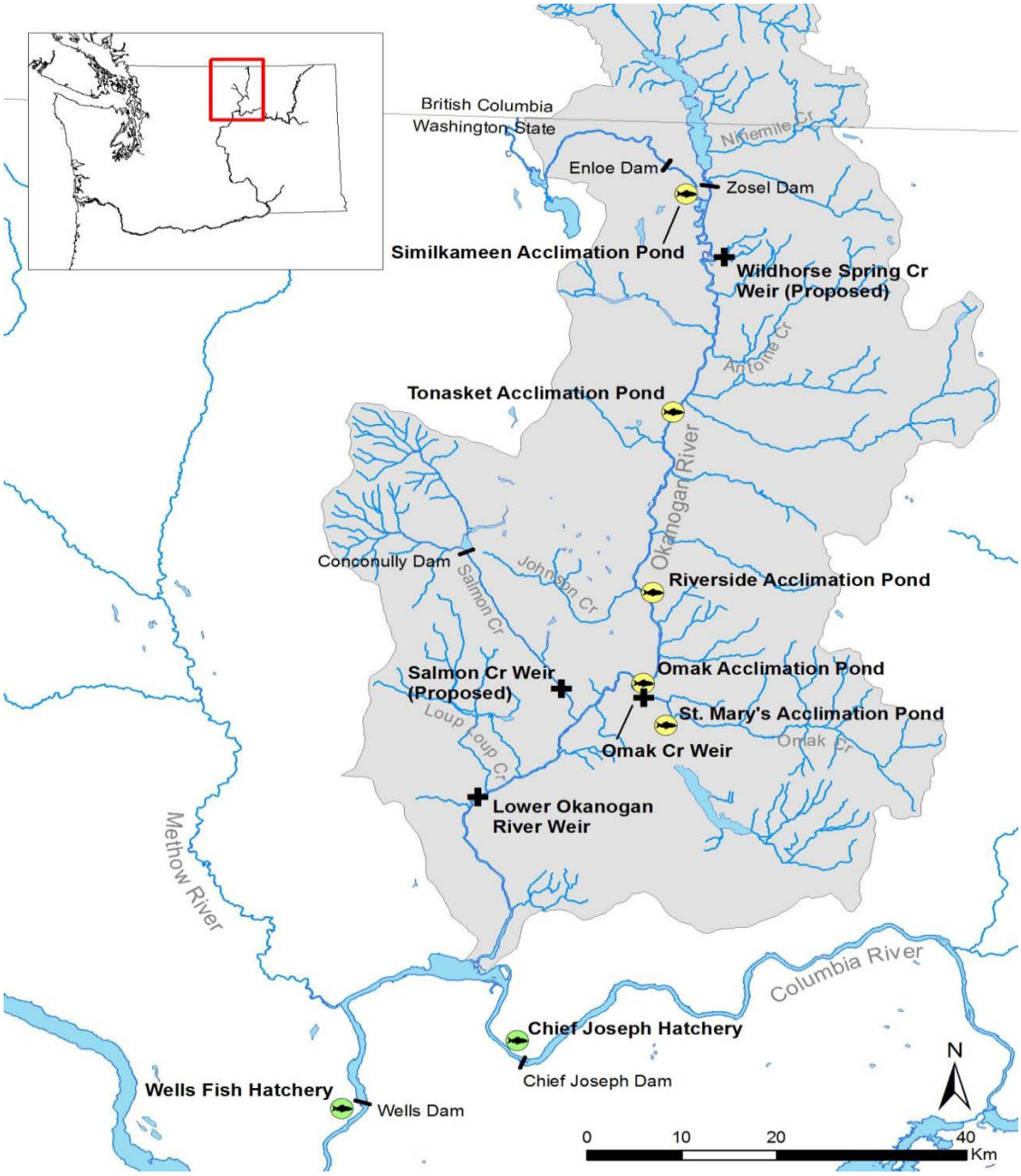

Figure 1. Action area for the proposed CTCR TRMP (CTCR 2014a) that is available for anadromous species.

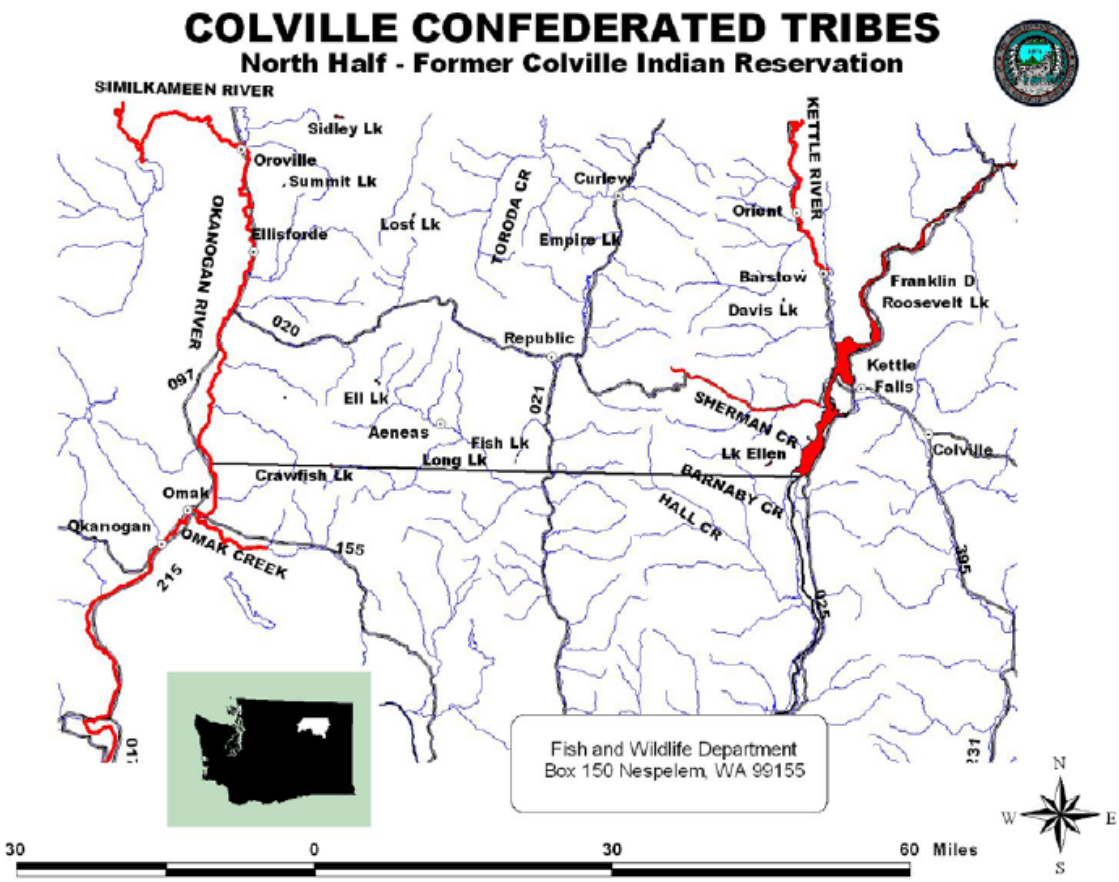

Figure 2. A portion of the CTCR reservation and North Half. The northern boundary of the current Colville Reservation (the 49th parallel) is depicted on the map near Crawfish Lake (CTCR 2016b).

2. Alternatives Including The Proposed Action

2.1. Alternative 1 (No-Action) – Do Not Make a Determination under the Tribal 4(d) Rule

Under this alternative, NMFS would not make a determination. For analysis purposes, NMFS has defined the No Action Alternative as the choice by the CTCR to continue to operate those portions of the program that are currently operating. This would not include the proposed activities including the CJ Dam tailrace fisheries, predator control, sturgeon RM&E, and kelt reconditioning.

2.2. Alternative 2 (Proposed Action) – Make a Determination that the TRMP Meets the Requirements of the Tribal 4(d) Rule

Under this alternative, NMFS would determine that the TRMP meets the criteria of the Tribal 4(d) Rule. This would result in the implementation of all proposed CTCR fishery, hatchery, RM&E, kelt reconditioning, and predator control activities as described in the TRMP to meet the purpose and need. The following describes the details of each activity.

2.2.1. Fisheries

2.2.1.1. Spring Chinook Salmon

The CTCR proposes to open selective tribal fisheries that will target spring Chinook salmon once 640 CJ Hatchery spring Chinook salmon adults are predicted to pass Wells Dam. Specifically, fish will be harvested from the tailrace at CJ Dam to the confluence of the Okanogan River. The harvest scenario intends to be consistent with the previous harvest framework agreement between CTCR and WDFW.

Table 2. Tribal and recreational allocations for selective harvest of spring Chinook salmon[1] above Wells Dam (modified Table 4 in (CCT and WDFW 2007).

Wells Dam Ad-clip Chinook Count[2] April 1 – June 30	Maximum CTCR Ad-clip Chinook Harvest (%)	Maximum Recreational Ad-clip Chinook Harvest (%)	Escapement/broodstock (%; minimum = 640)
< 1,000	30	0	70
1,001 – 1,500	40	0	60
1,501 – 2,000	50	0	50
2,001 – 4,000	50	20	30
4,001 – 6,000	60	20	20
6,001 – 10,000	70	20	10

[1]This table was developed before the designation of a non-essential experimental population of spring Chinook in the Okanogan subbasin under section 10(j) of the ESA, which does not include directed harvest.
[2]Adjustment to the Wells Dam spring Chinook salmon count possible to account for ad-clipped fish from Methow releases.

2.2.1.2. Summer/Fall Chinook Salmon

Currently, there are two processes that determine the thresholds and allocation of summer/fall Chinook salmon upstream of Wells Dam: *U.S. v. Oregon* and an agreement between WDFW and the CTCR (CCT and WDFW 2007). In harvest rate schedules in both processes, a total run size of UCR summer/fall Chinook salmon of greater than 29,000, as estimated at the mouth of the Columbia River, will meet requirements to allow opening of fisheries upstream of Priest Rapids Dam (Appleby et al. 2010). There is also a specific spawning escapement objective for summer/fall Chinook from the Methow/Okanogan stock of 4,700 fish, with 2,250 required for hatchery program broodstock. Gear for this fishery includes: tangle nets (individual and communal), beach seines (communal), hoop nets, dip nets, hook and line, floating fish trap, and purse seine.

Table 3. Number of summer Chinook available for harvest by CTCR fisheries (Tables 2 and 2a in (CCT and WDFW 2007). PRD = Priest Rapids Dam.

Columbia River mouth run size	Total fish available for harvest	Harvest below PRD	Harvest above PRD	% of non-treaty harvest above PRD reserved for the CTCR
0 – 29,000	1,450 – 1,740	0	1,450 – 1,740	90%
29,001 – 50,000	1,500 – 10,500	150 – 1,050	1,350 – 9,450	70%
50,001 – 60,000	10,500 – 14,250	1,050 – 4,275	9,450 – 9,975	50%
60,001 – 75,000	14,250 – 19,875	4,275 – 6,956	9,975 – 12,919	50%
75,001 – 100,000	19,875 – 29,250	6,956 – 11,700	12,919 – 17,550	50%
> 100,000	>29,250	>11,700	>17,550	>55%

[1]Derived from the summer Chinook salmon fishery framework in the U.S. v Oregon management agreement (NMFS 2008)

[2]The total number of harvestable fish at run sizes greater than 50,000 is to be determined by the following formula: (0.75 * (runsize- 50,000)) + 21,000 (NMFS 2008).

Non-selective snag fishery

The CTCR also proposes to conduct a non-selective snag fishery at the tailrace of CJ Dam, targeting unlisted UCR summer/fall Chinook salmon. The proposed season for this fishery would begin July 1 and end November 15, depending on the strength of the fall component of the Chinook salmon run and unless/until incidental take limits for unmarked spring Chinook salmon or steelhead are reached.

2.2.1.3. **Steelhead**

A steelhead fishery in the Okanogan River and Columbia River (CJD to the confluence of the Okanogan and Columbia Rivers) will only be implemented as a conservation tool to target hatchery fish in excess of broodstock and escapement needs. The current escapement objective for the Okanogan River is 1050 total spawners (plus 58 boodstock). Once 1108 steelhead are anticipated to the Okanogan River, tribal fisheries may be implemented to remove excess hatchery fish. Columbia River conservation fisheries may be implemented to remove hatchery fish in excess of broodstock and spawn escapement objectives. The proposed seasons for this fishery, if implemented, would run from early September 1 to March 31. Gear for this fishery includes; tangle nets (individual and communal), beach seines (communal), hoop nets, dip nets, hook and line, floating fish trap, and purse seine.

2.2.1.4. **Sockeye Salmon**

It is assumed that roughly 92-88 percent of the sockeye run ascending Wells Dam are natural-origin, so there is no need to have a selective fishery. A previous agreement with WDFW stated that the CTCR and Wanapum band would receive 90 percent of the non-treaty share of fish in excess of the 65,000 management target for Priest Rapids Dam (CTCR and WDFW 2007). When run sizes are in excess of 100,000 entering the Columbia River, the non-treaty share of harvestable fish would be allocated 75/25 between the upper Columbia River region and the lower Columbia River sport and commercial fisheries. When run size is in excess of 150,000 entering the Columbia River, CTCR harvest allocation is excess of escapement.

Table 4. Non-treaty sockeye harvest rates for the Columbia River (CCT and WDFW 2007); PRD = Priest Rapids Dam.

Sockeye run at mouth of Columbia River	Harvest below PRD	Wanapum band harvest	Recreational harvest above PRD of Okanogan origin	CTCR harvest of Okanogan origin
<50,000	< 1%	< 1%	< 1%	3%
50,001 – 75,000	< 1%	< 1%	< 1%	5%
75,001 – 100,000	1%	< 1%	1%	8%
100,001 – 150,000	3%	1%	2%	10%
150,001 – 200,000	5%	1%	2%	Excess of escapement[1]

[1] This escapement value is an agreed to value by all parties to the current and any new fishery agreement.

2.2.1.5. Resident Fish

The term "resident fish" refers here to all fish that do not migrate to the ocean. Common targets of resident fisheries include: rainbow trout, brook trout, westslope cutthroat trout, Lahontan cutthroat trout, brown trout, bull trout, whitefish (mountain and lake), kokanee, white sturgeon, largemouth bass, smallmouth bass, yellow perch, walleye, bluegill, pumpkinseed, black crappie, burbot, and any other fish designated as a game fish by the Business Council. Resident fisheries are open to Tribal members year round, and for non-members from June 1 to October 31. Gear for this fishery includes hook and line.

2.2.2. Hatcheries

The CJ Hatchery spring and summer Chinook hatchery programs funded by the Bonneville Power Administration (BPA) and Grant County (GPUD) and operated by the CTCR, were previously analyzed in an Environmental Impact Statement (BPA et al. 2009). We will provide brief descriptions of the various hatchery activities here for context, but more detailed descriptions of the activities and subsequent analysis of activity effects are included in the prior NEPA document.

The steelhead hatchery program is jointly managed by the CTCR, the Public Utility District No. 2 of Grant County (GPUD), and the Washington Department of Fish and Wildlife (WDFW) and operated by WDFW and the CTCR. Funding for the program is provided by the GPUD to mitigate impacts associated with the Priest Rapids Salmon and Steelhead Settlement Agreement (GPUD 2005) to address unavoidable losses of steelhead associated with the operation of Wanapum and Priest Rapids Dams (GPUD 2005).

2.2.2.1. Broodstock Collection and Spawning

Table 5. Summary of broodstock collection location and annual duration.

Species		Broodstock Capture

	Program Component	Number and origin	Locations	Approximate Timing
Spring Chinook	Not applicable	640 hatchery-origin	LNFH/CJ Hatchery	April 15 – June 30
			Live-capture in Okanogan and Columbia Rivers	April 1 – June 30
Summer/fall Chinook	Integrated	656 natural-origin[1]	Okanogan River weir	July 1 – November 15
			Live-capture in Okanogan/Columbia River	July 1 – November 15
			CJ Dam/Hatchery	July 1 – November 15
			Wells Dam	July 15 – September 15
	Segregated	550 hatchery-origin	Same as integrated component	
Steelhead	Not applicable	58 natural-origin	Okanogan and Omak Creek weirs/hook and line	Feb 15 – June 1
			Salmon and Wildhorse Spring Creek weirs[2]	March 15 – June 1

[1]There must be at least 800 natural-origin adults projected to the Okanogan River for the integrated program to begin broodstock collection. The use of 100 percent natural-origin fish will not be achieved with less than 1400 natural-origin adults projected back to the Okanogan.
[2]Omak Creek is currently the only tributary with a weir.

Spring Chinook Salmon

Spring Chinook salmon adults will be collected from unlisted Carson stock returning to Leavenworth National Fish Hatchery in the Wenatchee Basin and spawned at CJ Hatchery until hatchery-origin fish begin to return to CJ Hatchery. Broodstock is comprised of 100 percent hatchery-origin fish. Once fish return to CJ Hatchery, broodstock will be collected primarily from CJ Hatchery/Dam from April through June (Table 5).

Summer/Fall Chinook Salmon

Broodstock collection will target early (80 percent) and late (20 percent) summer Chinook consistent with the hatchery production objectives. The integrated components will use natural-origin adults, while the segregated program component will use only hatchery-origin adults. Collection will occur from July to November and will use a variety of gear and facilities (Table 5. Summary of broodstock collection location and annual duration.

Steelhead

The proposed hatchery program would be composed of 100 percent locally-collected steelhead from the Okanogan Basin to select/develop endemic steelhead with locally-adapted life history characteristics. Initially, some broodstock collection (e.g., 80 percent) could occur at Wells Fish Hatchery and Wells Dam fish ladders, which are part of the Upper Columbia River Steelhead DPS, until the program transitions to 100 percent broodstock from the Okanogan Basin. Broodstock collection will not remove greater than 33 percent of the natural-origin spawners in the population. Likewise, the broodstock extraction rate will be limited to 33 percent in the major spawning areas (Omak and Salmon Creek).

Once installed, weirs will be operated 24/7 and the traps will be monitored at least twice per day. Any incidentally caught listed species will be released upstream of the weir (or downstream if it

is a steelhead kelt), except for exotic invasive species (primarily smallmouth bass and eastern brook trout), which will be removed. Adult steelhead in excess to broodstock and specific tributary escapement needs may be surplused as a conservation measure. Adult steelhead will be trucked to Wells Hatchery for holding and spawning. Prespawn adult steelhead not needed for broodstock will be passed upstream of the weir or trucked above Mission Falls to meet escapement goals.

When possible, a 2x2 (2 females fertilized by two males) factorial approach will be used within each broodstock origin category: natural origin, locally-adapted hatchery origin (Omak Creek), returns from Wells Fish Hatchery collected in the Okanogan, and Wells Dam/ Hatchery collections. A 2x1 (two females fertilized by one male) cross may be made in order to maximize the number of natural-origin by natural-origin or locally adapted hatchery-origin progeny.

2.2.2.2. **Management of Adults on the Spawning Grounds**

Hatchery-origin adults that are in excess of harvest and escapement goals are likely to end up on spawning grounds where they can compete and spawn with naturally produced fish. Hatchery-origin fish on the spawning grounds can pose a risk to viability by changing genetic diversity of the population and reduction in short-term reproductive success and possibly the long-term productivity of the population (see Section 3.2.1).

Spring Chinook Salmon

Selective hook and line fisheries and tribal live capture harvest techniques (e.g., hoop, dip, and tangle nets) are the primary method for removing the unlisted spring Chinook salmon from CJ Hatchery. Given the non-local origin of the spring Chinook released at CJ Hatchery the CTCR propose to operate the CJ Hatchery adult fish ladder throughout the course of the run in conjunction with selective fisheries to remove as many hatchery fish as possible. Spring Chinook salmon may also be removed at tributary weirs in the Okanogan Basin. Hatchery-origin Chinook may be used for broodstock, tribal ceremonial and subsistence if suitable for consumption, or for nutrient enhancement.

Summer/Fall Chinook Salmon

Because the Okanogan summer/fall Chinook salmon population has been designated as primary population (Appleby et al. 2010), a proportion of hatchery-origin spawners and proportionate natural influence target exists for this population of 30 percent and 0.67, respectively. Fisheries include non-selective (snag fishery at CJD tailrace) and selective fisheries in the Columbia River mainstem and Okanogan River. Selective fisheries will be targeting hatchery-origin fish, therefore contributing to adult management efforts. In addition, weirs will be used to control the number of hatchery-origin summer/fall Chinook salmon returning to the Okanogan River basin. Removal of hatchery-origin Chinook salmon could also occur at CJ Hatchery. The fish captured at weirs and CJ Hatchery will be used to supplement broodstock collection, distributed to Tribal members as part of the harvest program, or surplused for food banks or nutrient enhancement.

Steelhead

Adult management includes the removal of pre-spawn adult steelhead for broodstock (if needed), reducing pHOS, and limiting escapement to levels at or near the spawner escapement objective.

The CTCR will assemble a technical team that will include at least the CTCR, the Washington Department of Fish and Wildlife, the Grant County Public Utility District, and NMFS to review stocking objectives annually. Returning adult hatchery fish will be removed when:

- The abundance of hatchery fish exceeds spawning escapement objectives and broodstock needs at the population level and at the tributary specific level have been met or exceeded.
- The natural origin abundance is large enough that it can withstand some take incidental to the activity that removes the hatchery fish.
- Facilities or methods are available that allow the selective removal of hatchery fish with acceptable handling mortality to natural-origin fish.

Table 6. Mean proportion hatchery-origin spawners (pHOS) and escapement data (2008-2012) compared to pHOS and escapement goals for various tributaries within the Okanogan Basin.

Location	pHOS Goal	Adult Escapement Goal	Mean pHOS	Mean Escapement
Salmon Creek	> 0.8	200	0.88	72
Omak Creek[1]	0.3-0.8	100	0.59	128
Antoine Creek	> 0.8	100	Not available	Not available
Johnson Creek	> 0.8	100	0.97	10.33
Ninemile Creek	0.3-0.8	50	0.71	47
Loup Loup Creek	> 0.8	50	0.94	41
Bonaparte Creek	0.3-0.8	30	0.58	58

[1]The goal for lower Omak Creek is 100, but 300 for the entire watershed; however, steelhead do not yet have unobstructed access above Mission Falls

2.2.2.3. Egg Incubation and Rearing

Egg incubation for the spring and summer/fall Chinook salmon programs will take place at CJ hatchery. The only potential effects these programs may have on natural-origin fish during incubation and rearing is from potential pathogen amplification and transmission and water withdrawal and discharge (see Subsection 3.2.5) because they rear unlisted species. These programs adhere to all applicable fish health policies to reduce the potential of pathogen transmission and amplification.

Egg incubation and rearing for steelhead will take place at Wells hatchery. This portion of the program is conducted by WDFW and is covered under the Wells Hatchery and Genetic Management Plan currently being evaluated (DPUD and WDFW 2011).

2.2.2.4. Juvenile Acclimation and Release

Spring Chinook

All 700,000 yearling, unlisted juvenile spring Chinook salmon will be acclimated and released from CJ Hatchery directly into the mainstem Columbia River from April to mid-May.

Summer Chinook

Fish from the integrated component will be released into the Okanogan Basin at Riverside, Similkameen, and Omak acclimation ponds. Transfer to the acclimation sites would occur in October for yearlings and late-April to early May for subyearlings. Fish from the segregated component will be released into the Columbia River at CJ Hatchery. A total of up to 2,200,000 summer/fall Chinook smolts may be released from the CJ Hatchery program (Table 7). This accounts for a 10-percent production overage for all program components. Yearlings will be allowed to migrate volitionally from these ponds during the spring emigration period (April to mid-May). Subyearlings will be force released in late-May to early-June.

Table 7. Production goals of summer/fall Chinook salmon for the Chief Joseph Hatchery (CTCR 2016a).

Life stage	Release Location	Release Goal
Yearling	Similkameen Facility	266,000
Yearling	Riverside Pond	267,000
Yearling	Omak Pond	267,000
Yearling	CJ Hatchery	500,000
Sub-yearling	Omak Pond	300,000
Sub-yearling	CJ Hatchery	400,000
Total: both life stages		**2,000,000**
Total yearlings		**1,300,000**
Total sub-yearlings		**700,000**

Steelhead

The program will target a 100,000 (±10%), 180 mm yearling smolt release and steelhead will be directly released at the sites listed in Table 6. Parr/pre-smolts would be transported to the St. Mary's acclimation sites on Omak Creek in March the year of release. Fish will be allowed to migrate volitionally from this pond during the spring emigration period (mid-April to mid-May). Non-migrants will not be forced out of the acclimation ponds. Non-migrants will be removed and taken to an alternative release location where residuals will have little to no effect on natural parr. When needed to meet the 100,000 fish released into the Okanogan obligation, the non-migrants will be released into the lower Okanogan at Mosquito Park (rkm 1.8). If excess to the 100,000 release obligation, the non-migrants will be released in a location where they are more likely to contribute to recreational and/or tribal harvest such as Lake Rufus Woods (rkm 946).

Table 8. Release sites and release number.

Water Body	River kilometer	Smolt Release Number
Lower Omak Creek[1]	5.6	10-20,000
Upper Omak Creek	9.6	10-20,000
Salmon Creek	21.4 or 10.6	40,000
Antoine Creek	5-20	5-20,000
Johnson Creek	2-15	Undetermined
Other smaller creeks	various	2-5,000
Similkameen River	7	18-38,000
Okanogan River	122	

[1]The St. Mary's acclimation site is located in lower Omak Creek which is the section of Omak Creek below Mission Falls.

All hatchery fish will receive a tag or mark (fin clip) that will allow for origin identification upon return. Juveniles with at least one hatchery parent will receive an adipose fin clip. Juveniles with two natural origin will get an alternative fin clip (e.g., ventral) and/or internal tag (CWT/PIT) so that they can be differentiated in mark selective fisheries and during broodstock collection. At least 5,000 fish will be PIT and CWT tagged at each tributary release location (excluding the smaller tributaries that receive 2,000 or fewer fish per year).

The disease management program for acclimation site/s will follow the requirements of all applicable fish health policies (IHOT 1995; NWIFC and WDFW 2006; Pacific Northwest Fish Health Protection Committee (PNFHPC) 1989). In addition, a rigorous sanitation program will be followed.

2.2.3. RM&E

Research, monitoring and evaluation (RM&E) for the programs being implemented by the CTCR are primarily coordinated and guided through four monitoring programs (1) OBMEP, (2) the CJ Hatchery RM&E Program, (3) BAM, and (4) Sturgeon RM&E.

2.2.3.1. Okanogan Basin Monitoring and Evaluation Program (OBMEP)

The primary goal of OBMEP is to understand the factors that affect the habitat and population status of spring and summer/fall Chinook salmon, sockeye salmon, and steelhead in the Okanogan River Basin.

To achieve this goal, the following objectives were developed:

1. Determine status and change in status related to the VSP parameters at the population scale for sockeye and steelhead in the Okanogan basin;
2. Determine status and trend of selected physical habitat parameters in mainstem and tributary locations;

3. Determine status and trend of selected water quality parameters in mainstem and tributary locations;
4. Evaluate if change is occurring in VSP parameters from the cumulative habitat restoration actions occurring throughout the Okanogan basin; and
5. Administer contracts and ensure that this effort continues in a scientifically sound manner that is closely coordinated across the Okanogan River basin, geo-political boundaries, upper Columbia ESU, Columbia River basin, and Pacific Northwest region.

To fulfill these objectives, the following monitoring activities will occur:

1. Conduct habitat evaluations and water quality monitoring
2. Adult steelhead enumeration through:
    a. PIT tag detection arrays
    b. redd surveys
    c. video monitoring
    d. tributary traps/weirs
3. Electrofishing
4. Snorkeling

2.2.3.2. Chief Joseph Hatchery RM&E

The primary goal of the CJ Hatchery RM&E program is to collect information to evaluate if the hatchery production program is successful in meeting its goals of increasing naturally spawning salmonids in the Okanogan River basin, and providing additional harvest for Tribal and non-Tribal members.

To achieve this goal, the following objectives were developed:

1. Determine status and evaluate change in status related to the VSP parameters at the population scale for spring and summer/fall Chinook salmon in the Okanogan basin;
2. Provide fish population information and performance metrics necessary to inform and adaptively manage the CJ Hatchery Program to meet its overall goals;
3. Administer contracts and ensure that this effort continues in a scientifically sound manner that is closely coordinated across the Okanogan River basin, geo-political boundaries, upper Columbia ESU, Columbia River basin, and Pacific Northwest region.

To fulfill these objectives, the following monitoring activities will occur:

1. Operate rotary screw traps in the mainstem Okanogan River
2. Conduct spawning ground surveys, which enumerate redds and collect biological information from Chinook salmon carcasses.
3. Operate the weir on the mainstem Okanogan River
4. Conduct beach seining operations in the Okanogan and Columbia River to PIT tag juvenile summer/fall Chinook
5. Conduct creel census monitoring to assess contribution to fisheries

2.2.3.3. Steelhead Broodstock, Acclimation, and Monitoring in the Okanogan Basin

The primary goal of this RM&E program is to collect information to evaluate if the hatchery steelhead production is successful in meeting its goal of increasing naturally spawning steelhead, specifically in Omak and Salmon creeks.

The objectives for the RM&E portion of this program are to:

1. Enumerate the abundance and run timing of NOR and HOS steelhead entering Omak and Salmon creeks.
2. Enumerate the abundance and outmigration timing of smolts produced in Omak Creek.
3. Acclimation summer steelhead in Omak Creek.

To fulfill these objectives the following activities may occur:

1. Operate a weir trap in lower Omak Creek from early March to mid-June.
    a. NOR steelhead not needed for broodstock will be inserted with a PIT tag, and be released upstream.
    b. Hatchery origin returns will be collected for broodstock, passed upstream if needed to meet spawn escapement objectives, removed for adult management (pHOS) purposes once escapement objectives have been met, or relocated to a different spawning tributary within the Okanogan Basin.
2. Operate a rotary screw trap in lower Omak Creek.
    c. Natural-origin steelhead smolts will receive a partial fin clip for a genetics sample, be inserted with a PIT tag, and released downstream.

2.2.3.4. Sturgeon RM&E

Three types of gear will be used to capture larval sturgeon; benthic beam trawl, a stationary bottom trawl, and a paired D-ring style benthic plankton net. Benthic trawling will be conducted in August and September throughout Wells Reservoir. Sampling for larvae with the stationary bottom trawl and plankton D-ring net will be conducted in June, July, and August in the Columbia River upstream of the confluence with the Okanogan River to the tailrace of CJ Dam. We anticipate very little bycatch of listed salmonids because Chinook salmon and steelhead generally migrate at depths < 10 m (Johnson et al. 2008), sampling occurs after smolt migration for steelhead and spring Chinook salmon, and the location of the bottom trawl and plankton D-ring net sampling is upstream of the spawning tributaries. Additionally, parr to smolt age classes of salmonids should be able to avoid the bottom trawl and plankton D-ring nets because they are passive gear designed to entrain larval fish.

Small-mesh (5.1 cm stretch mesh) gill nets are generally used for the capture of sub-yearling (age 0) white sturgeon (Burner et al. 2000; Howell and McLellan 2008) to assess natural recruitment and evaluate supplementation efforts. Results of sub-yearling white sturgeon indexing in the lower Columbia River (below Bonneville Dam) and in the lower Columbia River reservoirs (Bonneville, Dalles, John Day, and McNary) indicated that by-catch of salmonids was relatively low in small-mesh gill nets. For example, between 2008 and 2010 there were three adult Chinook salmon, two juvenile Chinook salmon, and three adult steelhead captured in approximately 450 overnight sets with small-mesh gill nets in the lower Columbia River

reservoirs (T. Jones, Oregon Department of Fish and Wildlife, personal communication). Additional efforts to prevent the incidental capture of ESA-listed salmonids in gill nets will include setting gill nets parallel to shore, at depths >10 m, limiting sampling to areas upstream of Wells Dam, and sampling in late August and/or September.

Baited setlines are the primary gear utilized to capture large juvenile (90-110 cm FL), sub-adult (>110 cm but sexually immature), and adult (>110 cm but sexually mature) sturgeon (Burner et al. 2000; Howell and McLellan 2008). Setline sampling would be conducted throughout the Wells Reservoir and potentially in the lower reaches of the Okanogan River. Sampling would be conducted between April and November. This gear has very low by-catch (Burner et al. 2000; Howell and McLellan 2007) and to our knowledge has not resulted in the capture of any salmonids.

Artificial substrate mats will be used to white sturgeon embryos (eggs). Artificial substrates are comprised of square steel frame and coated horse hair furnace material and are anchored to the river bottom. Sturgeon eggs, broadcast by spawning females, adhere to the substrate material. Sampling for eggs will be conducted in June and July in the Columbia River upstream of the confluence with the Okanogan River to the tailrace of CJ Dam. Although some disturbance of the substrate could occur during deployment, any salmonid eggs would have already hatched and this gear will primarily be set in the faster flowing areas near CJ Dam where listed salmonids are not known or expected to spawn and rear.

Angling will be used to capture adult white sturgeon. We will use large circle halibut hooks baited with pickled squid to avoid bycatch of salmonids. Angling will be conducted in the Columbia River at Brewster during June. We have no knowledge of a salmonid ever being caught with sturgeon angling gear.

2.2.4. Predator Control

The Wells Pool and Okanogan subbasin contain many fish, birds and mammals that prey on juvenile salmonids. Several of these predators are not indigenous to North Central Washington and anthropogenic structures (Dams) or effects (inundation, altered flow regime) allow for native and non-native predators to have enhanced foraging opportunities. The extent that these predators and conditions limit the survival of juvenile salmonids in the Okanogan is uncertain, but believed to be important. Therefore, the CTCR intends to implement an assessment to quantify the effects of predation and test particular gear types and protocols for effectiveness of predator removal. Additionally, other non-indigenous predators, such as Northern Pike, may invade the Columbia and Okanogan rivers in coming years as they have in Lake Roosevelt. If/when this invasion occurs it is likely that CCT and other fish co-managers will want to take swift action to prevent their establishment in anadromous salmonid habitats.

The goal for the predator assessment program would be to determine the extent of predation on, and potential effects on abundance and productivity, for juvenile salmonids in the Okanogan and Columbia Rivers adjacent to the Okanogan Basin. At this time, the CTCR Fish and Wildlife Department has not determined a course of action or timeline for predator assessment and

removal. When they do, this section of the TRMP will be updated and discussions with NMFS initiated to be sure that the activities and ESA take levels will fall within acceptable limits.

Potential Methods

1. Electroshocking
2. Hook and Line
3. Gill nets
4. Set lines

2.2.5. Kelt Reconditioning

The spawn escapement objective for Lower Omak Creek is 100 summer steelhead. Therefore the target of 6 percent (as determined by the NMFS 2014 biological opinion) could be met with 6 repeat spawners. The program will have a goal 30% survival to release and a 60% maturation rate (i.e., 6 of 10 surviving kelts will be sexually mature and ready to spawn shortly after release). Based on these goals, 33 female kelts would need to be collected per year to achieve 10 mature female reconditioned kelts at release and 6 repeat spawners. Program size would be affected by escapement, flow conditions and trap efficiency.

Kelts will be collected in the Omak Creek weir trap or dip netted from the upstream side of the weir. Kelts retained for reconditioning will be visually examined to verify they have completed spawning. Kelts will be measured, weighed, and a genetic sample will be taken. If not already PIT tagged, the kelt will be injected with a PIT tag before being placed into an oxygen injected holding tank on a transport vehicle filled with river water. Injections with antibiotics and medications will be administered to treat bacterial and parasitic infections. In addition, kelts will have a health check by a certified fish pathologist after they have stabilized and other medications may be administered as directed by the pathologist.

Kelts will be taken to the reconditioning site located at Saint Mary's on Omak Creek and released into large circular holding tanks. Steelhead kelts will be reconditioned for a period of 9 to 11 months before release. Salt will be used to prevent fungus and to reduce algae growth in the pond. Every 2-months, fish will be checked for parasites and treated if needed. If possible, kelts will be released into the Okanogan River near the confluence with the Columbia River at Mosquito Park during natural spawn timing, which typically begins in March. Each year the abundance and distribution of returning kelts will be evaluated using PIT tag data.

2.3. Alternative 3 – Termination of All TRMP Activities

Under this alternative, NMFS would determine that the TRMP does not meet the criteria of the Tribal 4(d) Rule. For analysis purposes, NMFS has defined this Alternative as the termination of all actions included in the TRMP regardless of whether or not those actions may already have existing ESA authorization.

This alternative would not meet the purpose and need because termination of all TRMP actions would not provide sufficient hatchery steelhead to contribute to the survival and recovery of Upper Columbia River ESA-listed steelhead, fulfill tribal reserved fishing rights, or mitigate

for lost natural origin salmon production under *U.S. v. Oregon* requirements for the Okanogan Basin.

2.4. Alternative 4 – Revise and Resubmit the TRMP with Decreased Production Levels

Under this decreased production alternative, NMFS would determine that the CTCR's TRMP meets the criteria of the Tribal 4(d) Rule.

Hatchery production would be decreased by 50 percent. Decreasing hatchery production by 50 percent would likely result in a reduction in harvest by a similar percentage. The RM&E, kelt reconditioning, and predator removal activities would likely continue to operate at the same levels. This alternative would not meet the purpose and need because decreased hatchery production would not provide sufficient numbers of adult steelhead to fulfill tribal reserved fishing rights, mitigate for lost natural origin salmon production, accelerate recolonization of existing and newly available habitat, and contribute to the survival and recovery of ESA-listed steelhead.

2.5. Alternatives Considered but not Analyzed in Detail

2.5.1. Approve only part(s) of the TRMP

Under this alternative, the Secretary would approve specific parts of the TRMP such as; only fisheries activities, only research, monitoring, and evaluation, or only predator fish removal. Approving only specific parts of the TRMP would not provide a meaningful analysis of effects, would be redundant to the alternatives above, would not meet the applicants purpose and need for conserving and recovering native fish populations, and would not meet NMFS purpose and need for meeting tribal trust responsibilities. Consideration of only portions of the current TRMP would probably only be possible if the CTCR re-designed and re-submitted its plan, with consequent loss of objectives intended to be achieved by the current plan. In particular, interactions between such activities as hatchery production, utilization, and monitoring and evaluation of efficacy of natural habitat use are carefully crafted components of the TRMP, and such interconnectedness would be lost if only portions of the TRMP were considered.

2.5.2. Approve only the TRMP with increased production

Under this alternative, NMFS would determine that the TRMP meets the criteria of the Tribal 4(d) Rule, after the TRMP is revised to reflect increased hatchery production resulting in an expansion of associated fisheries and RM&E activities. However, this alternative may not be feasible due to lack of sufficient infrastructure (e.g., weirs, traps, dams, funding) for removal of surplus hatchery-origin steelhead. In addition, substantially higher production levels would have a higher level of adverse impacts outside of the hatchery facility (e.g., competition and predation on other fish species). Thus, this alternative may result in greater adverse impacts than under the Proposed Action and would not meet NMFS' purpose and need to protect and conserve listed species.

3. AFFECTED ENVIRONMENT

The alternatives identified above can potentially affect the physical, biological, socioeconomic, cultural, and health related resources within the project area. These resources are:

- Water quality (Subsection 3.1)
- Salmon and steelhead (Subsection 3.2)
- Other fish species (Subsection 3.3)
- Wildlife (Subsection 3.4)
- Socioeconomics (Subsection 3.5)
- Environmental justice (Subsection 3.6)
- Cultural resources (Subsection 3.7)
- Safety/Human Health (Subsection 3.8)

The following is a summary of the resources that would be affected by any of the alternatives and the current baseline condition. See Table 9 for a brief overview of resources and how they are effected by the actions covered in the proposed program. No other resources were identified during internal scoping that would potentially be impacted by the Proposed Action or alternatives, that have not been previously identified in the CJ Hatchery FEIS (BPA et al. 2009), the Mitchell Act FEIS (NMFS 2014c), and the Okanogan 10(j) EA (NMFS 2014b).

Table 9. General mechanisms through which the proposed actions can affect the environment in the action area. The '*X*' symbol represents negligible or undetectable effects. The effects of the CJ Hatchery programs are discussed in the CJ Hatchery FEIS (BPA et al. 2009), the Mitchell Act FEIS (NMFS 2014c), and the Okanogan 10(j) EA (NMFS 2014b).

Effects of TRMP on Resources	TRMP Actions			
	Fisheries	**Hatcheries**	**RM&E**	**Predator Fish Removal**
Water Quality	*X*	• Reduce water quality in adjacent streams through discharge	• Provide information on water quality	*X*
Salmonid Genetics and Life History	• Alter genetics or life history of natural-origin salmonids through long-term fisheries-induced evolution	• Reduce reproductive performance of natural-origin salmonids • May alter genetics or life history of natural-origin salmonids	• Provide information on genetics and life history of natural-origin salmonids	*X*
Salmonid Ecological Interactions*	• Increase negative health effects on natural-origin salmonids	• Increase competition, # predators on, and prey sources for natural-origin salmonids • Increase difficulty in determining status of the natural-origin salmonids • May increase disease risk in natural-origin salmonids • Increase nutrients in freshwater systems	• Directly or indirectly increase risk of injury and mortality to salmonids • Provide information on ecological interactions	• Decrease number of predators, and increase amount of prey sources for natural-origin salmonids
Salmonid Population Viability	• Decrease population viability of natural-origin salmonids	• Preserve, increase, or decrease population viability of natural-origin salmonids • Decrease viability due to incidental fish caught from CJ Hatchery program production	• Provide information on status of natural-origin salmonid populations	• Preserve, increase, or decrease population viability of natural-origin salmonids
Other Fish and Wildlife	• Increase negative health effects on incidental catch • Decrease food resources available	• Preserve, increase, or decrease food resources for and predation on other fish and wildlife	• Provide information on status of other fish and wildlife	• Preserve, increase, or decrease food resources for and predation on other fish and wildlife
Socioeconomics and Cultural Resources	• Increase local economy and have positive effects on cultural resources	• Increase local economy and have positive effects on cultural resources	*X*	• Increase local economy and have positive effects on cultural resources
Environmental Justice	• Preserve or increase effects on environmental justice	• Preserve, increase, or decrease effects on environmental justice	*X*	• Preserve or increase effects on environmental justice
Human Health and Safety	• Increase risks to human health and safety	• Increase risks to human health and safety	*X*	*X*

*Ecological Interactions include competition/predation, prey enhancement, masking, disease transfer, and nutrient cycling.

3.1. Water Quality

The Clean Water Act (33 U.S.C. §§1251-1387) administered by the U.S. Environmental Protection Agency and state water quality agencies, is the principal Federal legislation directed at protecting water quality. Each state implements and carries forth Federal provisions, as well as approves and reviews National Pollutant Discharge Elimination System applications, and establishes total maximum daily loads for rivers, lakes, and streams. The Washington State Water Pollution Control Act (Revised Code of Washington Chapter 90.48), designates the Washington Department of Ecology (Ecology) as the agency responsible for carrying out the provisions of the Federal Clean Water Act within Washington State. These regulations are described in Washington Administrative Code (WAC) 173. Hatchery operations are required to comply with the Clean Water Act.

As part of administering elements of the Clean Water Act, Ecology is required to assess water quality in all rivers, lakes, and marine waters within the state. These assessments are published in what are referred to as the 305(b) report and the 303(d) list (the numbers referring to the relevant sections of the original Clean Water Act text). The 305(b) report reviews the quality of all waters of the state. The 303(d) list identifies specific water bodies considered impaired, based on the number of exceedances of water quality criteria in a water body segment.

Reaches of the Okanogan mainstem and Similkameen Rivers are listed under the 2008 Clean Water Act section 303(d) list as water quality-impaired for failure to meet temperature, dissolved oxygen, and pH standards (Ecology 2008). These same impairments exist today (Table **10**), in addition to impairment from bacteria and turbidity. The hatchery programs proposed in the TRMP are related to water quality because the hatchery programs release effluent, which could potentially influence the already impaired water bodies in Table 2. Okanogan River water temperatures often exceed lethal tolerance levels for salmonids in the mid- to late summer months. As water temperatures increase, the concentration of dissolved oxygen decreases. Dissolved oxygen concentration determines the water's ability to support oxygen-consuming aquatic organisms. The high summer water temperatures are partly a result of natural processes, such as solar heating of lakes in the Okanogan River system, poor riparian conditions, and flow alterations caused by dams and irrigation withdrawals.

Currently, all facilities in this Proposed Action are screened in compliance with the NMFS screening criteria from 1995, the addendum to those criteria (NMFS 1996), and repair or reconstruction updates to those criteria (NMFS 2011).

Table 10. Water quality data regarding the major water bodies in the project area.

Water Body	303(d) Impaired Listing Parameters
Omak Creek	Insufficient data
Salmon Creek	Insufficient data
Antoine Creek	Toxins, Dissolved Oxygen, pH
Johnson Creek	Dissolved Oxygen, pH
Similkameen River	Temperature, Toxins, Dissolved Oxygen, pH
Okanogan River	Bacteria, Temperature, Toxins, pH, Turbidity
Columbia River	Insufficient data

Source: (Washington Department of Ecology 2016), accessed April 12, 2016

3.2. Salmon and Steelhead

NMFS recognizes a salmon ESU (UCR Spring-run Chinook Salmon, *Oncorhynchus tshawytscha*) and a steelhead DPS (UCR Steelhead, *O. mykiss*) within the analysis area that require protection under the ESA (NWFSC 2016). In the analysis area, there are also two additional non-listed salmon species (UCR summer/fall Chinook salmon, *O. tshawytscha*; and UCR sockeye salmon, *O. nerka*). While not listed, the Okanogan subpopulation of UCR sockeye salmon is depressed according to (WDFW 2002).

A Federal recovery plan is in place for ESA-listed Upper Columbia River spring Chinook salmon and steelhead (Upper Columbia Salmon Recovery Board 2007). The recovery plan was a joint project developed by the Upper Columbia Salmon Recovery Board and NMFS. The Upper Columbia Salmon Recovery Board includes representatives from Chelan, Douglas, and Okanogan Counties, the Colville Confederated Tribes, and the Yakama Nation. The comprehensive recovery plan includes conservation goals and proposed habitat, hatchery, and harvest actions needed to achieve the conservation goals for each watershed within the geographic boundaries of the Upper Columbia River Spring Chinook Salmon ESU and Upper Columbia River Steelhead DPS.

WDFW's Hatchery and Fishery Reform Policy (Policy C-3619) was adopted by the Washington Fish and Wildlife Commission in 2009. It supersedes WDFW's Wild Salmonid Policy, which was adopted in 1997. Its purpose is to advance the conservation and recovery of wild salmon and steelhead by promoting and guiding the implementation of hatchery reform. The policy applies to state hatcheries and its intent is to improve hatchery effectiveness, ensure compatibility between hatchery production and salmon recovery plans and rebuilding programs, and support sustainable fisheries.

Critical habitat has been designated for UCR Spring-run Chinook Salmon ESU and UCR Steelhead DPS in the Columbia River estuarine areas and river reaches as far upstream as Rock Island Dam, as well as in specific stream reaches in the Wenatchee, Entiat, Methow, and

Okanogan River subbasins. Within these areas, NMFS identifies primary constituent elements, such as freshwater spawning and rearing sites as well as freshwater and estuarine migration corridors. Primary constituent elements are biological and physical features that are essential to the conservation of species. Each element requires adequate water quantity and quality, forage, natural cover, and freedom from obstruction and excessive predation. While the analysis area does not fall within designated critical habitat, the activities resulting from the Proposed Action may affect these critical habitats. Critical habitat has not been designated for UCR summer/fall Chinook salmon or UCR sockeye salmon because these populations are not ESA-listed.

Fisheries, hatcheries, RM&E, predator fish removal programs, and kelt reconditioning can affect natural-origin salmon and steelhead and their habitat through a variety of effects (Table **9**). However, the extent of effects (adverse to beneficial) depends on the design of the action, the condition of the habitat, and the status of the species, among other factors. The following subsections describe effects of CTCR TRMP components as they currently operate, in more detail. Because salmonids are highly mobile during migration, this section includes populations of fish and release sites immediately outside of the Okanogan subbasin project area that are not associated with the CJ Hatchery Programs. However, analyses focus on the activities within the project area within the Okanogan subbasin.

3.2.1. Genetics

Hatchery-origin salmonids can have a variety of genetic effects on natural-origin salmonid population productivity and diversity when they interbreed with natural-origin fish. NMFS considers three major areas of genetic risks of hatchery programs: within-population diversity, outbreeding, and hatchery-influenced selection.

Within-population genetic diversity is a general term for the quantity, variety, and combinations of genetic material in a population (Busack and Currens 1995). Within-population diversity is gained through mutations or gene flow from other populations and is lost primarily due to genetic drift (i.e., a random loss of diversity, usually due to small population size).

Outbreeding effects are caused by gene flow from other populations. Gene flow occurs naturally among salmon and steelhead populations through a process referred to as straying (Quinn 1993; Quinn 1997). Natural straying serves a valuable function in preserving diversity that would otherwise be lost through genetic drift and in re-colonizing vacant habitat. Straying is considered a risk only when it occurs at unnatural levels or from unnatural sources. Gene flow from other populations can have two effects. It can increase genetic diversity (Ayllon et al. 2006), but it can also alter established allele frequencies (and co-adapted gene complexes) and reduce the population's level of adaptation, a phenomenon called outbreeding depression (Edmands 2007; McClelland and Naish 2007). In general, the greater the geographic separation between the source or origin of hatchery fish and the recipient natural population, the greater the genetic difference between the two populations (ICTRT 2007), and the greater potential for outbreeding depression.

Hatchery-influenced selection occurs when selection pressures imposed by hatchery spawning and rearing differ greatly from those imposed by the natural environment and causes genetic

change that is passed on to natural populations through interbreeding with hatchery-origin fish, typically from the same population. These differing selection pressures can be a result of differences in environments or a consequence of protocols and practices used by a hatchery program. Hatchery selection can range from relaxation of selection that would normally occur in nature to inadvertent selection for different characteristics in the hatchery and natural environments, to intentional selection for desired characteristics (Waples 1999).

3.2.1.1. **Spring Chinook Salmon**

Spring Chinook salmon from this ESA-listed ESU currently spawn in three river basins in north-central Washington State: Methow, Entiat, and Wenatchee. A fourth population historically inhabited the Okanogan subbasin, but was extirpated in the 1930s because of over-fishing, hydropower development, and habitat degradation (UCSRB 2007). The ESU also includes six artificial propagation programs: Twisp River, Chewuch River, Methow Composite, Winthrop National Fish Hatchery, Chiwawa River, and White River spring Chinook salmon hatchery programs (79 FR 20802, April 14, 2014).

The spring Chinook salmon hatchery program at CJ Hatchery currently use fish from the Leavenworth National Fish Hatchery (i.e., Carson stock) as broodstock. Due to increases in releases and returns from hatchery programs in the Wenatchee and Methow subbasin drainages (Hillman et al. 2015), the proportions of natural-origin contributions to spawning has deceased in populations since 1990. The proportion of natural-origin fish has remained relatively stable since 1990 (Table **11**). The Carson stock released at the Leavenworth National Fish Hatchery is not part of the ESA-listed UCR Spring Chinook Salmon ESU, and therefore poses a threat to the genetic integrity of the ESU.

Table 11. 5-year mean of fraction natural-origin (sum of all estimates divided by the number of estimates).

Population	1990-94	1995-99	2000-04	2005-09	2010-14
Methow R. SpR	0.84	0.61	0.16	0.27	0.24
Entiat R. SpR	0.86	0.70	0.56	0.47	0.74
Wenatchee R. SpR	0.86	0.66	0.54	0.24	0.35

Source: (NWFSC 2016)

Hatchery-origin spawners heavily influence the UCR Spring-run Chinook Salmon ESU (NWFSC 2016). While hatchery programs may provide some short-term demographic benefits, there are uncertainties regarding the long-term risks of relying on high levels of hatchery influence to maintain natural production (Ford 2011).

The CJ Hatchery spring Chinook salmon program is a segregated program that propagates Carson stock, therefore, any straying of these fish is limited. Because the CJ Hatchery program first released fish in 2013, no adults have returned with which to estimate rates of straying. The HSRG recommended a pHOS of no more than 5 percent for a segregated program (Hatchery Scientific Review Group 2009). Thus, we expect straying from the CJ spring Chinook salmon hatchery program into populations within the UCR spring Chinook Salmon ESU to remain below 5 percent.

However, because the natural-origin spring Chinook population in the Okanogan River has been extirpated, there are unlikely to be any natural-origin spring Chinook salmon within the action area that would be susceptible to genetic effects of the CJ Hatchery program for spring Chinook salmon. However, as returns from fish originating from the 10(j) population begin in 2018, there could be some effects of straying into the Okanogan Basin from the CJ spring Chinook salmon program. Because spring Chinook salmon in the Okanogan Basin are extirpated, it is unclear what their distribution would be.

3.2.1.2. **Steelhead**

UCR steelhead spawn in four river basins in north-central Washington State: Wenatchee, Entiat, Methow, and Okanogan. The DPS also includes six artificial propagation programs: the Wenatchee River, Wells Hatchery in the Methow and Okanogan Rivers, Winthrop National Fish Hatchery, Omak Creek, and the Ringold steelhead hatchery programs (79 FR 20802, April 14, 2014). Historically, steelhead had access to Okanogan Lake (Wright and Smith 2003). The 2016 RM&E report (Miller et al. 2016) modeled that there were only an estimated 96 natural-origin steelhead redds in the Okanogan River mainstem, compared to the estimated 383 hatchery-origin steelhead redds in 2016. Moreover, this report estimated that there were 118 natural-origin steelhead redds in tributary reaches in 2015, compared to 241 hatchery-origin redds (Miller et al. 2016). Omak and Salmon Creeks are the two primary spawning and rearing habitats in the Okanogan subbasin for steelhead.

While other steelhead hatchery programs exist in the UCR region, hatchery-origin steelhead from the Wells Fish Hatchery are the predominant steelhead that exist in the action area (Table 4). Hatchery-origin UCR steelhead not are currently released into the Entiat River system, and natural-origin UCR steelhead are exclusively used for broodstock for hatchery programs in other watersheds. However, as a result of Wells Dam hatchery releases in the Columbia River Basin, there is a high rate of hatchery fish on the spawning grounds (Table **12**), but, according to genetic analyses from samples in the 1980s, there is little differentiation within populations in the UCR Steelhead DPS. Recent studies within the Wenatchee River subbasin found genetic differences in samples from Peshastin Creek, likely because this region is fairly isolated from hatchery spawning. Accordingly, before the onset of hatchery releases, there may have been a higher level of within and among population diversity (Seamons et al. 2012).

Table 12. 5-year mean of fraction natural-origin (NWFSC 2016).

Population	1990-94	1995-99	2000-04	2005-09	2010-14
Methow R. SpR	0.56	0.21	0.24	0.24	0.31
Entiat R. SpR	0.24	0.14	0.11	0.15	0.24
Okanogan R. SpR	0.11	0.05	0.06	0.09	0.13
Wenatchee R. SpR	0.30	0.41	0.34	0.38	0.58

3.2.1.3. **Summer/Fall Chinook Salmon**

The UCR summer/fall Chinook salmon is within the UCR Summer/Fall Chinook Salmon ESU (not ESA-listed) includes the Wenatchee, Entiat, Methow, Okanogan/Similkameen, and Upper Middle Columbia Rivers. For early arriving summer Chinook salmon, genetic sampling has indicated that there are no genetic differences between hatchery-origin and natural-origin stocks within the project area (Brown 1999). This result is probably because protocols for past broodstock collection that obtained fish from early arriving UCR summer/fall Chinook salmon integrated natural-origin fish into the hatchery program. Furthermore, most of the UCR summer/fall Chinook salmon that return to the Okanogan subbasin are progeny of the Wells Hatchery program, operated by WDFW (BPA et al. 2009). The high proportions of hatchery-origin fish have likely created a homogenized, single population of earlier-arriving summer/fall Chinook salmon.

3.2.1.4. **Sockeye Salmon**

The sockeye salmon run ascending Wells Dam are estimated to 88 to 93 percent natural-origin salmon. Currently, only two hatchery program (Prosser Hatchery and Canadian Okanagan Alliance) exist that propagates sockeye salmon above Wells Dam. Prosser Hatchery uses Okanogan stock from Priest Rapids to release 500,000 fry into the Lake Cle Elum and the Canadian Okanagan Alliance currently releases 500,000 Okanogan stock fry in Canada. Hatchery-influenced selection may still be a risk to natural-origin populations, but there are no risks associated with the proposed hatchery actions.

3.2.2. **Life History**

Life history information describes the major events that occur during the life cycle of an organism. In salmonids, the primary life events are juvenile emergence, smolt migration, adults return to freshwater, spawning, and death. These events are often scientifically measured in terms of egg quality and quantity, growth, smolt migration timing, age and size at reproductive maturity, smolt-to-adult return rates, spawning location and timing, fecundity, and mortality. Life history is often complex in salmonids, and not necessarily consistent. These events may change due to phenotypic plasticity or various evolutionary factors.

Hatchery-origin salmonids can potentially interfere with and alter natural-origin salmonid life history traits, as well as mirror genetic effects from hatcheries. Life history traits are often linked to genetic components (Giger et al. 2006), may contribute to population structure (Gharrett and Smoker 1993), and, therefore, may be influenced by hatchery reared fish. In addition, fisheries selectivity through differences in gear type can remove certain size classes of individuals from a population. This selection can remove individuals with certain life history traits, leading to fisheries-induced evolutionary effects. For example, fisheries that target the largest individuals may be removing the biggest, most fecund females (i.e., the “big old fat fecund female fish”) from a population. The smaller, less fecund females remaining in the population will then pass on those “lesser fecund” qualities to their offspring. This may lead to fisheries-induced evolutionary effects on life history traits of future generations. Epigenetics, the modification of gene expression due to environmental factors, could also alter the manifestation of life history

characteristics. Phenotypic plasticity aside, these factors should all be considered when determining effects of programs on life history traits.

3.2.2.1. **Spring Chinook Salmon**

Juvenile spring-run Chinook salmon in the Upper Columbia River Basin generally spend one year in fresh water before they migrate downstream (Healey 1991). Some juvenile spring-run Chinook salmon migrate out of their natal subbasin and rear in the mainstem Columbia River prior to their migration as smolts (NPCC 2004). Smolt migration occurs from mid-April through May. Most juvenile spring-run Chinook salmon spend two years in the ocean before migrating back to their natal streams. Spring-run Chinook salmon adults enter the Columbia River Basin from March through early June and enter their natal streams from late April through July. While in their natal streams, they hold in the deeper pools and under cover until the onset of spawning. Spawning occurs from late July through September, usually peaking in late August (Chapman et al. 1995).

As hatchery-origin spring Chinook salmon are reintroduced into the project area, natural-origin fish may become increasingly susceptible to changes in life history. Depending on genetic differences and environmental conditions (e.g., temperature, diet, nutrients in water, stress) during rearing in hatcheries, the life history traits of natural-origin fish may be modified through interbreeding. Furthermore, it is possible that fisheries are selecting certain size classes of individuals that may lead to fisheries-induced evolution and changes in life history characteristics. This information is discussed in more detail in the Okanogan 10(j) EA (NMFS 2014b).

3.2.2.2. **Steelhead**

O. mykiss, which steelhead are a part of, exhibit perhaps the most complex suite of life history traits of any species of Pacific salmonid. They can be anadromous (steelhead) or freshwater residents (rainbow trout), and, under some circumstances, can yield offspring of the opposite form. Those that are anadromous can spend up to seven years in fresh water prior to smoltification, and then spend up to three years in salt water prior to first spawning. Steelhead are also iteroparous (i.e., individuals may spawn more than once), whereas most Pacific salmon species are semelparous (i.e., individuals generally spawn once and die).

Steelhead can be divided into two basic reproductive ecotypes, based on the state of sexual maturity at the time of river entry and duration of spawning migration. The ‘‘stream-maturing’’ type (summer steelhead in the Pacific Northwest and Northern California) enters fresh water in a sexually immature condition between May and October and requires several months to mature and spawn. The “ocean-maturing” type (winter steelhead in the Pacific Northwest and Northern California) enters fresh water between November and April and spawns shortly thereafter. UCR steelhead are the “stream-maturing” type (i.e., summer steelhead). Steelhead that enter the Okanogan subbasin in August and September may experience some reaches of the river where water temperatures reach lethal levels.

UCR steelhead spawn in April, May, and early June. Steelhead spawn in cool, clear streams with suitable gravel size, depth, and current velocity. Intermittent streams may also be used for

spawning (Everest 1973). Steelhead juveniles emerge from the gravel in May through early August depending on time of spawning and water temperature during egg incubation (Chandler and Bjornn 1988). Smolt migration occurs from mid-April through mid-June.

Environmental conditions have the potential to alter life history information, and depending on the level of effect, this can have epigenetic effects. If these hatchery-origin fish were to mate with natural-origin fish, this could pass those life history traits (i.e., epigenetic tags) to future progeny. Moreover, fisheries may also alter life history traits of natural-origin fish by means of size selectivity.

3.2.2.3. **Summer/Fall Chinook Salmon**

Adult summer/fall-run Chinook salmon migrate past Wells Dam late-June through November to spawn during October and November in the Columbia River, Methow, and Okanogan subbasins. Historical spawning ground surveys indicated the heaviest spawning in the lower Okanogan River, where almost no spawning occurs today, and in the Riverside and Omak areas. In recent years, most UCR summer/fall-run Chinook salmon adults return to the Similkameen River to a 1.2-mile area in the vicinity of the Similkameen Acclimation Pond. Spawning also occurs in spatially discontinuous areas from the town of Malott upstream to Zosel Dam, an area approximately 15-64 river miles long on the Okanogan River. A large portion of the Okanogan River is underutilized and the habitat under seeded (NPCC 2004).

Emergence timing primarily occurs from January through April. Juveniles generally emigrate to the ocean as sub-yearling fry, leaving the Okanogan River from one to four months after emergence. Juveniles use the Okanogan River and Columbia River between Wells and CJ Dams for rearing before emigrating toward the ocean in their first year of life. Smolt migration occurs from mid-May through mid-August.

In 2013, the applicants released 420,000 sub-yearling and 780,000 yearling hatchery-origin summer/fall Chinook into the Okanogan and Columbia Rivers. Similar releases have occurred in recent years. These released fish may have influenced and could continue to influence the life history traits of natural-origin summer/fall Chinook, depending on differences in genetics and environmental rearing conditions.

3.2.2.4. **Sockeye Salmon**

Information on sockeye salmon was largely incorporated from the Okaongan 10J FEA (NMFS 2014b); therefore, refer to this document for additional information regarding references in this section.

Adult Okanogan River sockeye salmon migrate past Wells Dam during July and August and move rapidly through the Okanogan subbasin to Lake Osoyoos prior to spawning in October. However, generally in July or August, water temperatures in the mainstem Okanogan River rise to levels lethal for sockeye salmon (Hyatt et al. 2003). As a result, the late-arriving portion of the run stops migrating for about a month and remains in the cooler mainstem Columbia River until water temperatures drop to a tolerable level so that their migration can continue.

Juvenile Okanogan River sockeye salmon spend one year rearing in Lake Osoyoos (a United States and Canadian cross-boundary lake) before migrating to the Pacific Ocean. Their survival is adversely impacted in late summer when surface waters in Lake Osoyoos warm and deep waters become low in oxygen (Wright and Smith 2003). Sockeye salmon smolts emigrate mid-April through May. Unlike other species of Pacific salmon, sockeye salmon feed on zooplankton during their juvenile and adult stages. Insects are also part of their diet at the juvenile stage.

For many years, McIntyre Dam was the upstream boundary of Okanogan River sockeye salmon. Adult Okanogan River sockeye salmon would spawn up to the base of McIntyre Dam, and emergent sockeye salmon would move downstream to rear in Lake Osoyoos. This dam had been a barrier to fish passage under all but the highest flows since its construction in 1954. In 2009, McIntyre Dam was modified to allow sockeye salmon access into Vaseux Lake (Fryer et al. 2010). The increased habitat is likely to improve adult and juvenile survival and to greatly improve their abundance and productivity (Wright and Smith 2003).

In 2003, the Okanogan Nation Alliance developed a plan to reintroduce sockeye salmon into the high-quality rearing habitat of Skaha Lake. The outlet dam of Skaha Lake remains impassable to sockeye salmon, but the Okanogan Nation Alliance has moved adult sockeye salmon into Skaha Lake to evaluate the spawning and rearing potential (Wright and Smith 2003).

The influence of hatchery-origin sockeye salmon on natural-origin sockeye salmon life history is likely minimal because the vast majority of sockeye salmon in the project area are natural-origin. However, fisheries may alter life history traits of these natural-origin fish by means of size selectivity.

3.2.3. **Competition and Predation**

Competition is an interaction between organisms that usually results in the fitness of one individual being lowered by another. Competition can occur between individuals of the same species (*intraspecific* competition) or different species (*interspecific* competition) utilizing a limited resource. Of primary interest for this EA is intraspecific and interspecific competition between hatchery-origin and natural-origin fish, where the fitness of natural-origin individuals may be at risk. An example of a direct interaction is where hatchery-origin salmonids prevent natural-origin salmonids from utilizing a resource (like food or space). Indirect interactions include situations when the utilization of a limited resource by hatchery-origin salmonids limits the amount available for natural-origin fish.

Predation is the act of one organism preying on another organism. *Intraspecific* predation is the act of an individual preying on another individual of the same species. *Interspecific* predation is the act of an individual preying on another individual of a different species. Direct predation occurs when hatchery-origin salmonids prey on natural-origin salmonids. On the other hand, indirect predation occurs when the increased abundance of juvenile salmon and steelhead from hatcheries increases predation on natural-origin fish from other sources. The size at which salmonids feed on one another is debatable. Some reports suggest that hatchery-origin fish can prey on fish that are one-half their length (Pearsons and Fritts 1999), while others show that they prefer prey one-third of their length or less (Horner 1978) (Beauchamp 1990). Regardless, there

is risk of direct and indirect predation from hatchery-origin salmonids on natural-origin salmonids. To reduce predation risk, hatcheries rear juveniles to sufficient size and imprint them on surface water from natal streams to enhance smoltification, which reduces residence time in streams after release.

The Mitchell Act FEIS (NMFS 2014c) discusses competition and predation in regards to the hatchery effects of activities covered in the TRMP in more detail.

3.2.3.1. **Natural-origin Spring Chinook Salmon**

Intraspecific predation on natural-origin spring Chinook fish by hatchery-origin UCR spring Chinook salmon is a current risk in the Okanogan subbasin. In 2013, the CJ Hatchery Program released 420,000 yearling Carson stock smolts into the Columbia River and 200,000 Methow-composite smolts from the Methow River subbasin into the Okanogan River. The effects of these releases on natural-origin spring Chinook salmon were covered in the CJ Hatchery FEIS. The majority of emigrating UCR spring Chinook salmon smolts at any given time are hatchery-origin (NWFSC 2016), and natural-origin spring Chinook salmon sub-yearlings are roughly one-third the size of the hatchery-origin spring Chinook (Table 13), so it is possible that some natural-origin spring Chinook salmon are eaten by hatchery released fish. In addition, hatchery releases overlap with the natural occurrence of sub-yearlings in the analysis area by a month and a half, making it likely that some interspecific competition has occurred (Table 13).

Table 13. Estimated size and freshwater occurrence/release for natural-origin and hatchery-origin juvenile salmonids in the UCR.

Species (Origin)	Life Stage	Estimated Size (mean FL mm)	Occurrence/Release Timing
Spring Chinook (Natural)	Sub-yearling	< 45	March-May
	Yearling	~98	April-July
Spring Chinook (Hatchery)	Yearling	153	mid April-mid May
Summer Steelhead (Natural)	Sub-yearling	NA	May-early August
	Yearling	~119	mid April-mid June
Steelhead (Hatchery)	Yearling	~184	mid April-mid May
Summer/fall Chinook (Natural)	Sub-yearling	< 41	January-April
	Yearling	~97	mid May-mid August
Summer/fall Chinook (Hatchery)	Sub-yearling	<103	June
	Yearling	~160	mid April-mid May
Sockeye (Natural)	Sub-yearling	<31	early spring
	Yearling	~135	mid April-May

Source: (HETT 2014)

Information on spring Chinook salmon was largely incorporated from the Okanogan 10j FEA (NMFS 2014b); therefore, refer to this document for additional information regarding references in this section.

The degree to which food supply affects downstream survival is unknown (Muir and Coley 1996). Though salmon and steelhead occupy streams flowing through a wide spectrum of upland environments, their freshwater habitat preferences are limited to a comparatively narrow set of hydrological and streambed conditions (Reiser and Bjornn 1979). Studies generally show that, for yearling Chinook salmon, juvenile densities are typically highest in relatively low-gradient, unconfined stream reaches with well-defined pool structure (Hillman and Miller 2002; Petrosky and Holubetz 1988), while steeper-gradient, relatively confined tributary reaches typically support the highest relative densities of juvenile steelhead (Petrosky and Holubetz 1988; Burnett 2001). There may be areas in the Okanogan subbasin where juvenile spring-run Chinook salmon and Okanogan steelhead coexist. However, competition by juvenile salmonids of different species for food, space, and cover tends to be minimal (Hearn 1987).

Interspecific predation may also occur on natural-origin spring Chinook salmon juveniles with hatchery-origin steelhead and summer/fall Chinook salmon juveniles. Hatchery-origin steelhead yearlings are over three times the size of spring Chinook salmon sub-yearlings and around twice the size of yearlings (Table 13). There is also an overlap of one-and-a-half months for hatchery-origin steelhead yearlings and both natural-origin and hatchery-origin spring Chinook salmon juveniles (Table 13), making the natural-origin spring Chinook salmon juveniles susceptible to interspecific predation by hatchery-origin spring Chinook salmon juveniles and steelhead yearlings. Moreover, yearling hatchery-origin summer/fall Chinook salmon are over three times the size of sub-yearling natural-origin spring Chinook salmon with a month-and-a-half overlap of occurrence (Table 13), meaning there is also potential for interspecific predation by hatchery-origin summer/fall Chinook salmon.

Residual salmon, the remaining individuals in a given population that do not migrate, may also have a predation risk on natural-origin spring Chinook salmon juveniles. For each hatchery-origin population, the mean percentage of residuals ranged from one to four percent (HETT 2014). Thus, these one to four percent of hatchery-origin residual salmonids would remain in the analysis area and could prey on natural-origin spring Chinook salmon juveniles.

3.2.3.2. **Natural-origin UCR Steelhead**

3.2.3.2.1. Juveniles

Intraspecific predation on natural-origin UCR steelhead juveniles by hatchery-origin UCR steelhead is a current risk in the project area. The majority of smolts migrating through the project area are hatchery-origin (NWFSC 2016). There is an observable difference in size between the natural-origin (about 119 mm) and hatchery-origin (about 184 mm) yearling steelhead (Table 13). Moreover, the geographic occurrence and release times for hatchery-origin and natural-origin steelhead overlap, so intraspecific predation of hatchery-origin steelhead yearlings on natural-origin steelhead sub-yearlings likely is occurring.

Given the expected size for natural-origin sub-yearling steelhead (Table 9), interspecific predation may also occur. Natural-origin sub-yearlings have an overlap occurrence of two weeks with hatchery-origin spring Chinook yearlings, one month with hatchery-origin summer/fall Chinook sub-yearlings, and two weeks with hatchery-origin summer/fall Chinook yearlings

(Table 13). Thus, natural-origin sub-yearling steelhead are susceptible to interspecific competition.

According to the NTTOC database, hatchery-origin UCR summer steelhead populations have a mean percentage of juvenile residuals that ranged from 3 to 10 percent. Therefore, these three to 10 percent of hatchery-origin residual salmonids would remain in the analysis area and could prey on natural-origin spring Chinook salmon juveniles. However, a portion of the hatchery-origin produced from this program (20 to 40 percent) are released in Omak Creek due to transport of non-migrants to downstream areas. The amount of hatchery-origin residual steelhead would be less than three to 10 percent, therefore, the predation risks would also be less. The extent of that predation is difficult to predict but is likely to occur at a low level.

The hatchery-origin fish residence time (using PIT-tag data and the proportion of fish that residualize) represents the average number of days interactions may occur. The mean residence time for hatchery-origin juveniles in all populations ranged from one to 11 days. The summer steelhead reared at Wells Hatchery had the longest mean residence time of nearly 11 days, meaning juveniles released from this hatchery may have an increased risk of preying on natural-origin steelhead.

3.2.3.2.2. Adults

Steelhead are widely distributed in the Okanogan subbasin and have been recently recorded above Osoyoos Lake (NPCC 2004a). Omak and Salmon Creeks are the two primary spawning and rearing habitats in the Okanogan subbasin for UCR steelhead. According to the OBMEP Annual Reports, there is a 10 year average of 322 spawners recorded in the tributaries where most spawning occurs (Miller et al. 2016). There is overlap in spawn timing of hatchery-origin and natural-origin UCR steelhead spawning (Table 14). In addition, the proportion of hatchery UCR steelhead on the spawning grounds is high (87 percent) in the Okanogan subbasin (NWFSC 2016), meaning that there is likely competition for space between hatchery and natural-origin spawners. According to spawn timing data in Table 6, adult UCR natural-origin steelhead may also compete with adult UCR natural-origin spring Chinook salmon.

Table 14. Timing of adult return, spawning, juvenile emergence, and downstream migration.

Species	Freshwater Entry	Spawn Timing	Juveniles Emerge/Released	Downstream Migration
UCR Chinook salmon (spring)	*Wenatchee, Entiat, and Methow River basins*: mid/late April-July	*Natural-origin:* August-September	*Natural-origin:* March-May	*Natural-origin:* April-July
		Hatchery-origin: September-October	*Hatchery-origin:* mid April-mid May	*Hatchery-origin:* April-June
	UCR: July-November	*Natural-origin:* March-early June	*Natural-origin:* May-early August	*Natural-origin:* mid April-mid June

UCR Steelhead (summer)		*Hatchery-origin:* April-early June	*Hatchery-origin:* mid April-mid May	*Hatchery-origin:* mid April-mid June
UCR Chinook salmon (summer/ fall)	*UCR:* Mid July-November	*Natural-origin:* October-November	*Natural-origin:* January-April	*Natural-origin:* mid May-mid August
		Hatchery-origin: October-December	*Hatchery-origin:* mid April-mid May	*Hatchery-origin:* mid May-mid August
UCR Sockeye	UCR: July-August	*Natural-origin:* October	*Natural-origin:* early spring	*Natural-origin:* mid April-June

Sources: NMFS Okanogan 10(j), Chapman et al. 1995, Chandler and Bjornn 1988, YBFWRB 2009, Zimmerman and Reeves 1999, University of Washington 2012, CJ BiOp, WDFW and WWTIT (1994)WDFW and WWTIT (1994)WDFW and WWTIT (1994)WDFW and WWTIT (1994)WDFW and WWTIT (1994)WDFW and WWTIT (1994)WDFW and WWTIT (1994)WDFW and WWTIT (1994)WDFW and WWTIT (1994)WDFW and WWTIT (1994)WDFW and WWTIT (1994), NTTOC database, and http://www.fpc.org/

3.2.3.3. **Natural-origin Summer/Fall Chinook Salmon**

3.2.3.3.1. Juveniles

Natural-origin UCR summer/fall Chinook salmon are susceptible to intraspecific predation from hatchery-origin salmonids. The CJ Hatchery program released 780,000 yearling and 420,000 sub-yearling summer/fall Chinook salmon smolts into the Okanogan River in 2013. These hatchery fish may affect the natural-origin summer/fall Chinook juveniles in the project area. UCR natural-origin summer/fall Chinook salmon sub-yearlings are around one half the size of hatchery-origin sub-yearlings and less than one-third the size of hatchery-origin yearlings (Table 13). These differences in size make natural-origin sub-yearlings susceptible to intraspecific predation from hatchery-origin juveniles. The hatchery-origin yearling release times overlap by one month when natural-origin sub-yearlings are typically found in the river. However, the hatchery-origin sub-yearling release does not overlap with when the natural-origin sub-yearlings are typically found, and therefore, intraspecific predation of natural-origin sub-yearlings by hatchery-origin sub-yearlings is unlikely.

In addition, the mean percentage of juvenile residuals for hatchery-origin UCR summer/fall Chinook salmon populations ranged from one to two percent according to the NTTOC database. Further, hatchery-origin UCR summer/fall Chinook salmon had mean residence times between two and 30 days according to the NTTOC database. The residualizing portion of the hatchery-origin UCR summer/fall Chinook salmon and lengthy residence times of migrating hatchery-origin UCR summer/fall Chinook salmon may potentially increase the threat of intraspecific predation on natural-origin juveniles in the Okanogan subbasin. At this time, it is difficult to estimate the magnitude of these impacts, even though predation is likely to occur.

In addition, natural-origin summer/fall Chinook salmon sub-yearlings may also face interspecific predation from hatchery-origin yearling spring Chinook salmon and hatchery-origin yearling

steelhead. Both species of hatchery-origin yearlings are over three times the size of, natural-origin summer/fall Chinook salmon sub-yearlings (Table 13), which means that these natural-origin yearlings are small enough to be consumed by the hatchery-origin summer/fall Chinook salmon sub-yearlings. Moreover, these fish temporally and spatially share a two week overlap in that make the interspecific predation possible.

For a broad discussion of interspecific and intraspecific predation risks on natural-origin summer/fall Chinook salmon, refer to the CJ Hatchery FEIS (BPA et al. 2009).

3.2.3.3.2. Adults

Adult UCR summer/fall Chinook salmon spawn from October to November in the Okanogan subbasins (Table 14). Most UCR summer/fall-run Chinook salmon adults return to the Similkameen River to a 1.2-mile area near the Similkameen Pond. Spawning also occurs in spatially discontinuous areas from the town of Malott upstream to Zosel Dam. Due to overlap in location and spawning time, it is likely that hatchery-origin summer/fall Chinook salmon compete with natural-origin fish for spawning sites. Because there is no other temporal or spatial overlap, competition between other hatchery-origin spawners and UCR summer/fall Chinook salmon are unlikely to occur.

3.2.3.4. **Natural-origin Sockeye Salmon**

3.2.3.4.1. Juveniles

The risk of intraspecific predation is likely very low because the proposed actions do not release any hatchery-origin sockeye salmon. Natural-origin sub-yearling sockeye salmon are less than one-third the size of hatchery-origin spring Chinook salmon, steelhead, and summer/fall Chinook salmon yearlings, and all occur in the river system during the spring. Therefore, natural-origin sockeye on sub-yearlings are highly susceptible to interspecific predation.

For a more thorough discussion of interspecific and intraspecific predation risks on natural-origin sockeye salmon, please refer to the CJ Hatchery FEIS (BPA et al. 2009).

3.2.3.4.2. Adults

Adult Okanogan River sockeye salmon migrate past Wells Dam during July and August and move rapidly through the Okanogan subbasin to Lake Osoyoos prior to spawning in October. The majority (approximately 95 percent) of sockeye salmon in spawning grounds are natural-origin. Natural and hatchery-origin summer/fall Chinook salmon and sockeye all spawn in October. Therefore, interspecific competition for spawning space may occur.

3.2.4. **Prey Enhancement**

Hatchery releases of juvenile salmonids may provide a substantial prey resource for natural-origin salmon and steelhead. In 2014, the CJ Hatchery Program released 230,886 summer Chinook salmon yearling and sub-yearling smolts, derived from Okanogan subbasin natural-origin fish, into the Okanogan River from the Omak acclimation pond. The CJ Hatchery program

also released 265,676 sub-yearling summer Chinook salmon smolts into the mainstem Columbia River in 2014. In the spring of 2015, the CJ Hatchery program reared and released approximately 515,000 spring Chinook salmon juveniles and 924,000 summer/fall Chinook salmon juveniles into the Okanogan River and mainstem Columbia River. Additionally, the Summer Steelhead Broodstock Acclimation and Monitoring Program has released 100,000 steelhead annually into the Okanogan subbasin.

3.2.5. **Facility Operations**

Discussion of hatchery facility operations interacting with salmonids and the environment includes water intake structures at CJ Hatchery and the operation of Omak Creek and Okanogan River weirs. The facility operations of CJ Hatchery and these weirs have largely been covered previously in the CJ Hatchery FEIS (BPA et al. 2009). The kelt reconditioning program utilizes a pre-existing acclimation site located at St. Mary's Pond. At CJ Hatchery, only the 10j spring Chinook salmon are ESA listed from eyed egg to fall parr (all other fish are not listed), the water supply is not from critical habitat of listed fish, and hatchery effluent is monitored and located 32 miles from steelhead spawning grounds. Please refer to the CJ Hatchery FEIS (BPA et al. 2009) for information regarding water supply from CJ Hatchery. Water supplied to the Similkameen Pond, Bonaparte Pond, Riverside Pond, and Omak Pond is screened to NOAA flow and screen standards to avoid unnecessary entanglements. Water intake structures could have negative effects on salmon and steelhead, as well as aquatic and terrestrial environments, if proper care is not taken to prevent negative impacts. Hatchery water withdrawal is monitored through Ecology and Washington State chapter 90.03 Revised Code of Washington (RCW) water code. These methods of hatchery operation limit the stress on or mortality of salmonids and other species.

Weirs used to collect broodstock and/or to control the number of hatchery-origin fish on the spawning grounds can unintentionally interact with natural-origin salmonids as well as the neighboring terrestrial and aquatic environments. Weirs may isolate previously connected salmonid populations, limit or slow migrating fish (which can enable poaching or increase predation rates), alter the distribution of salmonid spawning, increase stress and mortality rates during capture and handling, force fish to spawn downstream of the location of the weir, and increase straying of adult salmonids. In addition, transportation of broodstock from capture site to facilities may potentially increase stress levels and the likelihood of mortality of the captured fish.

Two weirs included in this Proposed Action are the adult weir in Omak Creek and the lower Okanogan River mainstem (pilot weir testing for summer Chinook salmon management), which are used to collect salmon and steelhead broodstock. The Okanogan River weir is annually operated 24 hours a day, seven days a week from July to October. Incidental or surplus natural-origin fish are released upstream of the weirs (downstream, if kelt). Traps on the Okanogan River weir are monitored and cleared more than twice a day when capture rates of steelhead are high or when debris loads necessitate frequent attention. Monitoring includes two ten-minute long observations and three five-minute tower observations done daily. Frequent, diligent monitoring of operations decreases the potential negative risks associated with these traps. In 2014, 19 natural-origin summer Chinook salmon were collected from the weir and transported via a 2,500 gallon hatchery truck to CJ Hatchery. The Omak Creek weir is annually operated 24

hours a day, seven days a week, from February to May. Up to six adult steelhead have been transported from Omak Creek to Wells Fish Hatchery facility daily. Wells Fish Hatchery staff check and spawn (as needed) fish at a minimum of once a week. Encountered Chinook salmon and steelhead are held in a box by a v-shaped entrance, and cod triggers discourage fish from backing out.

In 2014, sockeye salmon and summer Chinook salmon were the most commonly encountered species at the Okanogan River weir. There were 134 sockeye salmon, 114 Chinook salmon, six unknown sucker, 5 bridgelip sucker, 2 carp, 1 mountain whitefish, and 1 smallmouth bass mortalities found at the weir. There were a total of 1,947 natural-origin and 269 hatchery-origin adult summer Chinook salmon encountered in 2014.

During 2013, 126 summer steelhead were captured in Omak Creek. Of these fish, 21 were natural-origin and 105 were hatchery-origin.

3.2.6. **Masking**

Masking occurs when unmarked hatchery-origin salmon and steelhead are included with population estimates of natural-origin salmonids, resulting in an overestimation of the count of natural-origin fish. Marking (e.g., adipose fin clip, coded-wire tag (CWT)) allows hatchery-origin fish to be distinguished from natural-origin fish. Mass marking allows for monitoring of hatchery fish stray rates to natural spawning areas, of program performance in meeting juvenile to adult fish survival goals, and, where applicable, of natural spawning population supplementation objectives. Currently, the CJ Hatchery implements marking practices in order to avoid masking effects. Currently, all hatchery-origin spring Chinook salmon are adipose fin clipped and 42 percent have CWT. All summer/fall Chinook salmon from the integrated as well as the segregated programs are adipose fin clipped. In the Okanogan Basin Summer Steelhead Conservation Program, all hatchery fish receive a tag or mark. Juvenile steelhead with at least one hatchery parent receive an adipose fin clip. Juveniles with two natural-origin parents may retain their adipose fins but receive an alternative fin clip (ventral) and/or internal tag (CWT/PIT). In addition, at each tributary release, 5,000 steelhead receive CWT and PIT tags. Thus, all fish are currently marked in a way that prevents masking and overestimating counts.

3.2.7. **Fisheries**

Fisheries have the potential to increase, decrease, or maintain the overall health of natural-origin salmonid populations. Fisheries have historically posed threat to natural-origin salmon and steelhead. Recently, selective fisheries (i.e., fisheries that target hatchery-origin fish with markings) are being used as a tool to manage hatchery-origin adults on the spawning grounds. Careful continued monitoring and analysis of fisheries practices can determine how specific fisheries may benefit or maintain natural-origin fish.

In 1985, Canada and the U.S. signed the Pacific Salmon Treaty (PST). It provides a framework through which the two countries work together to conserve and manage Pacific salmon. Summer/fall Chinook salmon from the UCR are the only species from the Action Area that are

affected in ocean fisheries (CTCR 2014a). The 2008 agreement maintains the current abundance-based management framework established in 1999.

The resident-fish fisheries are not discussed in this subsection because they occur above CJ Dam, where anadromous fish (i.e., salmon and steelhead species) cannot reach. Thus, the resident fisheries do not have the potential to harm salmon and steelhead and are only discussed in section 3.3 Other Fish Species.

3.2.7.1. **Spring Chinook Salmon**

Although historical changes in fishery management have substantially reduced harvest risks to natural-origin UCR spring Chinook salmon, some of these fish are captured incidentally in other fisheries. Less than 2 percent of UCR spring Chinook salmon are caught in ocean fisheries (Pacific Fishery Management Council 2014), but UCR spring Chinook salmon are also harvested in treaty and non-treaty fisheries in the mainstem Columbia River. In recent years, the harvest of UCR spring Chinook salmon has increased. The lower Columbia River harvest schedule produced in the *U.S. v. Oregon* proceedings allows a sliding scale in spring Chinook salmon harvest. This means that a larger number of fish can be harvested with larger run sizes, while years with smaller run sizes would mean a smaller harvest. This recent increase in harvest is primarily due to greater runs to the Snake River. There have only been a few fisheries in the past that have targeted spring Chinook salmon in the UCR, including (1) state and tribal fisheries for excess hatchery-origin fish returning to the Leavenworth National Fish Hatchery on Icicle Creek in the Wenatchee River basin, (2) CCT tribal fisheries in the CJ Dam tailrace (targeting stray Carson stock spring Chinook salmon), and (3) state fisheries in the Entiat River. Total harvest rates have ranged from 5.5 percent to 17 percent based on run size, in accordance with harvest agreements under *U.S. v. Oregon* (*U.S. v. Oregon* Technical Advisory Committee 2008).

The CTCR manage a hook-and-line snag fishery immediately below CJ Dam that targets summer/fall-run Chinook salmon. Few, if any, spring Chinook salmon are incidentally caught in this fishery. In addition, the CTCR has experimented with selective fishing gear since 2007 to test the feasibility, and evaluate the costs and effectiveness, of 12 different live-capture fishing gears. Each of the methods continues to be evaluated, with the purse/beach seines, weir, tangle net, hoop net, and dip net having the strongest potential for catching fish and allowing non-target species to be released with the lowest potential for unintended mortality. The two methods with the highest release survival rate were the purse seine (100 percent) and the beach seine (99 percent) (Miller et al. 2013).

Harvest of returning hatchery fish through selective fisheries can also increase population viability through the removal of surplus hatchery-origin fish destined for spawning grounds (3.2.1.1). The harvest of listed and non-listed UCR spring Chinook salmon varies from year-to-year, depending on an abundance-based harvest schedule. Mainstem Columbia River fisheries have been evaluated and authorized under a separate opinion on the *U.S. v. Oregon* Management Agreement (NMFS 2008).

3.2.7.2. **Steelhead**

UCR steelhead are generally not caught in ocean fisheries (Pacific Fishery Management Council 2012) but are harvested in treaty and non-treaty fisheries in the mainstem Columbia River. From 1999 to 2007, total harvest rates on wild steelhead above Bonneville Dam ranged from 4.1 to 7.4 percent for treaty fisheries and 0.1 to 0.4 percent for non-treaty fisheries, in accordance with harvest agreements under *U.S. v. Oregon* (*U.S. v. Oregon* Technical Advisory Committee 2008). Non-treaty steelhead fisheries use mark-select methods, which require harvesters to release unmarked natural-origin fish. The purpose of WDFW sport fisheries in the upper Columbia River, including the Okanogan subbasin, has been to reduce the number of hatchery-origin steelhead spawners. The CTCR manage a hook-and line-snag fishery below CJ Dam that targets summer/fall-run Chinook salmon that can also incidentally impact steelhead. Natural Okanogan subbasin steelhead that are caught incidental to targeting other fish by the CTCR and in steelhead sport fisheries managed by WDFW is less than 5 percent total.

3.2.7.3. **Non-listed salmonids**

Treaty and non-treaty recreational and commercial fisheries exist for non-listed UCR summer/fall Chinook salmon and sockeye salmon in the Okanogan subbasin. These fisheries are regulated to avoid threatened UCR steelhead and endangered UCR Chinook salmon; however, they may incidentally catch natural-origin non-listed salmonids. There are strict regulations in Washington that limit the number of fish anglers may catch and gear type in many areas for non-treaty recreational fisheries. These restrictions exist to help conserve and prevent natural-origin salmonids from becoming ESA-listed in the future. Ocean harvest may also modify natural-origin salmonids through incidental catch; however, increased enforcement after the outlawing of drift nets in 1987 has likely minimized such incidental catch. The Pacific Salmon Treaty exists to provide the framework for the United States and Canada to conserve and manage Pacific Salmon stocks, which includes non-listed salmonids.

3.2.8. **Disease**

For all programs, the applicants' fish health policies govern how fish health is managed within a hatchery and throughout the state of Washington by controlling the movement of fish, fish eggs, and water. Fish are monitored regularly and treated as needed during their hatchery residence (IHOT 1995; NWIFC and WDFW 2006; USFWS 2004). The "Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State" (WDFW and NWIFC 1998) and Pacific Northwest Fish Health Protection Committee (Pacific Northwest Fish Health Protection Committee (PNFHPC) 1989) guidelines, are implemented to minimize the risk of fish disease amplification and transfer, and to ensure that hatchery fish would be released in good health.

3.2.9. **Population Viability**

The viable salmonid population (VSP) concept was developed by (McElhany et al. 2000). Population viability is measured in terms of four measurable population indicators in order to assess conservation status: abundance (number of natural-origin salmonid spawners), productivity (ratio of natural-origin salmonid offspring produced per parent), genetic diversity (genetic variation among members in a population), and spatial structure/distribution

(distribution of individuals in a population across a subbasin(s)). Some actions in the proposed TRMP may potentially increase or decrease natural-origin salmonid population viability.

3.2.9.1. **Spring Chinook Salmon**

UCR spring-run Chinook salmon were originally listed under the ESA as endangered in 1998 (affirmed 2005 and 2012). The UCR Spring Chinook Salmon ESU consists of three extant populations that spawn and rear in the Wenatchee, Entiat, and Methow River subbasins, including spring Chinook salmon propagated in several hatchery programs. Hatchery fish from the Carson stock, which was widely used in the Upper Columbia historically, are not part of the ESU and are excluded from the listing.

Abundance has been stable or increasing, on average, for all populations in this ESU over the last 10 years (NWFSC 2016), and current estimates of spawner abundance has increased in all three extant populations since the last status review in 2015 (NWFSC 2016). However, abundance and productivity levels for the three populations are below the viable thresholds and are, thus, still considered at high risk for extinction (Table **15**). The three populations are rated as low risk for spatial structure, but high risk for diversity criteria (Table **15**). All three populations remain at high risk (NWFSC 2016).

Table 15. Upper Columbia River spring Chinook salmon ESU population viability status summary. Current (2005-2014) abundance and productivity estimates are geometric means. Range in annual abundance, standard error and number of qualifying estimates for productivities in parentheses. Upward arrow = current estimate increased over prior review; oval = no change; downward arrow = estimate has decreased.

Population	ICTRT minimum threshold	Natural spawning abundance	ICTRT productivity	Abundance and productivity risk	Spatial Structure and Diversity risk	Overall viability rating
Wenatchee River	2,000	545 ↑ (311-1,030)	0.60 ↑ (0.27, 15/20)	High	High	High risk
Entiat River	500	166 ↑ (78-354)	0.94 ↑ (0.18, 12/20)	High	High	High risk
Methow River	2,000	379 ↑ (189-929)	0.46 ○ (0.31, 16/20)	High	High	High risk

Source: (NWFSC 2016)

3.2.9.2. Steelhead

UCR Steelhead DPS was originally listed as endangered in 1997 under the ESA. The DPS was reclassified as threatened in 2006, and its threatened status was reaffirmed in 2009 (74 FR 42605, August 24, 2009). The UCR Steelhead DPS consists of four extant populations that spawn and rear in the Wenatchee, Entiat, Methow, and Okanogan River subbasins, including steelhead propagated in hatchery programs.

While UCR steelhead populations show an increasing trend from the low levels in the 1990s, three out of the four populations have abundance and productivity below the viability thresholds (Table 16). There are high proportions of hatchery-origin returns in natural spawning areas across the DPS, primarily in the Methow and Okanogan River populations (NWFSC 2016). The improvements in natural-origin returns in recent years are likely result of several years of relatively good natural survival in the ocean and tributary habitats (NWFSC 2016). All four populations remain at high risk of extinction (NWFSC 2016).

Designated critical habitat for UCR steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to the Rock Island Dam as well as specific stream reaches in the Wenatchee, Entiat, Methow, and Okanogan River subbasins (70 FR 52630, January 2, 2006).

Table 16. Viability assessments for extant Upper Columbia Steelhead DPS populations. Current (2005-2014) abundance and productivity estimates are geometric means. Range in annual abundance, standard error and number of qualifying estimates for productivities in parentheses. Upward arrow = current estimate increased over prior review; oval = no change; downward arrow = estimate has decreased.

Population	ICTRT minimum threshold	Natural spawning abundance	ICTRT productivity	Abundance and productivity risk	Spatial structure and diversity risk	Overall viability rating
Wenatchee River	1,000	1,025 ↑ (386-2,235)	1.207 ○ (.021, 3/20)	Low	High	Maintained
Entiat River	500	146 ↑ (59-310)	0.434 ↓ (.22, 12/20)	High	High	High risk
Methow River	1,000	651 ↑ (365-1,105)	0.371 ○ (0.37, 3/20)	High	High	High risk
Okanogan River	750	189 ↑ (107-310)	0.154 ○ (.275, 6/20)	High	High	High risk

Source: (NWFSC 2016)

3.2.9.3. **Summer/Fall Chinook Salmon**

In 1998, NMFS determined that UCR summer/fall-run Chinook salmon were not in danger of extinction, nor likely to become endangered in the foreseeable future (63 FR 11482, March 9, 1998). WDFW assessed the Okanogan summer/fall-run Chinook salmon population, which is part of the UCR summer/fall Chinook salmon population, in 2002 based on redd counts in the Okanogan and Similkameen Rivers and concluded the stock was healthy. The "total spawner abundance for this stock continues to be strong" (WDFW 2002). Between 2003 and 2008, the adult returns have ranged between 114,500 and 373,200 fish (Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife 2009). However, a steady declining trend occurred from a high of 373,000 fish in 2003 to a low of 114,000 fish in 2007, while the 2008 return was higher at 197,300 fish.

Critical habitat has not been designated for the UCR summer/fall-run Chinook salmon because the ESU is not ESA-listed.

3.2.9.4. **Sockeye Salmon**

Information on population viability of sockeye salmon was largely incorporated from the Okaongan 10J FEA (NMFS 2014b); therefore, refer to this document for additional information regarding references in this section. Sockeye salmon in the Columbia River Basin once comprised at least eight principal stocks (Fulton 1970; Fryer 1995). Today, only three stocks remain in the Columbia River Basin: Wenatchee Lake, Okanogan River, and Redfish Lake. The Okanogan River sockeye salmon population is the healthiest and makes up over 50 percent of the remaining wild sockeye salmon in the Columbia River Basin.

There is no critical habitat designated for the Okanogan sockeye salmon because the ESU is not ESA-listed.

Over the last 25 years, the Okanogan sockeye salmon run size at Wells Dam has varied from a low of 1,666 in 1994 to a high of 326,107 in 2012; the return in 2013 was 129,993.

3.2.10. **Nutrients**

Salmon and steelhead are important transporters of marine-derived nutrients into the freshwater and terrestrial systems through the decomposition of fish carcasses (1996; Cederholm et al. 2000). The decreased abundance of natural-origin salmon and steelhead from fisheries likely translates into a reduction of nutrient cycling between marine, freshwater, and terrestrial ecosystems. The return of hatchery-origin adults to freshwater areas increases nutrient cycling compared to what the remaining natural-origin fish supply, to the extent that hatchery-origin adults are allowed to move into, or are released as spawners or carcasses in, areas where their carcasses provide nutrition for juvenile salmonids or their prey items.

3.2.11. **Research, Monitoring, and Evaluation (RM&E)**

There are four monitoring programs currently being operated that can be used to assess the effects of the activities described in the Proposed Action of the TRMP. The CJ Hatchery, OBMEP, and Omak Creek steelhead programs could interact with salmon and steelhead through capturing and PIT tagging natural-origin salmonids using screw traps, beach seines, electrofishing, harassment activities (spawning surveys, habitat surveys, carcass sampling, rotary screw traps), adult enumeration through weirs, and hook-and-line surveys. For discussion of the potential environmental impacts associated with weirs, refer to Facility Operations (Subsection3.2.5, Facility Operations) of this document. Moreover, the CJ Hatchery FEIS (BPA et al. 2009) discusses in greater detail these RM&E activities associate with the CJ Hatchery. Sturgeon RM&E poses threat to sturgeon through the use of set lines baited with pickled squid, D-ring plankton nets, stationary bottom trawl, towed bottom beam trawl, small-mesh gill nets, artificial substrates (for eggs), and hook-and-line angling. However, physical harm done to fish is likely to be minimal, because the target species (white sturgeon) is very hardy.

Sturgeon RM&E is highly selective with certain gear types to only monitor white sturgeon, thus there are likely zero to very minimal incidental catch of salmon and steelhead in this program. Therefore, the only direct threat from this program is on sturgeon.

These programs are beneficial to ESA-listed and non-listed salmonids in the project area by providing information necessary to determine the potential negative genetic effects on natural-origin fish. Furthermore, the proposed Sturgeon RM&E program is potentially beneficial to white sturgeon, as these efforts will likely obtain useful ecological, population, and individual level biological information on sturgeon in the project area.

3.3. Other fish species

Other fish species exist in the analysis area that may be influenced by the Proposed Actions in this TRMP. Approximately sixty other species of fish live in the Columbia River and tributaries. Nearly half are native species primarily of the families Salmonidae, Catastomidae, Cyprinidae, and Cottidae. White sturgeon (*Acipenser transmontanus*) occur in the mainstem Columbia River and feed on detritus found on the bottom of the river. The Columbia River Basin also supports at least 25 introduced species mainly representing Percidae, Centrarchidae, and Ictaluridae. Most of the introduced species are game fish, which are the targets of fisheries that could incidentally encounter anadromous salmonids. It is unlikely that salmonid fisheries will encounter other fish species; however, if caught, all other fish species will be released as soon as they are landed. The potential interaction of other fish species with the Okanogan basin salmon and steelhead are summarized below in Table **17**.

Table 17. Other fish species in the analysis area and their relationship with Okanogan basin salmon and steelhead.

Species	Range	Federal/State Listing Status	Relationship		
			Prey	Competitor	Predator
Freshwater resident fish					
Pacific and Western brook lamprey	Coastal rivers and streams, Columbia River basin	Federal species of concern; state monitored species	√	√	√
Bull trout	Widespread	Federal threatened species	√	√	√
Redband trout	Columbia River basin	Federal species of concern	√	√	√
Westslope cutthroat trout	Widespread	Federal species of concern	√	√	√
Leopard dace	Columbia and Frasier River basin	Federal candidate species	√		
Umatilla dace	Columbia River basin	Federal candidate species	√		
Green and White Sturgeon	Coastal rivers, Columbia River basin	Green sturgeon: Southern DPS is a Federal threatened species; northern DPS is a Federal species of concern			√ (salmonid carcasses)
Three-spine stickleback	Widespread	None	√	√	
Rainbow trout	Widespread	None	√	√	√
Brown trout	Widespread	None	√	√	√
Freshwater introduced fish					
Lahonton cutthroat trout	Widespread	None	√	√	√
Grass carp	Widespread	None	√	√	√
Brook trout	Widespread	None	√	√	√
Smallmouth bass	Widespread	None	√	√	√
Largemouth bass	Widespread	None	√	√	√

Sources: (NMFS 2014a; Wydoski and Whitney 1979)

Bull trout are another ESA-listed fish species that may be present in the analysis area. Bull trout in the Columbia River Basin were listed as threatened on June 10, 1998 (63 FR 31647). The Columbia River population segment encompasses a vast geographic area, including portions of Idaho, Montana, Oregon, Washington, and British Columbia. Bull trout are present, and locally common, in most of the habitat occupied by anadromous fish in the upper Columbia River Basin. However, no self-sustaining bull trout populations have been identified in the Okanogan River watershed, though occasional encounters with bull trout have occurred. For further information regarding bull trout, refer to the Okanogan 10(j) EA (NMFS 2014b).

Lamprey are another fish species that may be present in the analysis area. Pacific lamprey and river lamprey are native to the Okanogan subbasin, and are Federal "species of concern". Lamprey are anadromous and parasitic jawless fishes. There is no commercial harvest allowed for Pacific lamprey. However, lamprey are considered culturally important to many tribes, and tribal harvest occurs. Pacific lamprey are believed to have declined to a remnant of their population prior to human development, and river lamprey are considered to be at "dangerously low numbers" and not present at many historical sites within the Columbia River Basin (Kostow 2002). Lamprey are susceptible to similar listing threats as salmonids, including barriers to passage, reduced access to spawning habitat, degradation of spawning and rearing areas, loss of emigrating juveniles to turbine entrainment, and the presence of nonindigenous predators (Kostow 2002). While lamprey prey on salmonids, they also act as a preferred food source to marine mammals, thus acting as a buffer for upstream-migrating adult salmon and steelhead.

This TRMP includes resident fish fisheries that target largemouth and smallmouth bass, burbot, walleye, whitefish, crappie, catfish, perch, sunfish, and trout. None of the targeted fish in the proposed resident fisheries are ESA-listed, and all populations are within a healthy range.

3.4. Wildlife

The Okanogan subbasin is home to a wide variety of wildlife species that inhabit and utilize riparian areas. A complete discussion of the species present and their habitat utilization is presented in the Okanogan 10(j) EA (NMFS 2014b), the Mitchell Act FEIS (NMFS 2014c), and the CJ Hatchery FEIS (BPA et al. 2009). The analysis area for wildlife is limited to the project area because interactions outside of this area are not likely to be substantially influenced by the proposed actions. As such, marine mammals are not considered in this analysis because these species do not exist within the project area.

In the upper reaches of the Methow and Okanogan Rivers, and in the tributaries of these rivers, faster flowing, small streams bordered by riparian forest are present. These upper reaches provide habitat for a variety of riparian forest and stream associated wildlife, such as American dippers (*Cinclus mexicanus*), Steller's jays (*Cyanocitta stelleri*), ruby-crowned kinglets (*Regulus calendula*), and tailed frogs (*Ascaphus truei*). Bald eagles (*Haliaeetus leucocephalus*) use these watersheds during winter and early spring months. The tributaries of the Methow and Okanogan Rivers extend into remote areas where species such as bobcats (*Lynx rufus*) and mountain lions (*Felis concolor*) are expected to be more common than in developed areas. Fishery, RM&E, and predator control activities as well as hatchery operations have the potential to influence wildlife by changing the total abundance of salmon and steelhead in aquatic and marine environments. Changes in the abundance of salmon can modify wildlife through predator/prey interactions.

Salmonids provide direct or indirect foraging opportunities for these species, in some cases to the extent of influencing the distribution or population status of a particular species (Cederholm et al. 2000). Wildlife species that prey on fish consume juvenile salmonids where encountered, benefiting the survival and productivity of the wildlife species through the nourishment provided. Many wildlife species also feed on salmon carcasses in the watersheds and subsequently bring marine derived nutrients from the salmon into the terrestrial ecosystem (i.e., nutrient cycling). For example, common mergansers (*Mergus merganser*) may congregate to feed on salmon fry when they are available (Cederholm et al. 2000). Turkey vultures (*Cathartes*

aura), in contrast, routinely feed on salmon carcasses as well as many other items, and are unlikely to respond strongly to changes in the availability of salmonids as a food source (Cederholm et al. 2000). An example of a species with an indirect link to salmonids is the American dipper (*Cinclus mexicanus*), which feeds on aquatic insects that benefit from nutrients derived from salmon carcasses (Cederholm et al. 2000). Because the availability of salmon varies seasonally, most species that directly consume salmon likely have flexible foraging strategies, eating salmon when they are available and alternate food sources at other times (Cederholm et al. 2000). Information about the number and distribution of salmon carcasses in the Okanogan subbasin is not available. Several wildlife species that may forage on salmonids are designated under state or Federal law as being at risk (Table 18).

Table 18. Special-status species of wildlife in the Okanogan subbasin that consume salmonids.

Species	Federal Status	State Status
Common loon (*Gavia immer*)	None	Sensitive
Bald eagle (*Haliaeetus leucocephalus*)	Species of Concern	Sensitive
Golden eagle (*Aquila chrysaetos*)	None	Candidate
Gray wolf (*Canis lupus*)	Endangered[1]	Endangered
Grizzly bear (*Ursus arctos horribilis*)	Threatened	Endangered

Sources: IBIS 2008, Cederholm et al. 2000

[1] USFWS removed wolves east of Highway 97 in Okanogan County from ESA protection in 2011, but retained the species' status as endangered west of the highway and proposed delisting the remainder of wolves on 6/13/13. http://www.gpo.gov/fdsys/pkg/FR-2013-06-13/pdf/2013-13982.pdf.

The 1964 Wilderness Act directs Federal agencies to manage wilderness so as to preserve its wilderness character. Lands classified as wilderness through the Wilderness Act may be under the jurisdiction of the U.S. Forest Service, National Park Service, U.S. Fish and Wildlife Service, or the U.S. Bureau of Land Management. The Pasayten wilderness area was designated in 1968 and has 531,375 acres, all of it in Washington. This is the only wilderness area that may overlap with the action area discussed in this EA. Wildlife within this wilderness area has been considered during our analysis of resources in Section 4.

In addition, marine life present in areas downstream near the mouth of the Columbia River may prey on Methow and Okanogan subbasin-origin salmon and steelhead. Marine mammals Federally protected under the Marine Mammal Protection Act present in these areas include harbor seals, Steller sea lions, California sea lions, northern sea otters, harbor porpoises, Dall's porpoises, Pacific white-sided dolphins, and southern resident killer whales. Steller sea lions are listed under the ESA as threatened and southern resident killer whale are listed under the Federal ESA as endangered. Although these marine mammals are not found in the Upper Columbia River mainstem (above Bonneville Dam) or freshwater tributaries in the Methow and Okanogan watersheds, they may intercept salmon returning to the basin when feeding in adjacent marine

waters or the Pacific Ocean. Great white sharks (*Carcharodon carcharias*) and salmon sharks (*Lamna ditropis*) also feed in coastal areas near the mouth of the Columbia River, and may occasionally prey on Methow and Okanogan subbasin-origin salmonids. Furthermore, seabirds may additionally prey on juvenile salmonids.

The Marine Mammal Protection Act of 1972 (16 U.S.C. §§1361-1407) as amended, establishes a national policy designated to protect and conserve wild marine mammals and their habitats. This policy was established so as not to diminish such species or populations beyond the point at which they cease to be a significant functioning element in the ecosystem, nor to diminish such species below their optimum sustainable population. All marine mammals in the U.S. are protected under the Marine Mammal Protection Act. NMFS is responsible for reviewing Federal actions for compliance with the Marine Mammal Protection Act. Fisheries, research and monitoring, and predator control activities as well as changes in hatchery production have the potential to indirectly affect marine mammals by altering the number of available prey (salmon and steelhead).

3.5. Socioeconomics

Information on socioeconomics was largely incorporated from the Okanogan 10j FEA (NMFS 2014b); therefore, refer to this document for additional information regarding references in this section.

The United States portion of the Okanogan River is located entirely within Okanogan County, while the segment of the mainstem Columbia River between the Okanogan River mouth and CJ Dam is within Okanogan and Douglas Counties. The Colville Reservation is bounded to the west by the Okanogan River and to the south by the Columbia River. Discussions in this subsection include socioeconomic information specific to the Colville Reservation where that information is available.

The analysis area for socioeconomics comprises Okanogan and Douglas Counties, as well as the Colville Reservation, because the Proposed Action would most likely effect local residents within these areas. Businesses and residents in other counties are unlikely to be affected to a noticeable degree by differences in the availability of fish resources because the socioeconomic benefits associated with fishing are typically realized primarily in the communities closest to fishing opportunities.

Douglas and Okanogan Counties and the Colville Reservation are relatively sparsely populated (Table 19). Refer to the Okanogan 10(j) EA (NMFS 2014b) for additional information regarding populations in Douglas and Okanogan Counties, communities, the Colville Reservation, and the State of Washington.

Table 19. Average monthly employment and per capita income Douglas and Okanogan Counties, the Colville Reservation, and the State of Washington.

Parameter	Douglas County	Okanogan County	Colville Reservation	State of Washington

Average Monthly Employment (2010)	10,823	17,329	N/A[1]	2,808,445
Per Capita Income (2009) ($)	29,565	32,136	N/A[1]	42,870

Source: State of Washington Office of Financial Management 2012
[1] N/A = Not available.

Average monthly employment in 2010 was 10,823 persons (28 percent of total population) in Douglas County and 17,329 persons (42 percent of total population) in Okanogan County. The per capita income for both counties is less than for the entire state (Table 19). As shown in Table 20, the employment sector with the highest average monthly number of employees for each of the counties is agriculture, forestry, fishing, and hunting, although this sector has the second-highest total amount of wages paid and one of the lowest average wages paid. The distribution of employees and wages paid by sector (Table 20), along with unemployment trends, indicate that much of the employment in the analysis area is seasonal (summer) and that many residents are not employed year-around, especially in Okanogan County. The four sectors most closely tied to seasonal employment (agriculture, forestry, fishing, and hunting; wholesale/retail trade; arts, entertainment, and recreation; and accommodation and food services) account for more than half of the total number of employees in each county (Table 20).

Table 20. Average monthly number of employees, total wages paid, and average wages paid by employment sector for Douglas and Okanogan Counties, 2010.

Employment Sector	Douglas County			Okanogan County		
	Employees	Wages ($)	Average Wages ($)[1]	Employees	Wages ($)	Average Wages ($)[1]
Agriculture, Forestry, Fishing, Hunting	3,038	51,712,560	17,022	5,560	82,342,788	14,810
Mining	--[2]	--	--	180	11,987,732	66,599
Utilities	*[3]	*	*	41	1,762,578	42,990
Construction	446	16,509,121	37,016	454	12,616,074	27,789
Manufacturing	356	15,235,299	42,796	348	8,927,984	25,655
Wholesale/Retail Trade	1,708	49,652,243	29,070	1,994	46,791,128	23,466
Transportation and Warehousing	281	9,688,839	34,480	89	3,053,287	34,307
Information	146	7,117,117	48,747	135	4,120,634	30,523
Finance, Insurance, and Real Estate	262	8,075,939	30,824	332	8,388,742	25,267
Professional and Technical Services	214	12,027,259	56,202	196	5,979,652	30,508

Management of Companies and Enterprises	*	*	*	34	1,501,095	44,150
Administrative and Waste Services	199	3,698,004	18,583	170	3,781,945	22,247
Education Services	*	*	*	37	538,836	14,563
Health Care and Social Assistance	629	18,327,885	29,138	1,173	35,536,927	30,296
Arts, Entertainment, and Recreation	342	5,980,378	17,486	106	1,713,767	16,168
Accommodation and Food Services	723	9,052,487	12,521	1,083	15,749,338	14,542
Other Services, Except Public Administration	308	4,220,459	13,703	658	9,015,809	13,702
Total Government	2,136	100,037,982	46,834	4,738	185,693,097	39,192
Not Elsewhere Classified	35	1,575,615	45,018	--	--	--
Total	10,823	312,911,187	28,912	17,329	439,501,413	25,362

Source: State of Washington Office of Financial Management 2012

[1] Total wages paid divided by average monthly number of employees.

Although comparable data are not readily available for the Colville Reservation, analogous information can be drawn from the Tribe's *Community Economic Development Strategies* planning document (CTCR 2012a). The CTCR employs approximately 1,500 people annually, with employment levels varying by season. The Colville Tribal Government is one of the largest employers in north-central Washington, providing almost 1,000 full-time jobs. The businesses of the Colville Tribal Enterprise Corporation and the Colville Tribal Federal Corporation employ around 500 persons (CTCR 2012a). Based on data from the 2010 United States census, the unemployment rate for the CTCR was higher than the statewide rate and the rate in Okanogan County (CTCR 2012a). Unemployment rates on tribal reservations are commonly higher than in surrounding areas (CTCR 2012a). Please refer to the M Mitchell Act FEIS (NMFS 2014c) for additional information regarding fisheries socioeconomics.

3.6. Environmental Justice

In 1994, the President issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low-income Populations*. The objectives of the Executive Order include developing Federal agency implementation strategies, identifying minority and low-income populations where proposed Federal actions could have disproportionately high and adverse human health and environmental effects, and encouraging the participation of minority and low-income populations in the NEPA process. Fisheries and research and monitoring activities, and changes in hatchery production have the potential to affect the extent of harvest available for minority and low-income populations.

Environmental justice is defined as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (cite to https://www.epa.gov/environmentaljustice). As such, environmental justice analysis necessitates the analysis of using thresholds to determine whether a disproportionately high and adverse human health or environmental effects of a program exist on minority populations and low-income populations, referred to as the environmental justice communities of concern. Moreover, EPA guidance extends beyond statistical threshold analyses to consider explicit environmental justice effects on Native American tribes (EPA 1998).

Under all alternatives, tribal treaty commercial and ceremonial and subsistence and recreational harvest opportunities for all population segments must be examined. Overall fishing opportunities and potential fishing opportunities for low-income persons would also be analyzed. Tribal treaty commercial and ceremonial and subsistence and recreational harvest opportunities for all population segments could be reduced and fishing opportunities and potential fishing opportunities for low-income persons could be impacted as well. Refer to the Okanogan 10(j) EA (NMFS 2014b), the Mitchell Act FEIS (NMFS 2014c), and the CJ Hatchery FEIS (BPA et al. 2009) for a more in depth discussion of Environmental Justice in the analysis area.

3.7. Cultural Resources

Salmon are a core symbol of tribal identity, individual identity, and the ability of the tribes to endure (NMFS 2005; NWIFC 2013). The survival and well-being of salmon is seen as inextricably linked to the survival and well-being of Native American people and the cultures of the tribes (NMFS 2005). As previously discussed, over-fishing, hydropower development, and habitat degradation resulted in the extirpation of UCR spring-run Chinook salmon and depressed returns of the remaining Chinook salmon and steelhead in the Okanogan Subbasin (Subsection 1.1.2, Upper Columbia Spring-run Chinook Salmon ESA Listing). As stated in the CJ Hatchery FEIS, "the remaining Okanogan and Columbia River fishery is inadequate to meet ceremonial and subsistence needs of tribal members" (BPA 2009).

The CTCR Colville Business Council approves fishing regulations, as it deems proper and necessary, to carry out policies of the CTCR. These fishing regulations are in the best interest of preserving, protecting, and perpetuating the anadromous fishery cultural resources on the Colville Reservation, North Half, and other waters within their usual and accustomed areas (CTCR 2014c).

Tribal fishing rights have been established through various court cases including *U.S. v. Oregon*, *Antoine v. Washington*, and Secretarial Order 3206. Moreover, The Federal Trust Responsibility exists to require Federal agencies to protect Indian treaty rights whilst performing duties.

U.S. v. Oregon legally upheld the Columbia River Treaty Tribes' reserved fishing rights and tribal entitlement to a fair share of fish runs and remains under the Federal court's continuing jurisdiction. Judge Belloni applied the 50-percent standard of the tribes' fair and equitable share from *U.S. v. Washington* to *U.S. v. Oregon in 1975*. In 1988, the cooperatively negotiated *Columbia River Fish Management Agreement* (Management Agreement) was adopted by the

Federal court, which included a detailed harvest and fish production process. The most current Management Agreement was adopted by the Federal court in 2008 and will be in place for 10 years (NMFS 2008). The governing Management Agreement has been cooperatively negotiated by the Federal and state governments and the involved treaty Indian tribes under the continuing jurisdiction of the Federal court to ensure implementation of tribal fishing rights. Although the CTCR are not a treaty tribe, they coordinate closely with WDFW and the other Federally-recognized tribes in the portion of the fish available for harvest by non-treaty Indian tribes.

The nature of the CTCR tribal rights reserved are described in the U.S. Supreme Court's decision in *Antoine v. Washington* (420 U.S. 194; 1975). The ruling was that the hunting and fishing rights reserved by the CTCR in the 1891 Agreement were in full force and effect. Congress's method of ratification in 1891 had the same Supremacy Clause effect as a treaty to pre-empt State regulation of tribal hunting and fishing activities. Executive Order 1872, reserved Federal water rights to the Tribes for fisheries preservation and irrigated agriculture. The U.S Court of Appeals for the Ninth Circuit (*Confederated Tribes of the Colville Reservation v. Walton*, 647 F.2d 42, 44, 46-7, 9th Cir. 1981) concluded that one of the reasons for the Indians to confine themselves to the Colville Reservation (and give up valuable tracts of land with improvements outside the Reservation) was to secure access to traditional salmon fisheries in the Columbia River and its tributaries (CTCR 2014a).

The U. S. government has a trust or special relationship with Indian tribes. The unique and distinctive political relationship between the U. S. and Indian Tribes is defined by statutes, executive orders, judicial decisions, and agreements and differentiates tribes from other entities that deal with, or are affected by the Federal government. Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, states that the U.S. has recognized Indian tribes as domestic dependent nations under its protection. Secretarial Order on American Indian Tribal Rights, Federal Tribal Trust Responsibilities and the ESA issued by the Secretaries of the Departments of Interior and Commerce (numbered by the Department of Interior as Secretarial Order 3206), clarifies the responsibilities of the Departments when actions taken under the ESA affect, or may affect, Indian lands, tribal trust resources, or American Indian tribal rights as they are defined in the Order. The trust responsibility has been interpreted to require Federal agencies to carry out their activities in a manner that is protective of Indian treaty rights (Brown 1995).

3.8. Human Health and Safety

Refer to the Okanogan 10(j) EA (NMFS 2014b), the Mitchell Act FEIS (NMFS 2014c), and the CJ Hatchery FEIS (BPA et al. 2009) for a discussion of the potential risks to human health from hatchery facility operations including common chemicals used, safe handling of those chemicals, potential toxic contaminants in hatchery-origin fish, and potential pathogens transmitted from handling hatchery-origin fish. Compliance with safety programs, rules and regulations, and the use of personal protective equipment limits the spread of pathogens and the potential risk to human health, but accidental skin contact and needle-stick injuries involving infected fish are potential human health risks for hatchery personnel. In addition, the minimal use of therapeutics in the United States and application of therapeutics in compliance with manufacturers' directions further limit the risk hatcheries pose to human health and the environment. However, locally high concentrations could occur depending on the nature of the receiving environment if therapeutics are needed to control or prevent a disease outbreak.

Another risk to human health is contaminant exposure through consumption. This risk is directly associated with the frequency of consuming fish, regardless of whether fish are of hatchery-origin or natural-origin; people who eat more fish are at higher risk of contaminant exposure (U.S. Environmental Protection Agency (EPA) 1999; Washington Department of Ecology (Ecology) 2013).

4. ENVIRONMENTAL CONSEQUENCES

This chapter provides an analysis of the direct and indirect environmental effects associated with the alternatives on the eight resource categories. The effects of Alternative 1 are described relative to current conditions are likely to appear into the future under continued implementation of the programs (Chapter 3). The effects of the other alternatives are described relative to Alternative 1 (No-Action). Where applicable, NMFS describes the relative magnitude of impacts using the following terms:

Undetectable – The impact would not be detectable.
Negligible – The impact would be at the lower levels of detection.
Low – The impact would be slight, but detectable.
Medium – The impact would be readily apparent.
High – The impact would be severe.

The aspects of critical habitat as defined by the ESA that may be affected include adequate water quantity and quality and freedom from excessive predation (WRIA 1 Salmon Recovery Board). Potential effects on critical habitat as defined by the ESA are analyzed in this EA in the broader discussion of impacts on habitat (Subsections 4.1, Water Quality; 4.2, Salmon and Steelhead; 4.3, Other Fish Species; and 4.4, Wildlife).

Note that the environmental effects of CJ Hatchery program activities are reviewed in more detail in the CJ Hatchery FEIS (BPA et al. 2009). Refer to this document for a more detailed description on the previous analyses done for these hatchery programs.

4.1. Water Quality

Table 21. Summary of change in effects on water quality relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Resource	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
Water Quality	Negligible-adverse	No change	Negligible-beneficial	No change

Under Alternative 1 (No Action), the CJ Hatchery programs would have the same production levels as under current conditions, so there would be no expected change in the discharge of ammonia, nutrients (e.g., nitrogen), biological oxygen demand, pH, suspended solid levels, antibiotics, fungicides, disinfectants, steroid hormones, pathogens, anesthetics, pesticides, herbicides, and temperature in the Okanogan subbasin analysis area annually. However, there

may be a potential accumulation of nutrients and chemicals from effluent in the aquatic environment. The level of accumulation depends upon the life expectancy of each substance and the uptake of those substances by biological organisms. Current fisheries and RM&E programs do not discharge detectable amounts of discharge. Overall, the risk of potential discharge accumulation in the environment results in a negligible adverse effect.

Under Alternative 2, the CJ Hatchery programs would have a very slight increased production level due to increased production from the Okanogan Basin Summer Steelhead Conservation Program, which utilizes acclimation ponds in the project area. Regardless, this activity would not increase production or change operations enough to alter water quality. The addition of the CJ Dam tailrace fishery, the sturgeon Wells pool RM&E program, the steelhead kelt reconditioning project, and the predator fish removal program would not result in a change in water quality relative to Alternative 1 because none of these activities discharge detectable additional effluent and are not likely to affect water quality. Overall, the current and continued compliance with fish health policies minimizes the potential for additional nutrients and chemicals in the effluent, resulting in no expected change in water quality relative to Alternative 1.

Under Alternative 3, the actions described in the TRMP would be terminated immediately, reducing nutrient and chemical discharge from CJ Hatchery and its related facilities over the short and long term. Termination of fisheries, RM&E, predator removal programs, and kelt reconditioning projects are not likely to change water quality in the environment. The termination of the proposed hatchery programs would likely improve water quality in the Okanogan and Columbia Rivers, and therefore, the effect on water quality improves slightly to a negligible beneficial effect relative to Alternative 1.

Under Alternative 4, the decreased production of steelhead, summer/fall and spring Chinook salmon by 50 percent may reduce the total amount of discharge of chemicals and nutrients from the hatchery facilitates relative to Alternative 1. However, because these hatchery facilities and programs would still largely be in operation, there would be no change in measurable effects relative to Alternative 1.

4.2. Salmon and Steelhead

This section compares effects from the hatchery program and associated actions under each alternative on natural salmon and steelhead populations in the project area.

4.2.1. Genetics

Table 22. Summary of change in genetic effects on natural-origin salmon and steelhead relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Species	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
UCR spring Chinook salmon	Negligible-adverse	No change	Negligible-beneficial	Negligible-beneficial

UCR Steelhead	Low-adverse	Low-beneficial	Low-beneficial	Negligible-beneficial
UCR summer/fall Chinook salmon	Low-adverse	No change	Low-beneficial	Negligible-beneficial
UCR sockeye salmon	Undetectable	No change	No change	No change

Under Alternative 1, the activities would be operated the same as under current conditions. Current conditions include hatchery programs, fisheries, RM&E, predator control, and kelt reconditioning covered in the CJ Hatchery FEIS (BPA et al. 2009) and the (NMFS 2014b). The current hatchery operations would have the largest genetic influence on natural fish among the alternatives. Currently, spring and summer/fall Chinook salmon and steelhead are collected for broodstock in the Okanogan and Columbia Rivers, summer/fall Chinook salmon and steelhead are managed as adults in the Okanogan and Columbia Rivers, spring Chinook salmon are managed as adults in the Columbia River, spring and summer/fall Chinook salmon are reared as juveniles at the CJ Hatchery, spring Chinook salmon are acclimated/released at the CJ Hatchery, summer/fall Chinook salmon are acclimated/released at the CJ Hatchery and in the Okanogan subbasin, and steelhead are acclimated/released into the Okanogan subbasin. Because all of these actions are currently happening, there would not likely be a change in genetic effects of the hatchery programs relative to current conditions. Over time, genetic effects of hatchery programs may be cumulative and could result in lowered fitness in the natural environment. If higher percentages of hatchery-origin spawners occur on spawning grounds, measured as pHOS, than natural-origin fish, hatchery-influenced selection may alter the integrity of natural-origin fish genetics. These details are covered in Section 3.2.1. Furthermore, the CJ Hatchery FEIS (BPA et al. 2009) analyzed these effects from past actions in greater detail. Therefore, any new actions are analyzed after these programs were already in operation. The current genetic effects on:

- UCR natural-origin spring Chinook salmon are negligible adverse because spring Chinook are functionally extirpated within the action area, and therefore spawning abundance is very low in the Okanogan subbasin. However, because Carson stock from the Leavenworth Hatchery are used as broodstock (not ESA-listed), there may be a small effect on the few spring Chinook within the action area.
- UCR natural-origin steelhead are low adverse because they are genetically indistinguishable from the hatchery-origin steelhead being reared. Mating with hatchery-origin fish could initiate hatchery-influenced selection, potentially resulting in reduced fitness, thus, there may be negative effects from hatchery rearing practices. Currently, this program uses Wells Hatchery broodstock. According to the NMFS Status Review (NWFSC 2015), the Okanogan steelhead population has a five-year mean of fraction natural origin of 0.13 for the years 2010-2014, meaning pHOS is likely 0.87. This pHOS is high, though the Natural Spawning Abundance is only 189 fish. Therefore, while the risk of genetic effects is present, it must be considered in the context of other risks, such as low abundance, which the hatchery programs attempt to address.

- UCR summer/fall Chinook salmon are low adverse because they are also genetically indistinguishable from hatchery-origin fish. Hatchery-influenced selection is also a risk for this species. According to the CJ Hatchery Program 2013 Annual Report (Baldwin et al. 2016), pHOS levels were at 0.27, meaning they currently fall within recommended levels (under 0.30). Moreover, this UCR Summer/fall Chinook ESU is not currently at risk of going extinct. While these genetic effects should be monitored, they are not a serious concern at the present time.
- UCR sockeye are undetectable because the applicants do not currently operate sockeye hatchery programs, which could produce fish capable of interbreeding with natural-origin sockeye salmon.

Under Alternative 2, all of the hatchery production would continue, so genetic effects should not appreciably change from Alternative 1. The Okanogan Basin Summer Steelhead Conservation Program and the proposed kelt reconditioning program would propagate future generations of steelhead in the Okanogan subbasin. Eventually, the Okanogan Basin Summer Steelhead Conservation Program would use 100 percent natural-origin broodstock from the Okanogan subbasin, with the goals of PNI greater than 0.67 and pHOS of less than 0.30. However, this program does not allow for mate selection, thus limiting natural processes contributing to the genetics of this population. The kelt reconditioning program poses no serious genetic threat to the population because natural-origin fish are released back into stream to be able to select a mate. The genetic effects on UCR steelhead from the proposed programs are low beneficial relative to Alternative 1, as soon as natural-origin broodstock goals are met. For the other salmonids, there is no change in genetic effects relative to Alternative 1 because the hatchery programs would be operated the same as under Alternative 1.

Under Alternative 3, the hatchery programs and associated activities would be terminated immediately. Thus, the immediate and long-term negative hatchery effects (i.e., hatchery-influenced selection) would be eliminated. The projected pHOS levels upon program elimination would eventually be zero, after all hatchery-origin fish had returned to spawn because no new fish would be released. The hatchery-origin fish recently released would still return as adults in four to five years; thus, it would take four to five years before the pHOS levels would be eliminated. It is difficult to quantify how many generations it would take for genetic fitness effects to fully reverse themselves; however, after the population would immediately begin to recover after the last hatchery-origin fish returned. For UCR spring Chinook salmon, the effects would be negligible beneficial relative to Alternative 1 because no Carson stock spring Chinook salmon would be available to potentially interbreed with natural-origin spring Chinook salmon. With UCR steelhead and summer/fall Chinook salmon, these effects would be low beneficial, compared to Alternative 1 because eventually, no hatchery-origin fish would mate with natural-origin fish. There would likely be no change in genetic effects on UCR sockeye relative to Alternative 1.

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent would potentially reduce genetic effects on salmonids in the project area; however, they would not be completely eliminated as the hatchery program operations would continue. The new expected pHOS levels are difficult to quantify, as hatchery-and natural-origin returns in those years would need to be projected before any meaningful calculations could be

made. However, we expect the pHOS levels to be roughly 50 percent of the impact as current conditions. For spring Chinook salmon, we would not expect there to be meaningful changes in pHOS, since these are functionally extirpated in the Okanogan subbasin. The pHOS levels would likely be lower than the estimated 0.87 for the Okanogan steelhead population; however, this could reduce the natural-origin spawning abundance to very low levels. Moreover, the summer/fall Chinook pHOS would continue to fall under the recommended 0.30 levels. Because the returns of adults from all the programs are expected to be reduced by 50 percent relative to Alternative 1, the effects would be low beneficial for UCR spring Chinook, negligible beneficial for both steelhead and summer/fall Chinook, and there would be no change in genetic effects on sockeye.

4.2.2. **Life History**

Table 23. Summary of change in life history effects on natural-origin salmon and steelhead relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Species	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
UCR spring Chinook salmon	Low-adverse	Low-adverse	Medium-beneficial	Low-beneficial
UCR Steelhead	Low-adverse	Low-adverse	Medium-beneficial	Low-beneficial
UCR summer/fall Chinook salmon	Low-adverse	No change	Low-beneficial	Negligible-beneficial
UCR Sockeye	Undetectable	No change	No change	No change

Under Alternative 1, the hatchery, fisheries, and RM&E activities described in the TRMP would be operated the same as under current conditions. Therefore, there would be no change in life history effects of the hatchery programs relative to current conditions. Over time, life history effects of hatchery programs may be cumulative and result in lowered fitness characteristics like altered migration timing, early maturation, decreased fecundity, lower smolt-to-adult returns, etc., which may be irreversible. The CJ Hatchery FEIS (BPA et al. 2009) analyzed these effects from past actions in greater detail, therefore any new actions are analyzed after these programs were already in effect. While life history traits are often phenotypically plastic and can change due to fisheries and hatchery systems, they can also be linked to genetic traits if conditions are severe enough to cause evolutionary effects over time. Potential changes in traits are expected to generally mirror potential genetic effects (Subsection 4.2.1, Genetics). The effects on:

- UCR natural-origin spring Chinook salmon are low adverse because 700,000 Carson stock spring Chinook smolt are proposed for release in the Columbia River in the future. These yearlings are roughly 33 percent larger than naturally occurring yearlings. Thus, hatchery-origin spring Chinook salmon yearlings may have increased growth rates compared to natural-origin fish, which could, in turn, increase early maturation, decrease fecundity, affect smolt-to-adult return rates, and migration timing in natural-origin fish. If these traits are heritable, interbreeding could potentially pass these traits on to future progeny. The use of size and gear selective fisheries may also alter life history traits, leading to a size truncation in a population with less fecund adults spawning.
- UCR natural-origin steelhead are low adverse because they are largely indistinguishable from the hatchery-origin steelhead being reared. 80,000 hatchery-origin steelhead would be released in the project area annually that could potentially interbreed with natural-origin fish and influence the life history traits of future generations. Yearling steelhead from nearby locations are roughly one third the size larger than naturally occurring yearlings. Thus, similar hatchery and fisheries effects, as previously discussed for spring Chinook salmon, may also occur for steelhead.
- UCR summer/fall Chinook salmon are low adverse because they are also indistinguishable from hatchery-origin fish. Under this alternative, 900,000 summer/fall Chinook salmon smolts would be released annually into the Okanogan River that could potentially interbreed with natural-origin fish and influence life history traits of future generations. These juveniles are around twice the size of their natural-origin counterparts. However, this UCR Summer/fall Chinook salmon ESU is not currently ESA-listed nor is it at risk of going extinct; therefore, while life history effects should be monitored, they are not a serious concern at the present time.
- UCR sockeye are undetectable because the applicants do not currently operate sockeye hatchery programs, so the life history traits of the natural-origin population are not likely to change.

Under Alternative 2, the conditions that hatchery-fish are reared in may influence life history traits. If smolt are released at a larger size (higher growth rate) than natural-origin fish, this could alter natural-origin fish life history, as discussed under Alternative 1. The kelt reconditioning program poses no serious life history threat to the steelhead population because adults are allowed to spawn freely after being conditioned. Overall, the life history effects on UCR steelhead and spring Chinook salmon from the proposed programs are low adverse relative to Alternative 1. The proposed summer/fall Chinook salmon CJ Dam tailrace fishery using snag hook gear is unlikely to immediately cause fisheries evolutionary effects, as these may take many generations to manifest. Moreover, the gear type is unlikely to preferentially select one size class from a population; thus, the risk of effects is minimized. The sockeye fishery utilizes gear and methods similar to the WDFW fishery that is currently operating. Therefore, there is no change in life history effects on summer/fall Chinook salmon and sockeye salmon relative to Alternative 1.

Under Alternative 3, the hatchery programs and associated activities would be terminated immediately. Thus, the immediate and long-term negative life history effects from hatchery and associated activities discussed under Alternative 1 from programs would be eliminated, making the population decrease in hatchery-origin salmonids and increase in natural-origin salmonids.

No new fish would be released; however, hatchery fish recently released would still return to spawn in 4 to 5 years. Fisheries would no longer exist that may incidentally harm natural-origin fish. Because no hatchery fish would be released and fisheries for hatchery fish would be eliminated, the effects of this alternative would be reduced compared to Alternative 1 (Table **23**).

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent would potentially reduce life history effects on salmonids in the project area; however, this would not eliminate the hatchery programs. Relative to Alternative 1, the adverse effects would be reduced for 3 of the 4 species, following the same logic from eliminating programs in Alternative 3. There would likely be no change in life history effects on sockeye salmon.

4.2.3. Competition and Predation

Table 24. Summary of change in competition and predation on natural-origin salmon and steelhead relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Species	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
UCR spring Chinook salmon	Low-adverse	Negligible-adverse	Negligible-beneficial	Negligible-beneficial
UCR steelhead	Low-adverse	Low-beneficial	Negligible-beneficial	Negligible-beneficial
UCR summer/fall Chinook salmon	Low-adverse	Negligible-adverse	Negligible-beneficial	Negligible-beneficial
UCR sockeye salmon	Undetectable	No change	Negligible-beneficial	Negligible-beneficial

Under Alternative 1, the hatchery programs would be operated the same as under current conditions. Over time, these effects of competition and predation could compound, leading to fewer natural-origin fish in the project area. The CJ Hatchery FEIS (BPA et al. 2009) analyzes these effects from past actions in greater detail; therefore, new actions are analyzed after these programs were already in effect. Moreover, genetic diversity may be altered if certain genotypes/phenotypes of fish are targeted as prey and competition. The effects on:

- Natural-origin UCR spring Chinook salmon are low adverse due to potential predation from hatchery-origin spring Chinook yearlings, hatchery-origin steelhead yearlings, and hatchery-origin summer/fall Chinook yearlings on natural-origin UCR spring Chinook sub-yearlings and yearlings. Residual hatchery-origin yearlings also pose risk to natural-origin juveniles. There is no competition between hatchery-origin and natural-origin spring Chinook salmon because there are currently no natural-origin spring Chinook

adults in the Okanogan basin. They do not compete with other species because of spawn timing.

- Natural-origin UCR steelhead are low adverse due to the likely predation from hatchery-origin steelhead yearlings, hatchery-origin spring Chinook yearlings, hatchery-origin summer/fall Chinook sub-yearlings, and hatchery-origin summer/fall Chinook yearlings on natural-origin steelhead sub-yearlings. Residual hatchery-origin juveniles may also prey on natural-origin juveniles. Additionally, natural-origin steelhead are likely to compete with hatchery-origin steelhead for spawning sites. They do not compete with other species because of spawn timing.
- Natural-origin UCR summer/fall Chinook salmon are low adverse because they may face predation threats from hatchery-origin summer/fall Chinook juveniles as well as hatchery-origin yearling spring Chinook salmon and hatchery-origin yearling steelhead. Residual hatchery-origin juveniles also threaten natural-origin juveniles. Moreover, natural-origin summer/fall Chinook salmon are likely also competing with hatchery-origin summer/fall Chinook for reproductive space. They do not compete with other species because of spawn timing.
- Natural-origin UCR sockeye salmon are undetectable because it is unlikely that they face predation risk from any hatchery-origin fish, due to location and migration timing. No hatchery-origin fish are released, therefore, there is no competition for spawning ground.

Under Alternative 2, the CJ Hatchery programs would have a slight increased production level due to increased production from the proposed kelt reconditioning program. The proposed kelt reconditioning program would increase the abundance of natural-origin steelhead in the project area, which could indirectly decrease predation and spawning risk on natural-origin steelhead. Thus, the effects on natural-origin steelhead from these proposed programs results in a decrease in adverse effects (low beneficial) relative to Alternative 1. There would also likely be a slight increase in predation and competition between hatchery-origin steelhead juveniles and natural-origin spring and summer/fall Chinook salmon juveniles. Therefore these effects would be negligible adverse. There is no overlap in spawn timing of hatchery-origin steelhead and other species, therefore there this would not affect natural-origin spring and summer/fall Chinook salmon adults and there would be no chance in effects of sockeye salmon. Furthermore, the proposed Predator Fish Removal program targeting walleye, smallmouth bass, and northern pikeminnow may remove predators that would otherwise prey on juvenile salmonids. The resulting effect may increase the abundance of all juvenile salmonids to serve as a prey source for natural-origin salmon and steelhead. There would be a slight increase in beneficial effects on other salmonids, resulting in a low beneficial effect relative to Alternative 1.

Under Alternative 3, the hatchery programs and other activities described in the TRMP would be terminated immediately. Consequently, no hatchery-origin fish would be released to compete with or prey on natural-origin fish. However, adults would continue to return for the next four to five years, leading to some spawning site composition, redd superimposition, and straying. Moreover, the termination of fisheries would increase natural-origin fish abundance, decrease juvenile competition and predation, and decrease competition between hatchery-origin and natural-origin adults on spawning grounds. Relative to Alternative 1, the effects on natural-origin fish would be negligible-beneficial for all species.

Under Alternative 4, the decreased production of steelhead, summer/fall and spring Chinook salmon by 50 percent would likely reduce predation and competition risks on all natural-origin salmonids in the project area by the same proportion. Thus, there should be a negligible beneficial effect from the reduction of programs, relative to Alternative 1.

4.2.4. Prey Enhancement

Table 25. Summary of change in prey enhancement effects on natural-origin salmon and steelhead relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Species	Alternative 1 No-action	Effects of Alternative Relative to No Action 2	3	4
UCR spring Chinook salmon	Medium-beneficial	Low-beneficial	Medium-adverse	Low-adverse
UCR steelhead	Medium-beneficial	Low-beneficial	Medium-adverse	Low-adverse
UCR summer/fall Chinook salmon	Medium-beneficial	Low-beneficial	Medium-adverse	Low-adverse
UCR sockeye salmon	Low-beneficial	Negligible-beneficial	Low-adverse	Negligible-adverse

Under Alternative 1, the hatchery programs would be operated the same as under current conditions. The effects of the programs on natural-origin fish are:

- Medium beneficial for natural-origin UCR spring Chinook because 420,000 Carson stock spring Chinook yearlings would be released into the Columbia River and 200,000 Methow composite stock spring Chinook yearlings would be released into the Okanogan River annually, and there is overlap in occurrence timing between natural-origin and hatchery-origin spring Chinook salmon. Hatchery-origin spring Chinook salmon juveniles are larger than natural-origin spring Chinook salmon juveniles, therefore it is unlikely that natural-origin fish will actively kill and feed on hatchery-origin fish. However, these natural-origin spring Chinook salmon juveniles may have the opportunity to feed on deceased hatchery-origin spring Chinook salmon juveniles in the system. Moreover, natural-origin spring Chinook salmon juveniles also partially overlap with other hatchery-origin fish released in the Proposed Action, which could serve as an additional prey source for them.
- Medium beneficial for UCR steelhead because Okanogan Summer Steelhead Conservation Program releases roughly 80,000 juvenile steelhead into the project area annually, and there is overlap in occurrence timing between natural-origin and hatchery-origin steelhead. Using the same logic as with spring Chinook salmon, natural-origin steelhead juveniles may have the opportunity to feed on deceased hatchery-origin steelhead juveniles. Moreover, natural-origin steelhead juveniles also partially overlap with other hatchery-origin fish released in the Proposed Action, which could serve as an

additional prey source for them. Moreover, natural-origin summer/fall Chinook salmon juveniles also partially overlap with other hatchery-origin fish released in the Proposed Action, which could serve as an additional prey source for them.

- Medium beneficial from UCR summer/fall Chinook salmon because 780,000 yearling and 420,000 sub-yearling summer/fall Chinook smolts are released into the Okanogan River annually, and there is overlap in occurrence timing between natural-origin and hatchery-origin summer/fall Chinook salmon. Using the same logic as with spring Chinook salmon and steelhead, natural-origin summer/fall Chinook salmon juveniles may have the opportunity to feed on deceased hatchery-origin summer/fall Chinook salmon juveniles.
- Low beneficial for natural-origin UCR sockeye salmon because there are currently no hatchery programs for this species in the project area. However, there is overlap in occurrence timing between natural-origin sockeye salmon and all three other hatchery-origin species released in the project area. Thus, these species could provide some nutritional benefit to natural-origin sockeye.

Under Alternative 2, the CJ Hatchery programs would have an increased production level due to increased production from the Okanogan Basin Summer Steelhead Conservation Program and the proposed kelt reconditioning program. The Okanogan Basin Summer Steelhead Conservation Program would release 100,000 UCR steelhead and the kelt reconditioning program would release 25 percent natural-origin kelts into the project area, thus slightly increasing the potential prey source for natural-origin salmonids. This would result in a negligible-beneficial effect for UCR steelhead. The proposed Predator Fish Removal program targeting walleye, smallmouth bass, and northern pikeminnow may remove predators that would otherwise prey on juvenile salmonids. The resulting effect may increase the abundance of all juvenile salmonids to serve as a prey source for natural-origin salmon and steelhead. There would be a slight increase in beneficial effects on other salmonids, resulting in a low beneficial effect relative to Alternative 1.

Under Alternative 3, the immediate termination of the hatchery programs and associated activities (kelt reconditioning and predator removal) would eliminate any prey enhancement benefit of hatchery-origin juveniles. Thus, prey enhancement adverse effects are medium (on spring Chinook salmon, steelhead, and summer/fall Chinook salmon) and low (sockeye salmon) relative to Alternative 1. The elimination of fisheries and RM&E would not have an effect on prey enhancement.

Under Alternative 4, the decreased production of steelhead, summer/fall and spring Chinook salmon by 50 percent for the proposed programs would decrease prey resource benefits from those species. There would still be a benefit provided by the decrease hatchery production level, but it would be lower than Alternative 1. The new effect would be low-adverse for the three species (on spring Chinook salmon, steelhead, and summer/fall Chinook salmon) and negligible-adverse for (sockeye salmon), relative to Alternative 1.

4.2.5. Facility Operations

Table 26. Summary of change in facility operation effects on natural-origin salmon and steelhead relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Species	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
UCR spring Chinook salmon	Low-adverse	No change	Low-beneficial	No change
UCR steelhead	Low-adverse	No change	Low-beneficial	No change
UCR summer/fall Chinook salmon	Medium-adverse	No change	Medium-beneficial	No change
UCR sockeye salmon	Medium-adverse	No change	Medium-beneficial	No change

Under Alternative 1, the hatchery programs would be operated the same as under current conditions. Only hatchery operations would have a facility effect, so only the effects of hatchery programs are considered here. While the screens used to operate facilities comply with the NMFS screening criteria, there are still potentially adverse effects on natural-origin fish from catching or physically harming them. The potential adverse effects of weirs are minimized by operators checking traps daily, releasing any fish not intended for broodstock, and typically encountering only a small portion (less than 5 percent) of outmigrating juveniles. Sockeye salmon are not produced in hatcheries in the action area, but they may still be encountered in weirs and traps. The 10 year average mortality of natural-origin steelhead from adult weirs was six fish, which were all used for broodstock collection. No natural-origin spring Chinook salmon have been encountered at weirs or RST's in the last 10 years. In 2014, there were 114 summer Chinook salmon mortalities and 134 sockeye salmon mortalities (10 year averages not available) at adult weirs. That being said, roughly 90% of these encountered mortalities were recorded as "wash-ups", meaning the CCTR staff thought it was unlikely that the weir caused the mortalities. However, it is difficult to determine the cause of mortalities. Thus, the potential for adverse facility operation effects are low for UCR spring Chinook salmon and UCR steelhead and medium-adverse for UCR summer/fall Chinook salmon and UCR sockeye salmon.

Under Alternative 2, the hatchery programs would be operated the same as Alternative 1. Thus, there would be no change in facility operation effects relative to Alternative 1.

Under Alternative 3, the immediate termination of the hatchery programs would eliminate the associated facility operations. Thus, there would be no use of weirs, water intake structures, or smolt traps, leading to a low beneficial effect on spring Chinook salmon and steelhead relative to Alternative 1. This would also lead to a medium beneficial effect on summer/fall Chinook and sockeye salmon, relative to Alternative 1.

Under Alternative 4, the decreased production of steelhead, summer/fall and spring Chinook

salmon by 50 percent would likely result in no change for weir, smolt trap, and water intake operations, as they would still be needed to maintain the program regardless of production size. Thus, there would be no change in facility operation effects relative to Alternative 1.

4.2.6. Masking

Table 27. Summary of change in masking effects on salmon and steelhead relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Species	Alternative 1 No-action	Effects of Alternative Relative to No Action 2	3	4
UCR spring Chinook salmon	Undetectable	No change	No change	No change
UCR Steelhead	Undetectable	No change	No change	No change
UCR summer/fall Chinook salmon	Undetectable	Undetectable	No change	No change
UCR Sockeye salmon	Undetectable	No change	No change	No change

Under Alternative 1, while hatchery programs and on-going actions associated with the TRMP would be operated identical to current conditions, there would potentially be an increased adverse masking effect (if masking effects existed). This is because the continued release of unmarked fish into the future would accumulate these fish, over time. However, these programs do not released un-marked fish and therefore any effects would be from accidental mis-clips. The program effects from masking are:

- Undetectable for UCR spring and summer/fall Chinook salmon because all hatchery programs producing these species adipose mark 100 percent of the fish. These programs also use additional methods (PIT/CWT) to ensure hatchery fish are properly identified.
- Undetectable for UCR steelhead because the current steelhead hatchery program adipose mark 100 percent of the fish.
- Undetectable for UCR sockeye because there are currently no hatchery programs for this species in the project area

Under Alternative 2, the proposed improvement to the Okanogan Basin Summer Steelhead Conservation Program intends to adipose mark 100 percent of all released juveniles with at least one hatchery parent. This program will also use additional methods (PIT/CWT) to ensure hatchery fish are properly identified. Therefore the effects of masking on this species would be undetectable. There would be no change for the other programs relative to Alternative 1, as they would continue to mark all fish released.

Under Alternative 3, the immediate termination of the hatchery programs would, in theory, reduce the effects of masking relative to Alternative 1. However, all fish in the current programs are adipose clipped, thus the effects of masking would remain undetectable.

Under Alternative 4, the decreased production of steelhead, summer/fall and spring Chinook salmon by 50 percent would result in no change relative to Alternative 1 because all of these fish would be marked and because there are currently no effects from masking.

4.2.7. Fisheries

Table 28. Summary of change in fisheries effects on natural-origin salmon and steelhead relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Species	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
UCR spring Chinook salmon	Low-adverse	No change	Negligible-beneficial	Negligible-beneficial
UCR Steelhead	Low-adverse	Low-adverse	Negligible-beneficial	Negligible-beneficial
UCR summer/fall Chinook salmon	Low-adverse	Low-adverse	Negligible-beneficial	Negligible-beneficial
UCR Sockeye salmon	Low-adverse	No change	No-change	No change

Under Alternative 1, there would be an increase in fisheries effects associated with the hatchery programs relative to current conditions, even though programs would be operated identically to current conditions. This is because the continued operation of the fisheries into the future would compound these effects. Fisheries effects due to the hatchery programs are:

- Low adverse for UCR spring Chinook salmon in the analysis area. There have only been a few state and tribal fisheries within the action area that existed to remove excess hatchery-origin fish returning to the Leavenworth National Fish Hatchery (and beyond). In particular, tribal fisheries have existed in the CJ Dam tailrace that targeted stray Leavenworth stock spring Chinook salmon. The use of size and gear selective fisheries may also lead to a size truncation in a population with less fecund adults spawning. Even though these fisheries target hatchery-origin spring Chinook salmon, they may incidentally harm natural-origin spring Chinook salmon through bycatch, leading to a low adverse effect.
- Low adverse for UCR natural-origin steelhead in the action area. Limitations on non-treaty (maximum harvest rate of 4% on A-run and 2% on B-run) and treaty (13-20% on B-run, dependent upon run size) steelhead fisheries exist. While fisheries primarily exist to limit the number of hatchery-origin fish returning to the Okanogan basin, the mortality rate on natural-origin fish averages 3.4%. The use of size and gear selective fisheries may also lead to a size truncation in a population with less fecund adults spawning. Moreover, natural-origin steelhead may also be incidentally caught as bycatch in other fisheries.
- Low adverse for UCR summer/fall Chinook salmon and sockeye salmon. Treaty and non-treaty recreational and commercial fisheries exist for non-listed UCR summer/fall

Chinook and sockeye salmon in the Okanagan basin. The use of size and gear selective fisheries may also lead to a size truncation in a population with less fecund adults spawning. Thus, there is a low adverse effect on natural-origin summer/fall Chinook salmon and sockeye salmon. Moreover, natural-origin summer/fall Chinook salmon and sockeye salmon may also be incidentally caught as bycatch in other fisheries.

Under Alternative 2, the introduction of hatchery programs and associated activities may influence fisheries effects relative to Alternative 1. The proposed Okanogan Basin Summer Steelhead Conservation Program intends to produce a minimum of 500 returning adult spawners, thus incidental steelhead caught in any fisheries in future years has a potential to increase. This program measured 324 returning hatchery-origin adults in 2012, meaning these would be potentially available to fisheries. There are strict limitations on both A and B run steelhead catch in the action area, but nonetheless, this Proposed Action may increase steelhead catch in treaty and non-treaty fisheries (within the limitations). Thus, the proposed Conservation Program may lead to increased harmful effects from fisheries on natural-origin steelhead, compared to Alternative 1.

Under Alternative 3, the immediate termination of the hatchery programs and associated activities would reduce fisheries effects relative to Alternative 1, directly and indirectly after the most recent juvenile hatchery-origin fish return as adults. Effects on steelhead as well as summer/fall and spring Chinook salmon would not be eliminated because these proposed programs are not the sole producers of fish for the fisheries. The effects on these natural-origin salmon and steelhead may increase because the hatchery-origin fish no longer shield natural-origin fish from being caught. However, it is likely that fisheries would become more restrictive to account for the decrease in fish abundance, resulting in a negligible beneficial effect relative to Alternative 1. There would likely be no change in effects on UCR sockeye salmon, because the hatchery programs do not and are not planning to produce UCR sockeye salmon.

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent may decrease the potential fish available for fisheries. These programs are not the sole producers of fish in the region; therefore, selective fisheries would likely still exist to remove hatchery-origin salmon and steelhead (however these would not occur in the action area). Moreover, fishery harvest levels may be further restricted due to this reduction in potential hatchery-origin fish on natural spawning grounds. It is difficult to predict the exact outcomes, but it is unlikely that this would greatly change fisheries effects from Alternative 1. There is expected to be a negligible beneficial fishery effect on natural-origin steelhead as well as summer/fall and spring Chinook salmon relative to Alternative 1.

4.2.8. **Disease**

Table 29 Summary of change in population viability of natural-origin salmon and steelhead relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Species	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
UCR spring Chinook salmon	Low-adverse	No change	Low-beneficial	Negligible-beneficial
UCR steelhead	Low-adverse	No change	Low-beneficial	Negligible-beneficial
UCR summer/fall Chinook salmon	Low-adverse	No change	Low-beneficial	Negligible-beneficial
UCR sockeye salmon	Negligible-adverse	No change	Negligible-beneficial	Undetectable

Under Alternative 1, the hatchery programs and associated activities would be operated identically to current conditions. Only the proposed hatchery operations are likely to have disease effects on salmonids in the project area. The effects of the hatchery programs disease effects on:

- UCR spring Chinook salmon, summer/fall Chinook salmon, and steelhead are low adverse due to the current hatchery programs that are operating. Diseases are more likely to spread in hatchery populations due to crowded living conditions with limited ability to escape infection.
- UCR sockeye salmon are negligible adverse because while no hatchery operations exist for this species in the project area, disease from other hatchery populations could spread into waters where they exist.

Under Alternative 2, the hatchery programs would be operated similar to Alternative 1. Thus, there would be no change in disease effects relative to Alternative 1.

Under Alternative 3, the immediate termination of the hatchery programs would eliminate the associated risks from diseases, leading to a low beneficial effect relative to Alternative 1. There would likely be a negligible beneficial effect in disease effects on UCR sockeye salmon relative to Alternative 1 because there would be no change in facility operations for this species; however, the other hatchery operations would cease.

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent would likely result in fewer risks from disease because a smaller number of hatchery-origin fish would be released, resulting in a smaller likelihood of infected hatchery-

origin fish being released into the natural environment. Thus, there would be a negligible beneficial effect from disease relative to Alternative 1, meaning there would still be a slight risk from disease associate with these programs for these species. There would likely be an undetectable change in effects on sockeye salmon, because the risk of disease from other hatchery-origin fish would likely still be negligible-adverse.

4.2.9. Population Viability

Table 30. Summary of change in population viability of natural-origin salmon and steelhead relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Species	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
UCR Spring Chinook salmon	Medium-beneficial	No change	Medium-adverse	Low-adverse
UCR Steelhead	Medium-beneficial	Medium-beneficial	Medium-adverse	Low-adverse
UCR summer/fall Chinook salmon	Low-adverse	No change	Low-beneficial	Negligible-beneficial
UCR sockeye salmon	Undetectable	No change	No change	No change

Under Alternative 1, the hatchery programs and associated activities would be operated identically to current conditions, but over time, there would be changes in population viability. The effects of the hatchery programs on population viability for:

- UCR spring Chinook salmon and steelhead are likely to increase through increased abundance from the current programs in the project area. The potential increases in abundance, through supplementing the natural population with fish reared in a hatchery, provide a benefit to population viability for all populations (Spring Chinook salmon: Wenatchee River, Entiat River, Methow River and Okanogan River; Steelhead: Wenatchee River, Entiat River, Methow River, Okanogan River, and Crab Creek), while management of PNI levels minimizes genetic risks. However, fish that have some hatchery influence may be less fit than natural-origin fish and could reduce the productivity of natural-origin fish. Over time, other viability factors, such as genetic diversity and spatial structure, are likely to increase as natural-origin returns increase, leading to a medium beneficial effect overall for these species.
- UCR summer/fall Chinook salmon from all populations (Wenatchee River, Entiat River, Methow River and Okanogan/Similkameen Rivers) are likely to slightly decrease with the introduction of hatchery-origin fish in the population. The population is not in danger of extinction, thus the only effects from the introduction of hatchery-origin fish will likely be small negative effect on genetic diversity and productivity because this population would not benefit from supplementation in abundance while the population is

exposed to a genetic risk from hatchery influenced selection. Thus, there will likely be a low adverse effect from the programs on summer/fall Chinook salmon.

- UCR sockeye salmon are undetectable for all populations, because hatchery programs do not exist for this species in the project area.

Under Alternative 2, all hatchery operations remain, though there is a potential for increased abundance, productivity, spatial structure, and genetic diversity with the improvement of the Okanogan Basin Summer Steelhead Conservation Program that would eventually release 100,000 smolts from 100 percent natural Okanogan origin broodstock into the project area. Fish from the program would be allowed to spawn naturally, with the result that a minimum of 500 more adults would return from the ocean to natural spawning areas. Until this happens, there may be a negative effect on genetic diversity from hatchery-origin fish. The eventual VSP goals are PNI of greater than 0.67 and pHOS of less than 0.30. This program will not extract more than 33 percent of the natural-origin returns as broodstock; therefore, this should have low levels of adverse effects on the abundance of natural-origin steelhead. Further, the kelt reconditioning program may potentially increase the beneficial effects on these variables as well. Ultimately, the immediate benefits from the proposed programs on abundance, productivity, and spatial structure are greater than the risks on diversity, thus, resulting in a medium beneficial effect on population viability of UCR steelhead relative to Alternative 1. There would be no change in effects on UCR spring and summer/fall Chinook salmon and sockeye salmon relative to Alternative 1 because there would be no change in hatchery operations for those species.

Under Alternative 3, the immediate termination of the hatchery programs and associated activities would reduce population viability for the integrated spring Chinook salmon and steelhead programs, but may increase population viability for summer/fall Chinook salmon. Because the spring Chinook salmon population is considered endangered with a high risk of extinction and low abundance relative to population viability targets, removing this program, and therefore the supplementation to the population abundance, would reduce any immediate and long-term population viability benefits. Thus, resulting in a medium adverse effect, relative to Alternative 1. In contrast, the elimination of the summer/fall Chinook programs may improve the population viability of natural-origin fish by eliminating genetic risks and maintaining the genetic diversity of the natural populations, resulting in a low beneficial effect. There is no change in effects on population viability of UCR sockeye because no hatchery programs exist for this species.

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent may decrease beneficial effects on population viability on spring Chinook and steelhead for similar reasons as previously discussed under Alternative 3. This results in a low adverse effect for both species relative to Alternative 1. Decreased production of summer/fall Chinook salmon may slightly decrease the negative effects on population viability because fewer hatchery-origin fish will be able to interbreed with natural-origin fish, thus resulting in a negligible beneficial effect relative to Alternative 1. There is no change in effects on population viability of UCR sockeye because no hatchery programs exist for this species.

4.2.10. Nutrients

Table 31. Summary of change in nutrient cycling on natural-origin salmon and steelhead relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Species	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
UCR spring Chinook salmon	Low-beneficial	Negligible-beneficial	Low-adverse	Negligible-adverse
UCR Steelhead	Low-beneficial	Negligible-beneficial	Low-adverse	Negligible-adverse
UCR summer/fall Chinook salmon	Low-beneficial	Negligible-beneficial	Low-adverse	Negligible-adverse
UCR sockeye salmon	Low-beneficial	Negligible-beneficial	Low-adverse	Negligible-adverse

Under Alternative 1, the hatchery programs would be operated identically to current conditions, but over time, there would be an increase in marine-derived nutrients associated with the return of adults produced by the hatchery programs relative to current conditions. The associated activities (fisheries and RM&E) would not likely detectable influence nutrient cycling in the environment. The effects of nutrient cycling are low beneficial on all species because some or all of the fish from the integrated programs would be spawned naturally, leaving carcasses in the ecosystem that would allow accumulation of nutrients in the system. Surplus hatchery fish from the segregated programs are typically given to tribal members for ceremonial or subsistence use (or taken to a landfill if not fit for human consumption) and not passed upstream, limiting their nutrient cycling benefits to strays.

Under Alternative 2, there is a slight potential for increased nutrients available with the increased production from the Okanogan Basin Summer Steelhead Conservation Program and the proposed kelt reconditioning program. All of the fish from the Conservation Program would be spawned naturally, with the result that a minimum of 500 more adults would return from the ocean to natural spawning areas. Further, the kelt reconditioning program may also increase abundance of this species because of their future potential for increased juvenile production in the project area. While this would substantially increase spawning adults in the natural environment, the changes in marine-derived nutrients reaching the natural production areas would be minimal in the overall environment. In addition, the proposed Predator Fish Removal program may reduce long-term nutrient cycling in the affected aquatic and terrestrial ecosystems, due to the loss of future generations of predator fish progeny that could have contributed to nutrient cycling as carcasses. Overall, this results in just a slight increase from the already low beneficial effect in Alternative 1 for all species because all salmon and steelhead would benefit equally from nutrient cycling.

Under Alternative 3, the immediate termination of the hatchery programs and associated activities would eventually eliminate any nutrient contribution from hatchery-origin fish, resulting in an elimination of the hatchery programs' beneficial effect described in Alternative 1.

The elimination of fisheries, RM&E, and the kelt reconditioning program would not likely have a detectable effect on nutrient cycling. All salmon and steelhead species would be affected equally, resulting in a low adverse effect for all species.

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent for the proposed programs would result in negligible changes in the effects of nutrient cycling relative to Alternative 1. Because production would be expected to decrease the number of adults returning from this program to natural spawning areas, the amount of marine-derived nutrients would be reduced, though the effect is minimal in the environment overall. This results in a small or negligible reduction in effect relative to Alternative 1 for all salmon and steelhead species, meaning these effects would be similar to, but slightly less than, the low beneficial effects in Alternative 1.

4.2.11. Research, Monitoring and Evaluation

Table 32. Summary of change in RM&E effects on natural-origin salmon and steelhead relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Species	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
UCR spring Chinook salmon	Low-adverse	No change	Negligible-beneficial	No change
UCR steelhead	Low-adverse	No change	Negligible-beneficial	No change
UCR summer/fall Chinook salmon	Low-adverse	No change	Negligible-beneficial	No change
UCR sockeye salmon	Low-adverse	No change	Negligible-beneficial	No change

Under Alternative 1, the hatchery programs would be operated identical to current conditions, but RM&E effects would continue to increase on natural-origin salmon and steelhead over time. The OBMEP, CJ Hatchery, and Omak Creek steelhead programs pose threats to salmon and steelhead through electro-fishing (EF), PIT tagging (screw trap, beach seine, and EF), harassment activities (spawning surveys, habitat surveys, carcass sampling, rotary screw traps), adult enumeration through weirs, and hook-and-line surveys (steelhead juvenile remote PIT tags). There is potential for these programs to interfere with spawning and rearing of natural-origin fish during spawning and outmigrant surveys. In particular, the use of rotary screw traps pose certain threat to natural-origin salmon in the project area, by means of direct and indirect interference. These efforts target natural-origin spring and summer/fall Chinook salmon as well as sockeye salmon and are operated between March and July. Moreover, these sampling efforts also overlap with natural-origin UCR steelhead spawning, therefore, potentially interfering with migration. The benefits of conducting this research to better our understanding of these

populations is substantial, thus the resulting effect of RM&E on natural-origin salmon and steelhead is low adverse.

Under Alternative 2, the proposed hatchery programs and associated actions result in no change in RM&E effects for all salmon and steelhead species relative to Alternative 1. The introduction of the sturgeon Wells Pool RM&E program is unlikely to affect natural-origin salmon and steelhead because these research methods are extremely effective at only targeting sturgeon for studies through the use of set lines, D-ring plankton nets, stationary bottom trawl, towed bottom beam trawl, small-mesh gill nets, artificial substrates (for eggs), and hook-and-line angling.

Under Alternative 3, the immediate termination of the hatchery programs and associated activities would eliminate the need to conduct RM&E, thereby eliminating adverse effects of the RM&E activities. However, this would eliminate the beneficial effect of conducting this research. The valuable information gathered from conducting RM&E on natural-origin populations would be lost, thus the severity of potential adverse effects on natural-origin salmonids is increased. This would result in a negligible-beneficial effect relative for all species to Alternative 1.

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent for the proposed programs would result in no change in RM&E effects on natural-origin populations relative to Alternative 1, as hatchery programs and associated activities would still need RM&E to evaluate the remaining released fish.

4.3. Other Fish Species

Table 33. Summary of change in effects on other fish species relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Resource	Effects	Alternative 1 No-action	Effects of Alternative Relative to No Action 2	3	4
Other Fish Species	Competition	Low-adverse	No change	Low-beneficial	Negligible-beneficial

Under Alternative 1, the hatchery programs would be operated identical to current conditions, but the hatchery effects on other fish species would increase relative to current conditions with the continued operation of the hatchery programs. Hatchery-origin salmonids may prey on or compete with other fish species, though this is not highly likely. Juvenile hatchery-origin salmon and steelhead may also act as a prey source for other fish species. Thus, the effects of competition are low adverse while the effects of predation are negligible adverse. The effects of prey enhancement are low beneficial because salmon and steelhead released as juveniles from a hatchery could act as a prey source for other fish species. Facility effects are low adverse because any other fish encountered would be released according to safe fish handling protocols. Fisheries' effects on other fish species are low adverse because the fisheries would use selective gear to target their sought after fish. White sturgeon are occasionally caught incidentally in salmon and steelhead fisheries, but they are quick to recover and do not often suffer from injuries

leading to mortality from these actions. Resident fisheries target healthy populations, and therefore, fisheries effects are likely low adverse. Disease effects are also negligible adverse because many pathogens found in hatcheries are specific for salmon and steelhead and not likely to affect other fish species. Nutrient cycling effects are low beneficial because hatchery-origin fish are likely to contribute nutrients to the system after spawning. Overall, the effects on other fish species are low adverse, relative to Alternative 1.

Under Alternative 2, the operation of the hatchery programs and associated actions would likely result in the same effects as Alternative 1 for all effects except for the effects of nutrient cycling. The Okanogan Basin Summer Steelhead Conservation Program and kelt reconditioning program would increase juvenile steelhead released into the environment, thereby increasing available prey sources for other fish species. The proposed predator removal program would directly kill predatory fish that may serve as prey for other fish; however, the carcasses would remain in the environment as a potential prey source. However, killing these individuals would also prevent their future creation of progeny, which would decrease future nutrient cycling in the system. Further, the proposed fishery would also potentially remove salmonids that may act as a prey source for other fish species. These predation and prey enhancement effects are likely to cancel each other out, resulting in no change from Alternative 1. Facility operations are unlikely to change, and other fish species are still not expected to be affected by salmonid pathogens. Nutrients would likely increase with the improvement of the proposed Okanogan Basin Summer Steelhead Conservation Program, due to the slight increase of juvenile steelhead released from the hatchery into the environment. This results in a negligible beneficial effect on other fish relative to Alternative 1. Fisheries' effects on other fish species are low adverse relative to Alternative 1 because they use selective gear to target their sought after fish. The proposed sturgeon RM&E and kelt reconditioning programs are unlikely to influence any of these outcomes because sturgeon are hardy and these activities will not likely encounter bycatch, resulting in no change relative to Alternative 1. Overall, there is not likely to be a change in effects on other fish species, relative to Alternative 1.

Under Alternative 3, the hatchery programs and associated actions would be terminated immediately. Consequently, the total number of hatchery-origin salmon and steelhead available to other fish species as prey and for nutrients would decrease, resulting in low adverse effects on prey enhancement and nutrients relative to Alternative 1. However, the adverse effects of operating the hatchery facilities and fisheries, and introducing hatchery-origin salmonids as potential predators, competitors, and sources of disease for other fish species would be eliminated, therefore, resulting in low beneficial effects on other fish species relative to Alternative 1 for predation, competition, facilities, and diseases. Overall, the effects on other fish species are low beneficial, relative to Alternative 1.

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent for the proposed programs would be expected to have no change from Alternative 1 for facilities and disease effects. Facility operations are unlikely to change, and other fish species would remain largely unaffected by salmon and steelhead pathogens. The abundance of juveniles released from hatcheries would be lower than in Alternative 1, thus slightly decreasing this potential prey source and available nutrients for other fish, leading to a negligible adverse effect. Hatchery-origin salmon and steelhead may still compete with other fish

species for space and resources; therefore, this changes the effect to negligible beneficial compared to Alternative 1. Prey enhancement and nutrients would likely slightly increase with the introduction of the proposed Okanogan Basin Summer Steelhead Conservation Program, due to the increase of juvenile salmonids released from the hatchery into the environment (and potential returning adults). This results in a negligible beneficial effect on prey enhancement and nutrients of other fish species relative to Alternative 1. Fisheries effects on other fish species remain low adverse because the fisheries use selective gear to target their sought after fish, while occasionally incidentally catching other fish. Therefore, there will be no change in fisheries effects relative to Alternative 1. Overall, the effects on other fish species are negligible beneficial, relative to Alternative 1.

4.4. Wildlife

Table 34. Summary of change in effects on wildlife relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Resource	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
Wildlife	Negligible-adverse	No change	Negligible-beneficial	No change

Under Alternative 1, the hatchery programs and associated actions would be operated the same as current conditions, but the effects on wildlife relative to current conditions would increase along with continued program operation. Passive deterrent methods (i.e., fencing) are used against predators in facility operations, and all outdoor facilities are fitted with netting to prevent avian predation and with electrical wiring to prevent entry of land-based predators. Therefore, the effect of facility operations is negligible adverse on wildlife species. Prey enhancement and nutrient cycling will likely have a low beneficial effect on wildlife because juveniles released from the hatcheries act as a prey source for wildlife (e.g., eagles, bears) and hatchery-origin adult carcasses to the extent they spawn naturally, contribute nutrients into the system. Hatchery-origin salmonids are more likely to be prey rather than predators for most wildlife, so predation is potentially a negligible beneficial effect. Salmonids are also unlikely to compete with other wildlife species; therefore, the competition effects are likely negligible adverse. Furthermore, diseases found in hatchery-origin salmon and steelhead are unlikely to affect other wildlife species. The overall effects on wildlife would likely be negligible adverse.

Under Alternative 2, the operation of the hatchery programs and associated actions would likely result in the same effects as Alternative 1 for facility operations, diseases, as well as competition and predation. This is because facility operations are unlikely to change, and wildlife are still not expected to be affected by salmonid pathogens. While salmonids are unlikely to compete with or use wildlife for prey, the abundance of juveniles released from hatcheries would increase by up to 100,000 smolts as a result of the Okanogan Basin Summer Steelhead Conservation Program, thus increasing this potential prey source. The proposed predator removal program would kill predators that may serve as prey for other wildlife; however, the carcasses will remain in the environment as a potential food source. Further, the proposed fishery would also remove salmonids that may act as a prey source or may prey on other wildlife. These predation effects

are likely to cancel each other out, resulting in no change in predation effect relative to Alternative 1. Additionally, it is unlikely for hatchery-origin salmon and steelhead to compete with other wildlife species, therefore resulting in no change from Alternative 1. Moreover, the proposed predator removal program would not eliminate fish from the system; instead, the program would kill and release the fish back into the environment to allow nutrients to remain in the system. Prey enhancement and nutrient cycling would likely increase slightly with the improvement of the Okanogan Basin Summer Steelhead Conservation Program and introduction of the kelt reconditioning program, due to the increase of juvenile steelhead released from the hatchery into the environment. This results in a negligible beneficial effect on wildlife prey enhancement and nutrient cycling. Overall, there is likely to be no change in effects on wildlife relative to Alternative 1.

Under Alternative 3, the hatchery programs and associated actions would be terminated immediately. Consequently, Alternative 3 would eliminate the effects of facility operations on wildlife, including disease risks, leading to a negligible-beneficial effect relative to Alternative 1 for facility and disease effects. In addition, this alternative would reduce hatchery salmon and steelhead prey for wildlife, resulting in a low adverse prey enhancement effect relative to Alternative 1. This alternative may also increase competition for wildlife species with shared food preferences (e.g., gulls and cormorants) and may shift predation pressure to other wildlife species (e.g., frogs) to compensate for the loss in salmon, leading to low adverse predation and competition effects relative to Alternative 1. Terminating these hatchery programs would reduce nutrient exchange among the marine, freshwater, and terrestrial ecosystems in four to five years after the last adults return and would lead to a low adverse nutrient effect. Overall, these effects on wildlife are likely to be negligible beneficial relative to Alternative 1.

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent for the proposed programs may result in similar effects as Alternative 2 because while the hatcheries would reduce production, they would still be in operation. The effects from facility operations, diseases, as well as competition and predation are expected to remain unchanged from Alternative 1. Facility operations are unlikely to change and wildlife remain largely unaffected by salmonid pathogens. The abundance of juveniles released from hatcheries would be lower than in Alternative 1, thus slightly decreasing this potential prey source and available nutrients, resulting in a negligible adverse effect for predation and nutrient cycling. Additionally, it is still unlikely for hatchery-origin salmon and steelhead to compete with other wildlife species, therefore resulting in no change from Alternative 1. Prey enhancement and nutrient cycling would likely increase with the introduction of the proposed Okanogan Basin Summer Steelhead Conservation Program, due to the increase of juvenile salmonids released from the hatchery into the environment. This results in a negligible beneficial prey enhancement and nutrient cycling effects on wildlife. There is not likely to be a change in effect on wildlife, relative to Alternative 1.

4.5. Socioeconomics

Table 35. Summary of change in effects on socioeconomics relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

	Alternative 1	Effects of Alternative Relative to No Action

Resource	No-action	2	3	4
Socioeconomics	Medium-beneficial	Medium-beneficial	Medium-adverse	Medium-adverse

Under Alternative 1, the hatcheries and associated programs would be operated the same as under current conditions, which would likely result in the maintenance of employment opportunities and a cumulative increase in the local procurement of goods and services for hatchery operations. The CTCR employs approximately 1,500 people annually, and many of these jobs include those from actions within the TRMP. In addition, current hatcheries and fisheries also benefit the Okanogan and Douglas County economies through fisheries socioeconomic effects. Therefore, contribution of these programs on the regional economy leads to a medium beneficial effect.

Under Alternative 2, there is a potential for increased employment opportunities, with the expansion of the Okanogan Basin Summer Steelhead Conservation Program, the summer/fall Chinook CJ Dam tailrace fishery, the sturgeon RM&E program, the kelt reconditioning program, as well as the predator fish removal program. Therefore, the result would likely be a medium beneficial effect relative to Alternative 1.

Under Alternative 3, the hatchery programs and associated actions would be terminated immediately. Operation of the hatchery programs and fisheries would no longer contribute jobs or operational expenses to the regional economy. Fish available for harvest would be immediately reduced. Furthermore, hatchery production would be reduced in four to five years after the last adults' return, which could potentially result in a reduction in the income of commercial anglers. Indirect effects under this alternative include the elimination of excess hatchery fish for contract buyers and a potential decline in the purchase of fishing-related supplies. Overall, this is expected to result in a medium adverse effect relative to Alternative 1.

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent for the proposed hatchery programs would likely slightly decrease employment opportunities. Returning adults would likely be limited in 4 to 5 years, which may decrease fishing opportunity and procurement of goods needed for fishing (e.g., bait, licenses). Therefore, the termination of these programs would be expected to lead to a medium adverse effect relative to Alternative 1.

4.6. Environmental Justice

Table 36. Summary of change in effects on environmental justice relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Resource	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
Environmental Justice	Medium-beneficial	Low-beneficial	Medium-adverse	Low-adverse

Under Alternative 1, the hatchery programs and associated activities would be operated the same as under current conditions. Over time, the hatchery fish would continue to be available to Tribes

for harvest. The hatchery programs, fisheries, and RM&E programs currently operated by the Tribes would continue to provide jobs and personal income, resulting in a medium beneficial effect.

Under Alternative 2, the operation of the proposed hatchery programs, fisheries, RM&E program, kelt reconditioning program, and predator fish removal project would increase, increasing the benefits on environmental justice communities. This would likely result in similar increases in harvestable fish and the maintenance of jobs and personal income over time. Thus, there may be a low beneficial effect on environmental justice relative to Alternative 1.

Under Alternative 3, the termination of the hatchery programs and associated activities would result in a small increase in the amount of surface and ground water that would be available to environmental justice communities of concern. Termination of these programs would likely result in an overall reduction in nutritional sources as well as the number of fish available for ceremonial and other cultural practices due to the immediate loss of fisheries and hatchery practices. In addition, the employment and economic benefits to the community associated with the hatcheries, fisheries, and associated programs would be lost. Furthermore, this may result in a reduction of available commercial and recreational non-treaty fisheries in Okanogan County. Some of these fisheries (notably the spring Chinook salmon fishery) are in response to an excess of hatchery-origin fish within a population. Overall, these potential outcomes result in a medium adverse effect relative to Alternative 1.

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent would likely decrease the availability of tribal fisheries for spring and summer/fall Chinook salmon and steelhead in the Okanogan basin. This may result in decreased fish available for cultural practices as well as decreased economic opportunity for environmental justice communities. This may also result in a reduction of available commercial and recreational non-treaty fisheries in Okanogan County. Some of these fisheries (notably the spring Chinook fishery) are in response to an excess of hatchery-origin fish within a population. Overall, the 50 percent reduction in surplus fish could affect the availability of fish for tribal food banks, though not as adversely as under Alternative 3, leading to a low adverse effect on environmental justice relative to Alternative 1.

4.7. Cultural Resources

Table 37. Summary of change in effects on cultural resources relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Resource	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
Cultural Resources	Medium-beneficial	Low-beneficial	Medium-adverse	Low-adverse

Under Alternative 1, the hatchery programs and associated activities would be operated the same as under current conditions. The production of salmon and steelhead, as well as the existence of fisheries, contribute to the cultural integrity and well-being of the Tribes. However, these hatcheries and fisheries are not the only programs in the project area that benefit tribal members.

Therefore, the maintenance of natural resource practices for the Tribes results in a medium beneficial effect on Tribal cultural resources.

Under Alternative 2, the operation of the proposed hatcheries and their associated programs would increase Tribal cultural resource use through contribution to a healthy fish stock. Because hatchery facilities are currently in place, there is no additional risk of harming culturally meaningful historical artifacts. Furthermore, these activities would increase Tribal cultural integrity and well-being by increasing natural resource activities that are integral to the Colville Tribe. Therefore, this results in a low-beneficial effect in comparison to Alternative 1.

Under Alternative 3, the immediate termination of the hatchery programs and associated activities would reduce the number of salmon and steelhead available to be utilized in the Tribes' fishing areas. Furthermore, this would prevent the Tribes' immediate access to salmon and steelhead for cultural practices from fisheries from these programs. Termination of these programs would also likely reduce the nutritional well-being of the Tribes, especially for elders who depend on surplus fish as a source of fresh salmon. The immediate termination of these programs would overall result in a medium adverse effect relative to Alternative 1.

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent for the proposed programs may reduce the number of harvestable fish returning to the Tribes' fishing areas, thus decreasing natural resource practices and limiting cultural well-being of the Colville Tribe. Therefore, cultural resources would be substantially impacted in the near term, and would suffer in the longer term from the loss of hatcheries, though not as much as under Alternative 3. The resulting effect would be low adverse relative to Alternative 1.

4.8. Human Health and Safety

Table 38. Summary of change in effects on human health and safety relative to Alternative 1 (No Action). Alternative 2 is the Proposed Actions Alternative.

Resource	Alternative 1 No-action	Effects of Alternative Relative to No Action		
		2	3	4
Human Health and Safety	Low-adverse	No change	Low-beneficial	No change

Under Alternative 1, the hatchery programs and associated activities would be operated the same as under current conditions, so the adverse effects on human health and safety would likely increase over time due to the continued use and discharge of harmful chemicals from the hatchery programs, which may accumulate in the environment. Hatchery-origin fish are likely to continue to serve as a source of food for humans, despite the potential health risks associated with consuming these fish. Other activities in the Okanogan subbasin, like fisheries, may also have adverse effects on human health and safety of anglers in the region. Therefore, overall, this resource would have a low adverse effect.

Under Alternative 2, the operation of the hatchery programs and fishing activity would slightly increase from Alternative 1 (due to the participation in RM&E programs, predatory fish removal,

and kelt reconditioning programs); however, these changes would not result in increased effects on human health and safely. Participation in RM&E programs, predatory fish removal, and kelt reconditioning programs would not likely alter the effect on human health and safety, relative to Alternative 1. Overall, no change in effects on human health and safety is expected relative to Alternative 1.

Under Alternative 3, the hatchery programs and associated activities in the Okanogan basin would be terminated, immediately reducing any potentially harmful effects associated with hatchery operations and fisheries on human health and safety. The reduction in hatchery fish would reduce health risks related to consumption of hatchery-origin fish because the number of fish available for consumption would decrease. Moreover, the participation in activities that could harm the health and safety of anglers would cease. The reduction in harmful effects from hatchery practices and fishing would outweigh the benefits from the loss of salmonid-based nutrition in the local area. Thus, the effects are low beneficial relative to Alternative 1.

Under Alternative 4, the decreased production of steelhead and summer/fall and spring Chinook salmon by 50 percent may result in a reduction in the total amount of therapeutics used to manage fish diseases and the associated risks with consuming hatchery-origin fish. This would lead to a reduction in the potentially harmful effects on human health and safety, but likely not enough to noticeably be different relative to Alternative 1.

5. CUMULATIVE EFFECTS

5.1. Introduction

The NEPA requires the analysis of cumulative impacts that reviews all of the relevant past, present, and reasonably foreseeable future actions, whether they are Federal or non-Federal actions, together (i.e., cumulatively) (40 CFR 1508.7). For this EA analysis, these actions include those that are hatchery-related (e.g., hatchery production levels) and non-hatchery related (e.g., human development). This chapter considers the cumulative effects of each alternative in the context of past actions, present conditions, and reasonably foreseeable future actions and conditions. Past hatchery actions covered in the Mitchel Act FEIS (NMFS 2014c), the Okanogan spring Chinook 10(j) EA (NMFS 2014b), as well as the CJ Hatchery FEIS (BPA et al. 2009) include cumulative effects that are not covered in this EA. Thus, only new effects are outlined in Chapter 5 that include potential effects from the Proposed Actions. The Mitchel Act FEIS (NMFS 2014c) is the most recent document that includes the proposed hatchery programs. Fisheries, RM&E, and kelt reconditioning programs are not included in the Mitchell Act FEIS.

5.2. Geographic and Temporal Scales

The cumulative effects analysis area is the Okanogan Basin, which includes the freshwater tributaries to the Okanogan River and areas adjacent to the hatchery facilities. The analysis areas for cumulative effects varies by resource, depending on the geographic area of the direct and indirect effects being analyzed. For physical and biological resources, as well as land use and cultural resources, the cumulative effects analysis area consists of the Okanogan basin. For social resources (i.e., socioeconomics and cultural resources), the cumulative effects project area consists of Okanogan and Douglas Counties as well as the Colville Reservation.

The scope of the action considered here includes the rearing and release of hatchery salmon and steelhead, fisheries, and RM&E actitivites in the Okanogan and Columbia Rivers. Adult collection, rearing, and release activities would occur in localized areas only; associated direct and indirect effects of these activities are analyzed in Section 4, Environmental Consequences. Cumulative effects within the analysis area are analyzed below.

The direct, indirect, and cumulative reviews address potential effects in the entire project area, although adult collection, rearing, and release activities would occur in localized areas only. The TRMP would be in effect after the associated ESA 4(d) determinations are made, and would remain in effect until the applicants replace or retract them, or until NMFS determines that the plan is no longer effective. There would be periodic reviews of the TRMP by NMFS every 5 years, and the plan would be modified when warranted by NMFS as specified in the approval of the plan.

5.3. Climate Change

The changing climate is becoming recognized as a long-term trend that is occurring throughout the world. The Mitchell Act FEIS does not specifically address climate change; therefore, this section updates effects described in the FEIS. Changes to biological organisms and their habitats are likely to include shifts in timing of life history events, changes in growth and development rates, changes in habitat and ecosystem structure, and rise in sea level and increased flooding (Johannessen and Macdonald 2009; Littell et al. 2009). The most heavily affected ecosystems and human activities along the Pacific coast are likely to be near areas having high human population densities, and on the continental shelves off Oregon and Washington (Halpern et al. 2009). For the Pacific Northwest, Ford (2011) summarized expected climate changes in the coming years as leading to the following physical and chemical changes (characterized certainty of occurring is in parentheses):

- Increased air temperature (high certainty)
- Increased winter precipitation (low certainty)
- Decreased summer precipitation (low certainty)
- Decreased winter and spring snowpack (high certainty)
- Decreased summer stream flow (high certainty)
- Earlier spring peak flow (high certainty)
- Increased flood frequency and intensity (moderate certainty)
- Increased summer stream temperatures (moderate certainty)
- Increased sea level (high certainty)
- Increased ocean temperatures (high certainty)
- Intensified upwelling (moderate certainty)
- Delayed spring transition (moderate certainty)
- Increased ocean acidity (high certainty)

Hamlet (2011) notes that climate changes will have multiple effects in the Pacific Northwest, including:

- Overtaxing of storm water management systems at certain times
- Increases in sediment inputs into water bodies from roads
- Increases in landslides
- Increases in debris flows and related scouring that damages human infrastructure
- Increases in fires and related loss of life and property
- Reductions in the quantity of water available to meet multiple needs at certain times of year (e.g., for irrigated agriculture, human consumption, and habitat for fish)
- Shifts in irrigation and growing seasons
- Changes in plant, fish, and wildlife species' distributions and increased potential for invasive species
- Declines in hydropower production
- Changes in heating and energy demand
- Impacts on homes along coastal shorelines from beach erosion and rising sea levels

The cumulative effects of climate change will be separately discussed for each resource (water quality and quantity, salmon and steelhead, other fish species, wildlife, socioeconomics, environmental justice, cultural resources, and human health and safety) in the following sections: 5.4.1, 5.4.2, 5.4.3, 5.4.4, 5.4.5, 5.4.6, 5.4.7, and 5.4.8.

5.4. Mitchell Act Final Environmental Impact Statement

NMFS completed a Final Environmental Impact Statement to inform Columbia River Basin hatchery operations and the funding of Mitchell Act hatchery programs (as described earlier and hereafter FEIS) (NMFS 2014c). The FEIS analyzed a wide range of hatchery programs throughout the Columbia River Basin, across a suite of policy directions (i.e., alternatives). These policy directions were related to how hatcheries might be operated to manage effects (negative and positive) on natural salmon and steelhead populations, both ESA-listed and non-listed. Additionally, an example set of alternative hatchery programs (baseline and alternatives), basin wide, were developed in the FEIS to illustrate how these FEIS alternatives might be implemented. Further, the example set of alternative hatchery programs analyzed impacts on all resources identified as having a potential environmental impact from operation of these programs.

The FEIS (NMFS 2014c) has been incorporated by reference into this EA, in part because the proposed implementation of the CJ Hatchery programs is encompassed within the larger analyses of the FEIS. Consequently, the FEIS informs the analysis of the contribution of the proposed CJ Hatchery programs to the cumulative effects of hatchery programs in the Columbia River Basin, which includes the Okanogan River Basin. The FEIS is also incorporated by reference because it not only evaluates Mitchell Act-funded hatchery programs, but all the hatchery programs within the Columbia River Basin, including the CJ Hatchery programs. The FEIS evaluates likely effects of hatchery production on a broad species and multi-species scale (i.e., ESUs and DPSs) in the Columbia River Basin, while this EA specifically evaluates effects of the proposed CJ Hatchery programs at a site-specific level of detail.

The draft EIS analyzing Columbia River Basin hatchery operations and Mitchell Act funding included five alternatives (one no-action and four action alternatives) that were retained in the

FEIS (NMFS 2014c). NMFS then formulated and evaluated a sixth alternative, the Preferred Alternative, in the FEIS. The FEIS also provides an updated analysis of the original five alternatives evaluated in the draft EIS.

The specific programs described in the TRMP for the Proposed Action, including site-specific information about facility operations of the CJ Hatchery, were not considered in the FEIS. Nonetheless, the CJ Hatchery programs under the Proposed Action Alternative (Alternative 2) in this EA falls within Alternative 6 of the FEIS (NMFS 2014c). Specifically, FEIS Alternative 6 assumes that the Interior Columbia River Hatchery programs would meet stronger performance goals, meaning hatchery operations would be similar in type of program and release level compared to those in the Proposed Action. These cumulative effects do not include fisheries, RM&E, and kelt recondition program effects, which will be discussed in more detail in addition to the effects from Alternative 6 in the FEIS.

The FEIS examined the history of hatchery effects on other resources, such as water quality and quantity, salmon and steelhead, other fish species, wildlife, socioeconomics, and environmental justice resources. The hatchery effects on these resources from hatchery operations under FEIS Alternative 5 when compared to FEIS Alternative 1 (NMFS 2014c) are proved below in sections 5.4.1, 5.4.2, 5.4.3, 5.4.4, 5.4.5, 5.4.6. Additional resources not previously analyzed in the FEIS (cultural resources and human health and safety) will be analyzed below in sections 5.4.7 and 5.4.8.

5.4.1. Water Quality

Successful operation of hatcheries depends on a constant supply of high quality surface, spring, or groundwater that, after use in hatchery facilities, is discharged to adjacent receiving environments.

NMFS compared the FEIS Alternative 1 (No-action) and the FEIS Alternative 6 and determined that FEIS Alternative 6 would have the following water quality effects:

- maintain water quality, and
- potentially decrease the use of chemicals and antibiotics.

The CJ Hatchery programs and associated activities under the Proposed Action in this EA would not be expected to have any measurable effect on the Columbia River, Okanogan River, or tributary water quality because the hatchery water operations are the same as previously operated conditions. For the purpose of cumulative impacts analysis, these alternatives are analyzed together because the difference in degree of cumulative effects are not meaningfully different among the alternatives. Because reaches of the Okanogan mainstem and Similkameen Rivers are listed under the 2008 Clean Water Act section 303(d) list as water quality impaired for failure to meet temperature, dissolved oxygen, and pH standards (Ecology 2008), it may be difficult to discern new impairments. However, the hatchery programs included in the Proposed Action use water non-consumptively and monitor pollutants, thus the Proposed Action results in no change on water quality compared to current conditions when added to the other cumulative effects in the analysis area. Water quality in the mainstem Columbia River would not be measurably affected by the proposed hatchery programs because they are operated to meet NPDES permit

requirements. The slight increase in the number of juveniles released under the Proposed Action in this EA would not result in a substantial change in the amount of chemicals and antibiotics used, resulting in negligible effects on Columbia River Basin water quality.

Climate change could potentially exacerbate some of the effects of the Proposed Action on water quality. This is because increased air and water temperature, stream flow, acidity, precipitation, sediment, landslides, debris, and changes in plants and animal distributions from climate change could add to the effects of the Proposed Action on water quality. The magnitude of these potential effects is unknown; therefore, continuous monitoring of program and climate change environmental effects is needed.

5.4.2. Salmon and Steelhead

The Mitchell Act FEIS summarized the potential environmental consequences of hatchery operations in the Columbia Basin on ESA-listed and non-listed salmon and steelhead (NMFS 2014c). This summary concluded that hatchery programs would:

- affect natural-origin abundance where hatchery broodstock is collected from the natural-origin population;
- pose genetic risks to salmon and steelhead, affecting productivity and diversity at numerous hatcheries across the basin;
- employ weirs, which can impede spatial structure;
- pose risks of effects related to operation of hatchery facilities, such as blocked passage, reduced habitat, entrainment and diminished water quality;
- pose competition and predation risks to natural-origin salmon and steelhead;
- pose a risk of masking hatchery effects without adequate marking and sampling; and
- pose a risk of disease transfer to natural-origin populations.

This EA analyzed these identified risks specifically with respect to the CJ Hatchery programs and their effects in the Okanogan River basin under various alternatives. NMFS compared the FEIS Alternative 1 (No-action) and FEIS Alternative 6 and determined that for all of the ESUs/DPSs within the Columbia River Basin, including ESA-listed and non-listed populations, FEIS Alternative 6 would:

- reduce juvenile hatchery releases by 15 percent,
- reduce total adult salmon and steelhead abundance by 6 percent,
- reduce the total number of Columbia River fish harvested from 944,525 to 872,884
- introduce 12 new weirs,
- achieve stronger genetic diversity metrics for 93 percent of the primary populations in the Interior Columbia Recover Domain,
- 13 of the 17 salmon and steelhead ESUs/DPSs would have increases in abundance of natural-origin spawners (four would have decreases in abundance),
- 12 of the 17 salmon and steelhead ESUs/DPSs would have increases in the percentage of populations meeting the stronger genetic diversity performance metrics (5 would have no change), and
- reduce the percentage of natural-origin and hatchery-origin salmon and steelhead emigrating through the Columbia River estuary by 13 percent.

For the purpose of cumulative impacts analysis, the Alternatives 1, 2, and 4 from the EA (represented by Alternative 6 of the FEIS) are analyzed together because the difference in degree of cumulative effects are not meaningfully different among these alternatives. Alternative 6 from the FEIS would maintain the Okanogan summer steelhead conservation hatchery program to meet the conservation goal in the Okanogan River; however, this program would become an integrated program, replacing the Wells Pool stock with local Okanogan steelhead broodstock. Under Alternative 3, the hatchery programs would be eliminated; however, the effects of masking, competition and predation, prey enhancement, diseases, population viability, nutrient cycling, facility operations, and RM&E would be at most low beneficial within the Okanogan subbasin. Therefore, these effects are not likely to have any measurable cumulative effects on salmon and steelhead species beyond the effects analyzed in the FEIS.

In general, salmon and steelhead abundance naturally alternates between high and low levels on large temporal and spatial patterns that may last centuries and on more complex ecological scales than can be easily observed (Rogers et al. 2013). The effects of climate change on salmon and steelhead are described in ISAB (2007) and would vary among species and among species' life history stages. Effects of climate change may affect every species and life history type of salmon and steelhead in the cumulative effects analysis area (Glick et al. 2007; Mantua et al. 2009). Climate change, particularly changes in streamflow and water temperatures, would likely impact hatchery- and natural-origin salmon and steelhead life stages in various ways as summarized in Table 39.

Table 39. Examples of potential impacts of climate change by salmon and steelhead life stage under all alternatives. The effects of climate change on genetics, life history, competition and predation, prey enhancement, facility operations, masking, fisheries, disease, population viability, nutrients, and RM&E are noted in parentheses.

Life Stage	Effects
Egg	• Increased water temperatures and decreased flows during spawning migrations would increase pre-spawn mortality and reduce egg deposition for some species. • Increased maintenance metabolism would lead to smaller fry. • Faster embryonic development would lead to earlier hatching. • Increased mortality for some species because of more frequent winter flood flows. • Lower flows would decrease access to or availability of spawning areas. *(Likely to increase negative effects on genetics, life history, competition and predation, fisheries, disease and population viability. It is difficult to speculate whether facility operations, masking, and RM&E effects from climate change would be negative or positive)*
Spring and Summer Rearing	• Faster yolk utilization may lead to early emergence. • Smaller fry are expected to have lower survival rates. • Growth would be slower if food is limited or temperature increases exceed optimal levels. • Growth could increase where food is available, and temperatures are below stressful levels. • Lower flows would decrease habitat capacity. • Sea level rise would eliminate or diminish the tidal wetland capacity. *(Likely to increase negative effects on genetics, life history, competition and predation, fisheries, disease and population viability. It is difficult to speculate whether facility operations, masking, and RM&E effects from climate change would be negative or positive)*
Overwinter Rearing	• Smaller size at start of winter is expected to result in lower winter survival. • Mortality would increase because of more frequent floods. • Warmer winter temperatures would lead to higher metabolic demands, which may decrease winter survival if food is limited, or increase winter survival if growth and size are enhanced. • Warmer winters may increase predator activity/hunger, which can decrease winter survival. *(Likely to increase negative effects on genetics, life history, competition and predation, fisheries, disease and population viability. It is difficult to speculate whether facility operations, masking, and RM&E effects from climate change would be negative or positive)*
Out-Migration	• Earlier snowmelt and warmer temperatures may cause earlier emigration to the estuary and ocean either during favorable upwelling conditions, or prior to the period of favorable ocean upwelling. • Increased predation risk in the mainstem because of higher consumption rates by predators at the elevated spring water temperatures. *(Likely to increase negative effects on genetics, life history, competition and predation, fisheries, disease and population viability. It is difficult to speculate whether facility operations, masking, and RM&E effects from climate change would be negative or positive)*
Adult	• Increased water temperatures may delay fish migration. • Increased water temperature may lead to more frequent disease outbreaks. *(Likely to increase negative effects on genetics, life history, competition and predation, fisheries, disease and population viability. It is difficult to speculate whether facility operations, masking, and RM&E effects from climate change would be negative or positive)*

Sources: (Beamish et al. 2009; Beechie et al. 2013; Glick et al. 2007; ISAB 2007)

Previous and new developments associated with the increase in the human population (e.g., residential), accidental discharges of hazardous materials (e.g., oil), and the potential for landowner and developer noncompliance with regulations continue to affect aquatic habitat used by salmon and steelhead (Puget Sound Action Team 2007). These developments result in environmental effects such as land conversion, sedimentation, increased imperviousness of surfaces (increasing water runoff to streams), changes in stream flow because of increased consumptive uses, channelization in lower river areas, and barriers to fish passage (Quinn 2010). These environmental effects would continue to affect salmon and steelhead, especially those

species that reside in lower river areas (such as floodplains and estuaries) because that is where development tends to be concentrated.

Although regulatory changes for increased environmental protection (such as local critical areas ordinances), monitoring, and enforcement have helped reduce impacts, development and fisheries may continue to reduce salmon and steelhead habitat and contribute to salmon and steelhead mortality.

Restoration of habitat will improve salmon and steelhead habitat, with particular benefits to localized freshwater and estuarine environments where the activities occur.

Hatcheries in the Columbia and Okanogan River basins are designed to support fisheries, offset developmental impacts, and/or conserve native populations. Thus, CJ Hatchery programs may also be used as a tool to offset climate change impacts. However, hatcheries can also pose a number of risks to natural populations as described in Subsection 4.2. As NMFS continues to evaluate programs under the ESA, the number and degree of risks are anticipated to decrease over time. Thus, the Proposed Action has no change compared to current conditions on salmon and steelhead when added to the other cumulative effects in the analysis area.

The Mitchell Act FEIS does not specifically address salmon and steelhead fisheries; therefore, this section is in addition to those effects from the FEIS. It is likely that the salmon and steelhead fisheries in the analysis area would change over time. These changes are likely to reduce effects on natural-origin salmon and steelhead listed under the ESA. For example, effects on natural-origin salmon and steelhead would be expected to decrease over time to the extent that fisheries management programs continue to be reviewed and approved by NMFS under the ESA, as evidenced by the beneficial changes to programs that have thus far undergone ESA review. Fisheries management program compliance with conservation provisions of the ESA will ensure that listed species are not jeopardized and that “take” under the ESA from salmon and steelhead fisheries is minimized or avoided. Where needed, reductions in effects on listed salmon and steelhead may occur through changes in areas or timing of fisheries, or changes in types of harvest methods used.

5.4.3. Other fish species

The FEIS analyzed the effects of CJ Hatchery operations on listed and non-listed fish, which includes other fish species besides salmon and steelhead. The FEIS in analyzing the effects of CJ Hatchery operations on listed and non-listed resident-fish species determined that, depending on the species, hatchery juveniles and adults could either be prey for the listed/non-listed species, preyed upon the listed/non-listed species, and/or compete for resources with the listed/non-listed species (NMFS 2014c). The FEIS analyzed these effects by estimating the relative abundance of hatchery and natural-origin smolts and the total number of hatchery and natural-origin returning adults for each of the alternatives as compared to FEIS Alternative 1. NMFS compared the FEIS Alternative 1 (No-action) and the FEIS Alternative 6 and determined that FEIS Alternative 6 would:

- reduce juvenile hatchery releases by 15 percent, and
- reduce total adult salmon and steelhead abundance by 6 percent.

Under FEIS Alternative 6 the reduction in the total number of smolts in the Columbia River Basin would be expected to reduce the potential for competition with and predation on listed/non-listed species affected. However, this would also reduce the abundance of prey for those listed/non-listed species that consume salmonid smolts (NMFS 2014c). Under all of the alternatives in this EA, the effects would be expected to be similar because smolt releases would decrease compared to the FEIS Alternative 1, but the contribution of the smolt reductions to the overall effects in the Columbia River Basin would not be measurable.

The Mitchell Act FEIS does not specifically address resident fish fisheries; therefore, this section discusses additional effects from the FEIS. It is likely that the resident fish fisheries in the analysis area would change over time. However, these effects fall outside of anadromous waters; therefore, these effects will not be covered in this section because the effects of the Proposed Action is not discernible outside of anadromous waters.

Other fish species would likely respond to climate change in similar ways as salmon and steelhead. Thus, climate change has the potential to increase the effects under all of the alternatives on other fish species. Refer to Section 5.4.2, Salmon and Steelhead, for these potential effects.

5.4.4. Wildlife

As compared to FEIS Alternative 1, FEIS Alternative 6 would have the following wildlife effects:

- reduce the abundance of wildlife (i.e., birds, marine mammals, etc.).

The CJ Hatchery programs under the Proposed Action in this EA would not be expected to have a measureable effect on the abundance of wildlife within the Columbia River and Okanogan River basins, as identified under FEIS Alternative 6 (NMFS 2014c) because under the Proposed Action Alternative in this EA, the annual release goal of juvenile hatchery fish would be minimal in comparison to the annual release of an estimated 140,593,000 hatchery salmon and steelhead smolt into the Columbia River Basin under FEIS Alternative 1. Furthermore, the fisheries, RM&E, and kelt reconditioning programs are not likely to adversely affect wildlife.

Because the impacts of climate change on salmon and steelhead (Section 5.4.2, Salmon and Steelhead) as well as other fish species are thought to increase over time, this may also have negative impacts on other wildlife species that utilize anadromous and resident fish as a food source. Therefore, the impacts of climate change on these fish species may compound on wildlife. The magnitude of these potential effects is unknown; therefore, continuous monitoring of program and climate change environmental effects is needed.

5.4.5. Socioeconomics

As compared to FEIS Alternative 1, FEIS Alternative 6 would have the following socioeconomic effects (including those associated with tourism and recreation):

- not affect total commercial harvest in the UCR, but would decrease total commercial harvest by 10.4 percent,
- increase recreational harvest in the UCR by 19.2 percent, but would decrease total recreational harvest by 3.3 percent,
- not affect ex-vessel value in the UCR, but would decrease total harvest by 2 percent,
- increase economic impacts on personal income by 18.3 percent in the UCR, and increase total economic impacts on personal income by 0.1 percent, and
- increase economic impacts on jobs by 18.8 percent in the UCR, and decrease the total economic impacts on jobs by 0.3 percent.

The CJ Hatchery programs under all of the alternatives in this EA would not be expected to have a measurable contribution to the reductions in total harvest, ex-vessel value, and total economic benefit to income, jobs, and recreational expenditures in the Columbia River Basin. Any effects from Alternatives 1, 2, or 4 from this EA on socioeconomics would likely be slightly beneficial, due to small increases in smolt production and the addition of fisheries, RM&E, and kelt reconditioning programs. Moreover, the CJ Hatchery programs would likely help increase tribal fishing revenue of the CTCR, as smolt released directly contribute to tribal fisheries and additional tribal fisheries will be added.

The positive impacts of the actions on socioeconomics under Alternatives 1, 2, and 4 could partially be reversed due to increasing impacts of climate change on the environment in the project area. The expected effects of climate change on salmon and steelhead (Section 5.4.2. Salmon and Steelhead) may cause a decrease of available fish to be utilized for the CJ Hatchery programs from this TRMP. Some of the environmental impacts from climate change on the Pacific Northwest covered in this section (e.g., increased landslides) could also make it harder for humans to inhabit areas near hatcheries, thus, making it more difficult to continue the proposed CJ Hatchery program operations.

5.4.6. Environmental Justice

As compared FEIS Alternative 1, FEIS Alternative 6 would have the following environmental justice effects:

- increase tribal harvest by 787 fish,
- increase tribal fishing revenue in the UCR by an estimated $36,311,
- increase total tribal fishing revenue to an estimated $86,600 annually, and
- increase per capita income in Okanogan county by $6.25.

The CJ Hatchery programs under Alternatives 1, 2, and 4 in this EA would have a direct and positive impact on tribal fishing revenue within the Columbia and Okanogan River basins. This is because fish released in these programs directly contribute to tribal fisheries, and new tribal fishery would also be allowed under Alternatives 2 and 4. The CJ Hatchery programs would also produce a slight increase in returning adults, so this could also support local recreational and commercial fisheries in the mainstem Columbia River. Under Alternative 3, all hatchery operations would cease, likely decreasing any benefits of these programs on environmental justice.

The positive impacts of the actions under Alternatives 1, 2, and 4 on environmental justice could also be reversed due to increasing impacts of climate change on the environment in the project area. The expected effects of climate change on salmon and steelhead (Section 5.4.2, Salmon and Steelhead) may cause a decrease of available fish to be utilized for the CJ Hatchery programs from this TRMP. Some of the environmental impacts from climate change on the Pacific Northwest covered in this section (e.g., increased landslides) could also make it harder for humans to inhabit areas near hatcheries, thus, making it more difficult to continue the proposed CJ Hatchery program operations.

5.4.7. Cultural Resources

The Mitchell Act FEIS does not specifically address cultural resources; therefore, this section is in addition to those effects from the FEIS. The CJ Hatchery programs under Alternatives 1, 2, and 4 in this EA would have a direct and positive impact the tribal identity of the CTCR within the Columbia and Okanogan River basins. This is because fish released in these programs directly contribute to tribal fisheries, and new tribal fisheries would also be allowed under Alternative 2 and 4. These fishery would increase the number of salmon and steelhead available to tribal members for food and for ceremonial purposes. Thus, the actions under Alternatives 1, 2, and 4 would positively affect cultural resources available to the CTCR. The end of hatchery operations under Alternative 3 would have a direct negative impact on cultural resources available to the CTCR.

Climate change actions may reduce the number of salmon and steelhead available for harvest over time. This may reduce the number of salmon and steelhead available to tribal members for food, ceremonial purposes, and as a part of their tribal identity. This reduction in salmon and steelhead may also increase tribal reliance on other consumer goods. Although habitat restoration is likely to improve habitat for salmon and steelhead and may help mitigate the effects of climate change and development, the potential benefits of habitat restoration actions within the cumulative effects analysis area are difficult to quantify. The adverse effects of climate change would also be mitigated by hatcheries, which will likely ensure that some salmon and steelhead remain in the Tribes' Usual and Accustomed Fishing Areas.

5.4.8. Human Health and Safety

Climate change may negatively affect human health and safety. The CJ Hatchery operations covered under Alternatives 1, 2, and 4 of this EA do pose some potential low adverse effects on human health and safety through the release of chemicals and therapeutics through the hatchery effluent. Under Alternative 3, the hatchery operations would cease, and, therefore, any threats to human health and safety from the CJ Hatchery would be eliminated. It is likely that with increased development, increased pollution would occur that could potentially affect human health and safety, increasing susceptibility of humans to chemical exposures, but likely masking any effects of the hatchery chemicals and therapeutics. Thus, the actions under all alternatives would have no change compared to current conditions when added to other cumulative effects within the analysis area.

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