United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
510 Desmond Dr. SE, Suite 102
Lacey, Washington 98503

APR 15 2016

In Reply Refer To:
01EWFW00-2015-F-0366

Robert P. Jones, Jr., Chief
Anadromous and Inland Fisheries Program
Sustainable Fisheries Division
National Marine Fisheries Service
7600 Sand Point Way NE
Seattle, Washington 98115

Dear Mr. Jones:

Subject: National Marine Fisheries Service 4(d) rule determination for the Washington Department of Fish and Wildlife Early Winter Steelhead Hatchery Program in the Nooksack River Watershed

This letter transmits the U. S. Fish and Wildlife Service's (USFWS) Biological Opinion (Opinion) on the proposed National Marine Fisheries Service (NMFS) 4(d) rule determination for the Washington Department of Fish and Wildlife (WDFW) Nooksack River watershed early winter steelhead hatchery program located in Whatcom County, Washington, and its effects on bull trout (*Salvelinus confluentus*) and designated critical habitat for the bull trout. The NMFS determined that operation of the hatchery facilities would "adversely affect" bull trout and bull trout critical habitat. Formal consultation on the proposed action was conducted in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). Your January 28, 2015 letter for the early winter steelhead (*O. mykiss*) (EWS) program requesting formal consultation was received on January 28, 2015.

Your January 28, 2015 letter requested formal consultation for WDFW EWS programs in the Nooksack, Stillaguamish, and Dungeness River watersheds. The USFWS completed its reviews of the Dungeness and Stillaguamish programs in separate consultations (Dungeness, USFWS Consultation No. 01EWFW00-2014-F-0132; Stillaguamish, USFWS Consultation No. 01EWFW00-2016-I-0511). Therefore, the enclosed Opinion includes only the Nooksack River watershed EWS program and operations. It is based on information provided in the April 29, 2015, Biological Assessment, telephone conversations, emails, and other sources of information cited in the Opinion. A complete record of this consultation is on file at the Washington Fish and Wildlife Office in Lacey, Washington.

In an email dated March 14, 2016, NMFS determined that the proposed action will have "no effect" on marbled murrelets (*Brachyramphus marmoratus*) or northern spotted owl (*Strix occidentalis caurina*). The determination of "no effect" to listed resources rests with the action agency. The USFWS has no regulatory or statutory authority for concurring with a "no effect" determination, and no consultation with the USFWS is required. We recommend that the action agency document their analysis on effects to listed species, and maintain that documentation as part of the project file.

If you have any questions regarding the enclosed Opinion, our response to your concurrence request(s), or our shared responsibilities under the Act, please contact Mark Celedonia at (360) 534-9327, or Martha Jensen at 360-753-9000.

Sincerely,

Carolyn Scafidi

for Eric V. Rickerson, State Supervisor
Washington Fish and Wildlife Office

Enclosure

cc:
NOAA, Lacey, WA (T. Tynan)
WDFW, Olympia, WA (E. Kinne)

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

U.S. Fish and Wildlife Service Reference:
01EWFW00-2015-F-0366

NMFS 4(d) Rule Determination for WDFW Early Winter Steelhead Hatchery Operations in the Nooksack River Watershed

Whatcom County, Washington

Federal Action Agency:

National Marine Fisheries Service

Consultation Conducted By:

U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
Lacey, Washington

for Eric V. Rickerson, State Supervisor
Washington Fish and Wildlife Office

4/15/16
Date

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ACRONYMS AND ABBREVIATIONS

Act	Endangered Species Act of 1973, as amended (16 U.S.C. l531 *et seq.*)
BA	Biological Assessment
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHU	Critical Habitat Unit
EWS	early winter steelhead
FL	fork length
FR	Federal Register
HCP	Habitat Conservation Plan
HGMP	Hatchery and Genetics Management Plan
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
Opinion	Biological Opinion
PCE	Primary Constituent Element
PCSRF	Pacific Coastal Salmon Recovery Fund
RM	river mile
RPM	Reasonable and Prudent Measures
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington State Department of Ecology
WRIA	Water Resource Inventory Area

INTRODUCTION

This document represents the U. S. Fish and Wildlife Service's (USFWS) Biological Opinion (Opinion) based on our review of the National Marine Fisheries Service (NMFS) proposed 4(d) rule determination for the Washington Department of Fish and Wildlife (WDFW) Nooksack River watershed early winter steelhead (EWS) hatchery programs in Whatcom County, Washington. We evaluated the effects of the proposed action on the bull trout (*Salvelinus confluentus*) and designated critical habitat for bull trout in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). Your January 28, 2015 letter requesting formal consultation was received on January 28, 2015.

Your request for formal consultation on early winter steelhead also included the early winter steelhead programs in the Dungeness and Stillaguamish River watersheds. The USFWS completed its reviews of these programs in separate consultations: Stillaguamish, USFWS Consultation No. 01EWFW00-2016-I-0511; Dungeness, USFWS Consultation No. 01EWFW00-2014-F-0132.

This Opinion is based on information provided in the April 29, 2015, Biological Assessment, telephone conversations, emails, and other sources of information as detailed below. A complete record of this consultation is on file at the Washington Fish and Wildlife Office in Lacey, Washington.

The NMFS is proposing to authorize WDFW's Nooksack River watershed Early Winter Steelhead (*Oncorhynchus mykiss*) hatchery program under Limit 6 of the Act's section 4(d) rule for listed salmon and steelhead (50 CFR 223.203(b)(6)). Limit 6 allows for exemption of take of listed salmon and steelhead associated with joint Tribal/State fishery management plans developed under the United States v. Washington or United States v. Oregon settlement process. To be exempt under Limit 6, the joint fishery management plans must meet specific criteria and be subject to NMFS review and authorization. The NMFS proposes to determine that the Nooksack River EWS program, and associated operations at the Kendall Creek Hatchery, is consistent with Limit 6. The proposed hatchery operations will affect bull trout (*Salvelinus confluentus*) and bull trout critical habitat. The effects of these hatchery operations on bull trout, bull trout critical habitat are entirely encompassed by the effects of the NMFS determination.

CONSULTATION HISTORY

The USFWS received a request from the NMFS to initiate formal consultation on WDFW EWS hatchery programs in the Nooksack, Stillaguamish, and Dungeness River watersheds on January 28, 2015. The USFWS completed its reviews of the Dungeness and Stillaguamish programs in separate consultations.

A draft Biological Assessment (BA) for WDFW Nooksack River watershed salmon and steelhead hatchery programs and associated facilities was received from the WDFW on March 20, 2015.

The USFWS requested additional information on April 13, 2015, which was responded to by WDFW on April 29, 2015 with a revised draft BA.

In early January 2016, the WDFW provided staff to assist with completing the hatchery consultations and meet litigation-driven deadlines and timing for the release of juvenile fish.

From January 2016 through April 11, 2016 the USFWS and WDFW cooperated on providing additional information and filling analytical gaps in the draft BA that were necessary to complete the consultation, including the following: configuration and operation of the Kendall Creek weirs with regards to fish passage; location of the Kendall Creek Hatchery surface water intake in relation to the weirs and the upper extent of bull trout use; bull trout usage of Peat Bog Creek (McKinnon Pond water source); effects of Kendall Creek Hatchery and McKinnon Pond water withdrawals on surface water hydrology and habitat conditions; pollution control equipment in use at the two facilities; location where angling would occur for broodstock collection; landscaping chemicals used at the two facilities and proximity of chemical use to surface waters.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

A federal action means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas (50 CFR 402.02).

Introduction

The proposed action is determination by the NMFS (NMFS 2016a) whether the WDFW EWS hatchery program in the Nooksack River watershed and associated operations at the Kendall Creek Hatchery adequately address the criteria established for Limit 6 of the Act's section 4(d) rule for listed salmon and steelhead (50 CFR 223.203(b)(6)), including the Puget Sound steelhead Distinct Population Segment. The effects of the hatchery operations on bull trout are entirely encompassed by the effects of the NMFS determination. The NMFS determination will be made for the WDFW's on-going hatchery program that releases non-listed steelhead trout into the Nooksack River watershed. The determination would authorize the continued operation of the hatchery program as described in the WDFW's Hatchery and Genetics Management Plan (HGMP) (WDFW 2014). All activities necessary for broodstock collection, incubation, rearing, release, facility maintenance, and research, monitoring and evaluation of the Nooksack River EWS program at sites and facilities affiliated with this program would be authorized through the NMFS determination. These are summarized below and described in detail in the Biological Assessment (WDFW 2015b) and the HGMP.

Program and Facilities

The Nooksack River watershed EWS program is production-oriented, intended solely to provide fish for harvest. Fish for this program are derived from Chambers Creek (Puget Sound) stock, also known as early winter steelhead (EWS). This is a segregated program intended to keep hatchery-origin and naturally-reproducing fish genetically isolated from one another. This program is expected to operate in perpetuity.

Two facilities support this program and are proposed for operation and maintenance as part of the action (Figure 1):

- Kendall Creek Hatchery, a fully functional hatchery facility located near the mouth of Kendall Creek at river mile (RM) 46 of the North Fork Nooksack River. This facility includes the following features: two permanent channel-spanning weirs, a fish ladder, and holding pond (trap) on Kendall Creek; on-site groundwater withdrawals and surface water withdrawals from Kendall Creek; a pollution abatement settling pond; and return water (effluent) that is discharged back into Kendall Creek.

  The hatchery operates two weirs, separated by 1,500 feet, on Kendall Creek. The lower weir blocks all upstream moving fish and is used for broodstock collection. Blocked fish may volitionally enter an off-channel adult collection pond from late-May through mid-March. Some non-target, natural-origin species, including coho salmon (*Oncorhynchus kisutch*) and cutthroat trout (*O. clarkii*), are passed upstream into the stream reach between the two weirs. Others, including bull trout, steelhead, Chinook salmon (*O. tshawytscha*), and pink salmon (*O. gorbuscha*), are placed back in Kendall Creek below the lower weir. The upper weir directs streamflow into the facility. Passage above the upper weir is provided by a fish ladder.

- McKinnon Pond, a constructed asphalt pond used solely for rearing juvenile fish located at RM 4.4 on the Middle Fork Nooksack River. This facility is not currently being used for the EWS program. However, it may be used in the future and is included in the NMFS 4(d) authorization. Therefore, we evaluated effects of proposed facility operations should the facility be used for the EWS program in the future. There are no effects to bull trout associated with not operating the McKinnon Pond facility.

  This facility would withdraw and return surface water from a small unnamed tributary locally known as Peat Bog Creek. EWS would be reared here from December to March 1. Fish reared here would be transferred from the Kendall Creek Hatchery, and returned to the hatchery for final rearing and acclimation.

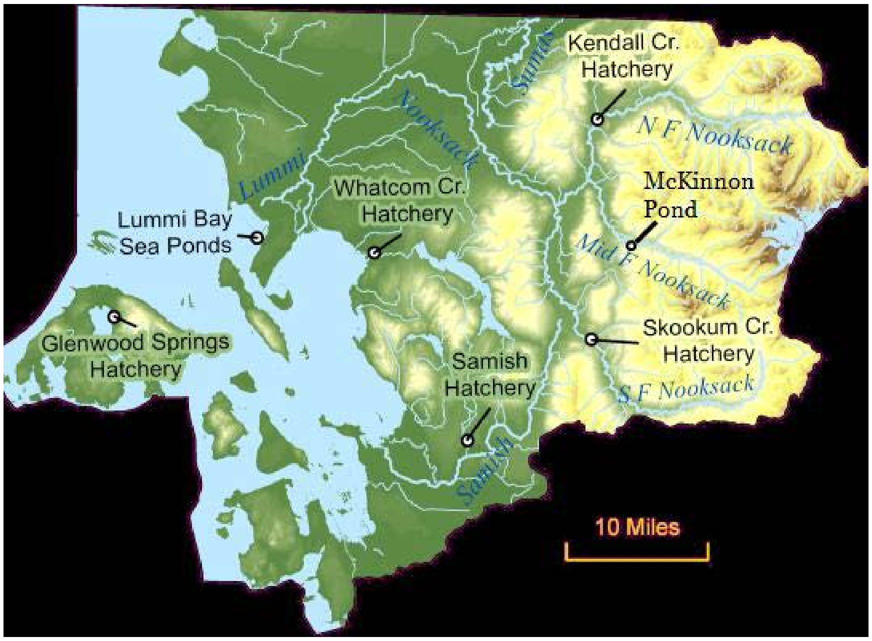

Figure 1. Nooksack River watershed vicinity, including locations of Kendall Creek Hatchery and McKinnon Pond.
Other facilities shown on the map are for reference only and are not included in this consultation. Nearly all hatchery early winter steelhead activities occur in the immediate vicinity of the Kendall Creek Hatchery and McKinnon Pond. See text (page 7) for a complete definition of the action area.

Hatchery broodstock collection

The Kendall Creek Hatchery weir and trap described above are operated from December through March 15 to collect EWS broodstock and to remove hatchery-origin EWS from the river. The weir is also operated from late May to December for other hatchery salmon programs which are not considered in this EWS consultation. The pond is checked daily for presence of fish when operating, and is monitored for debris and/or flow issues. Collection efforts infrequently (two times in the past ten years) include hook-and-line capture of returning adult EWS during open seasons and in open waters. These efforts are in the North Fork Nooksack River below the hatchery, lower reaches of the South Fork Nooksack River, and the mainstem Nooksack River, from December 1 through January 31. No collection of broodstock occurs at McKinnon Pond.

Release of hatchery juveniles

All hatchery-reared EWS are released directly from the Kendall Creek Hatchery. There are no off-station releases of hatchery EWS. The Kendall Creek Hatchery releases approximately 150,000 EWS smolts per year (plus or minus 10 percent). Fish are usually released in early- to mid-May, depending on their size and other conditions, and may be released as early as April 15.

Juvenile EWS are approximately 198 to 210 mm fork length[1] (FL) in size at release. Monitoring, reporting, and control of specific fish pathogens are conducted in accordance with up-to-date, scientifically-based disease control policies approved by the co-managers. These policies are currently detailed in The Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State (WDFW and WWTIT 2006), which requires fish to be certified as pathogen-free prior to release.

Water withdrawal and discharge

Water usage at both facilities is non-consumptive. All water used at the facilities is discharged to nearby surface waters within 1,500 ft of the point where it is withdrawn. The Kendall Creek Hatchery uses both groundwater and, when available, surface water from Kendall Creek. There are five wells that provide up to 27 cubic feet per seconds (cfs) of water, of which 7.7 cfs are used for the EWS program (NMFS 2016c, p. 43). Well water is passed through a de-nitro tower to improve the dissolved oxygen content. The surface water intake at the Kendall Creek Hatchery is upstream of the upper hatchery weir. Intake screening is not in compliance with current NMFS (2011a) standards, but meets superseded standards (NMFS 1995; NMFS 1996). The surface water supply at the hatchery is limited by water flows; Kendall Creek is a seasonal stream that can go dry during summer. Surface water is typically withdrawn at up to 24 cfs from October through April, and 6.7 cfs of this is used for the EWS program. Kendall Creek is not gaged, so the proportion of instream flow this represents is not known. However, visual inspection by WDFW staff suggests that the hatchery removes approximately 20 percent of the total creek flow during average flows for all hatchery programs combined. All water used at the hatchery is discharged back into Kendall Creek above the lower weir or immediately below the lower weir at the entrance to the fish ladder and adult collection pond.

The McKinnon Pond uses gravity fed surface water from a stream locally known as "Peat Bog Creek" (WRIA 01.0352). Up to 2 cfs of surface water may be diverted into the facility. No stream flow data are available for this water source either, but there is a 300-foot reach of the creek that is partially dewatered by the hatchery water withdrawal (distance between intake and discharge). The intake screening is in compliance with current NMFS (2011a) standards at McKinnon Pond.

Water rights for groundwater and surface water withdrawals at the Kendall Creek Hatchery are formalized through trust water right permits G1-10562c, G1-23261c, G1-23273 and S1-00317. Water rights for surface water withdrawals at McKinnon Pond are formalized through trust water right permit S1-27351.

The Kendall Creek Hatchery operates under the “Upland Fin-Fish Hatching and Rearing” National Pollution Discharge Elimination System (NPDES) general permit. The EWS program operates within the limitations established in permit WAG 13-3007 administered by the Washington Department of Ecology. The McKinnon Pond facility does not require an NPDES permit as it is under the 20,000 pound fish production threshold set by the Washington

[1] Fork length is a standard measure of length for juvenile salmonids. It is the length of the fish from the tip of the snout to the fork in the tail. All fish measurements in this Opinion are given in fork length.

Department of Ecology (WDOE). Outflow from McKinnon Pond enters a settling box and goes through approximately 100 yards of heavily vegetated stream channel before entering Peat Bog Creek, not far above the confluence with the Middle Fork Nooksack River.

Pathogen control

All facilities operate in accordance with up-to-date, scientifically-based disease control policies approved by the co-managers. These policies are currently detailed in The Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State (WDFW and WWTIT 2006). This policy details current minimum best management practices for monitoring, managing, and minimizing pathogens in the hatchery, and for minimizing amplification of pathogens in the hatchery and release of elevated pathogen loads into receiving waterbodies.

Maintenance Activities

Routine maintenance is required for "watered" facilities such as ponds, troughs, incubators, pumps, water diversions, outfalls, plumbing, and the weirs, as well as buildings and grounds. Removal of minor debris accumulations from surface water diversion structures and from discharge outfall structures is necessary to maintain their integrity and performance. Removal of large sediment accumulations requiring use of heavy equipment is not covered in this consultation, as this is not considered normal hatchery maintenance. Minor repairs and adjustments to the weirs are also required on occasion. Bank armoring or construction activities using heavy equipment that impact aquatic environments, shorelines, substrates or riparian vegetation are not considered routine hatchery operation and maintenance activities and are not proposed under this action. These types of activities would require individual consultations.

Maintenance of hatchery ponds is a regular occurrence. This involves the vacuuming and removal of accumulated sediment on the bottoms of hatchery ponds and raceways. All facilities have pollution abatement structures, which act as additional settling chambers for sediment-laden water. Solids are periodically removed from the abatement structures and disposed of at upland locations on the hatchery grounds or at commercial sites.

Other hatchery maintenance includes building and grounds maintenance, which includes painting, minor building repairs, security repairs such as lighting and fence repair, and weeding and mowing. No landscaping chemicals are used at McKinnon Pond. Typical chemicals that are used during ground maintenance at the Kendall Creek Hatchery include Roundup Promax or a similar aquatic-approved herbicide. Herbicide application is small in scale, follows manufacturer's label guidelines, and occurs during dry weather conditions (i.e., not raining or windy) to prevent runoff into surface waters. Roundup is used around buildings and landscape that are greater than 200 feet from the river. A backpack sprayer is used for all applications. On an annual basis, approximately 2.5 gallons of Roundup is used.

Conservation Measures

Conservation measures and best management practices to minimize effects to the aquatic ecosystem and naturally-reproducing fish populations are integrated within hatchery operations. These are described as appropriate throughout this document.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment. The action area for this proposed federal action is based on the geographic extent of brood stock collection, water withdrawal, effluent discharge, fish release, facility maintenance, research, monitoring and evaluation, and disturbances associated with these activities, including bull trout capture and handling, dewatering of stream channels, sediment disturbance, in-air sound, and inter-species interactions between released hatchery fish and bull trout. This generally includes anadromous reaches of rivers and streams in the Nooksack River watershed as well as Bellingham Bay (Figure 1). The USFWS anticipates that these are the areas in which physical or chemical effects due to the proposed action, including interrelated and interdependent actions, may be measurable. We anticipate that steelhead released from the hatcheries will distribute themselves in the marine environment in concert with local currents. Beyond this area and extending out into the Pacific Ocean, effects quickly become diluted and are no longer measurable even though individual steelhead released as part of this program may venture widely.

Term of consultation

The NMFS 4(d) rule, Limit 6 take authorization is open-ended in duration and is valid in perpetuity, subject to the permitee's compliance with program operational requirements and take limits specified in the NMFS determination, and required annual reporting.

The effects of the hatchery operations evaluated by this Opinion cannot reasonably be evaluated beyond 20 years. This is because climate change is expected to have substantial implications to baseline conditions, Nooksack core area bull trout, hatchery operations, and success of recovery programs. Because the nature and extent of climate change and the effects of climate change cannot be predicted with adequate certainty beyond 20 years, we cannot evaluate effects of the action on bull trout after this time. Therefore, this consultation will expire 20 years from issuance, at which point consultation on these actions must be reinitiated.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

The following analysis relies on the following four components: (1) the *Status of the Species*, which evaluates the rangewide condition of the listed species addressed, the factors responsible for that condition, and the species' survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) *Cumulative Effects*, which evaluates the effects of future, non-federal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the species' current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of listed species in the wild.

The jeopardy analysis in this Opinion emphasizes the rangewide survival and recovery needs of the listed species and the role of the action area in providing for those needs. It is within this context that we evaluate the significance of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

The designation of critical habitat for bull trout uses the term primary constituent elements (PCEs). The new critical habitat regulations (81 FR 7214) replace this with the term physical or biological features. This shift in terminology does not change the approach used in conducting our analysis, whether the original designation identified primary constituent elements or physical or biological features. References to PCEs in the following analysis should be viewed as synonymous with physical or biological features.

Our analysis of effects to critical habitat relies on the following four components: (1) the *Status of Critical Habitat*, which evaluates the range-wide condition of designated critical habitat for the bull trout in terms of PCEs, the factors responsible for that condition, and the intended recovery function of the critical habitat overall; (2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and (4) *Cumulative Effects*, which evaluates the effects of future, non-federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

The proposed federal action is evaluated to determine if it would likely result in a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of bull trout. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features.

STATUS OF THE SPECIES: Bull Trout

Status of the Species Rangewide

For a detailed account of bull trout biology, life history, threats, demography, and conservation needs, refer to AppendixA, Rangewide Status of the Species: Bull Trout.

Status of the Species in the Core Area and Marine Foraging Habitat in the North Puget Sound

Core areas represent the closest approximation of a biologically functioning unit for bull trout and consist of habitat that could supply all of the necessary elements for every life stage of bull trout (e.g., spawning, rearing, migration, overwintering, foraging). Core areas have one or more local populations of bull trout, and are also the basic units upon which to gauge recovery within a bull trout recovery unit.

The project is located in the Coastal Recovery Unit, Nooksack River core area, which supports 10 local populations of bull trout. Anadromous, fluvial, and likely resident bull trout from both of these local populations are present in the action area. Anadromous fish from these populations also forage and migrate within Bellingham Bay and nearby areas of Puget Sound.

Nooksack River Core Area

The Nooksack River core area completely overlaps the action area. Therefore, the status of the species in the core area is as described below in the section Environmental Baseline, Current Condition of the Species and Critical Habitat in the Action Area.

North Puget Sound

The action area includes North Puget Sound marine nearshore areas because hatchery EWS smolts and returning adults seasonally occupy this general area at approximately the same time as juvenile bull trout and foraging adults and subadults. Beyond the overlapping presence of these species over broad spatial and temporal scales, there are no other effects of the action in the North Puget Sound. The only possible effect to bull trout from the presence of hatchery EWS in the North Puget Sound are competitive interactions for rearing space and forage resources. However, such effects are extremely unlikely due to the broad expanse of marine habitat available to these species in the nearshore areas of North Puget Sound relative to the abundance of these two populations in this area. There are no data to suggest that there are negative competitive interactions between bull trout and hatchery EWS or natural-origin steelhead trout in the North Puget Sound marine nearshore, or any other marine nearshore habitat that bull trout occupy across their range. Therefore, the status of bull trout in the North Puget Sound marine environment will not be discussed.

STATUS OF CRITICAL HABITAT: Bull Trout

Status of Critical Habitat Rangewide

For a detailed account of the status of designated bull trout critical habitat, refer to Appendix B, Status of Designated Critical Habitat: Bull Trout.

Status of Critical Habitat in the Nooksack River Critical Habitat Subunit

The Nooksack River Critical Habitat Subunit completely overlaps the action area. Therefore, the status of critical habitat is as described below in the section Environmental Baseline, Current Condition of the Species and Critical Habitat in the Action Area.

Status of Critical Habitat in the North Puget Sound

Critical habitat not only includes designated freshwater habitats, but also extends offshore to the depth of minus 33 feet relative to the mean low low-water line, which is the photic zone and is considered to be the habitat most consistently used by bull trout in marine waters. Although the action area includes critical habitat within the North Puget Sound, effects to critical habitat from the proposed action are extremely unlikely to occur outside of the Nooksack River. Therefore, the status of Critical Habitat in the nearshore marine areas of North Puget Sound will not be discussed.

ENVIRONMENTAL BASELINE: Bull Trout and designated Bull Trout Critical Habitat

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed federal projects in the action area that have undergone section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress.

General Features and Characteristics of the Action Area

The Nooksack River flows in a westerly direction, entering the Puget Sound near the City of Bellingham. The Nooksack River watershed is a large basin that includes three forks (North Fork, Middle Fork, and South Fork) and encompasses approximately 825 square miles. The North and Middle Forks join at river mile (RM) 41.5. Downstream of here, the South Fork joins at RM 38.5. The river downstream from the confluence of the South Fork is typically referred to as the mainstem. The watershed includes steep, mountainous terrain in the upper watershed, foothills in the middle, and a broad valley and alluvial fan adjacent to Puget Sound. Upper watershed areas to the east lie on the west slope of the Cascade Mountains, and include the headwaters of each of the three forks. The flow regime in the Nooksack River is characterized by high flows from snowmelt in late spring and early summer, and variable high flows in winter from rainfall. Lowest annual river discharges usually occur during September and October. The North and Middle Forks receive meltwater from glaciers on the slopes of Mount Baker. Much of the basin is situated on top of thick alluvial deposits.

Lands below RM 35 are primarily in private ownership. Land use in this area is predominantly agriculture, rural residential and urban development within and near the city of Bellingham. Lands between RM 35 and middle to upper sub-watershed areas of the three forks are privately owned or owned by the State of Washington, and contain mostly active timberlands and second growth forest at various stages of succession. Lands above RM 51 on the North Fork, RM 14 on the Middle Fork, and RM 32 on the South Fork are in federal ownership, comprised of the Mt. Baker - Snoqualmie National Forest. Approximately half of these national forestlands are protected within designated wilderness areas.

Impacts to salmonid habitat

The lower watershed (below RM 35) has been considerably altered from historical, pre-disturbance conditions, and generally provides limited marginal to poor habitat for salmon, trout, and char (Smith 2002). The main channel of the river is confined and highly simplified, generally lacking in large wood, pools, and physical and hydraulic complexity. Substrates are unstable, scouring at relatively low flows. Valuable and highly-productive side channel and off-channel habitat has been substantially reduced. One of the most significant factors contributing to these deficient habitat conditions are decades-old levees along both banks of the river. These levees have disconnected the river from the floodplain and substantially reduced the quantity and quality of salmonid habitat, increased flood flow velocities and depths, impaired large wood recruitment, and reduced subsurface flows and groundwater inputs. Other contributors to the current state of the lower river include the following: historical removal of large wood from the main channel and tributaries; widespread logging and deforestation of riparian, floodplain, and upland areas throughout the watershed; hydraulic constrictions imposed by bridges; installation and maintenance of riverbank protection (i.e., riprapped banks); surface water diversion for irrigation and municipal use; groundwater extraction; and polluted runoff and contaminated groundwater from widespread agricultural operations. Logging and logging roads in the upper watershed likely increase sediment inputs and contribute to channel instability and aggradation in the lower watershed. Much of the lower river floodplain has been converted to agriculture, rural residential development, and urban development, which limits future restoration opportunities. A variety of small-scale restoration efforts along the mainstem and in tributaries - including large wood additions, planting trees and creating riparian buffers, conservation easements, levee setbacks, and dike breaches - have either been implemented or are planned, which will help improve habitat conditions.

The middle and some upper portions of the watershed have been subject to large-scale commercial timber extraction since the early- to mid-1900s. Timber extraction and deficient construction and management of logging roads have resulted in unstable slopes, mass wasting, erosion, and high inputs of fine sediments into the river. Timber extraction and road construction and maintenance practices have improved, in part through the 1990 Land and Resource Management Plan, as amended by the 1994 Northwest Forest Plan and its associated Aquatic Conservation Strategy. However, logging roads that were constructed prior to these plans taking effect continue to degrade water quality and aquatic habitats. The U.S. Forest Service has identified and implemented some restoration projects (e.g., road decommissioning, and tree planting) to help address these issues.

With continued human population growth projected in the region, threats to salmonid populations and the loss and degradation of their habitat will persist. Areas along the mainstem and lowland tributaries are most likely to be affected by growth and development pressures. When riverine lands are converted to residential and urban areas, forest cover and ecosystem processes are altered or lost and the change is commonly permanent.

The altered state of the river channel, riparian areas, and floodplain along the mainstem Nooksack River and lower reaches of the tributaries is one of the primary factors that have contributed to the decline of salmonid populations in the watershed. Abundance of naturally-reproducing anadromous salmon and steelhead populations in the Nooksack River watershed is generally low. Nutrient pulses related to adult spawner abundance have been identified as a primary driver of individual growth and population productivity in salmonids (e.g., Moore et al. 2008; Rinella et al. 2012; Walters et al. 2013, p. 516; Nelson and Reynolds 2014), including bull trout (Zimmerman and Kinsel 2010, p. 30; Copeland and Meyer 2011, pp. 937-938). Thus, habitat degradation and diminished salmon abundance may operate synergistically to persistently suppress salmon populations.

Fisheries

There are currently no fisheries for bull trout in the Nooksack River watershed or nearby marine waters. However, bull trout are highly susceptible to incidental capture in fisheries targeting other species when those fisheries overlap in time and space with bull trout. Incidentally-captured bull trout are exposed to inadvertent injury and immediate and delayed mortality associated with hooking, suffocation (e.g., from gill nets), handling, stress and physical exhaustion, and predation (e.g., Arlinghaus et al. 2007, pp. 105-134). Poaching and intentional killing (i.e., from anglers that believe bull trout are a threat to their preferred target species or confuse them with other species) are also a concern in some areas.

Various commercial, Tribal, and recreational fisheries in the Nooksack River watershed and nearby marine waters are open annually. It is currently not legal to retain bull trout captured in any of these fisheries. Fishing regulations, including when and where the fishing seasons are open, may change from year to year. Most, if not all, of these fisheries are supported by WDFW and Tribal hatchery programs in the Nooksack River watershed and have been ongoing since before bull trout were listed. The bull trout 4(d) rule, implemented at the time of bull trout listing in 1999, exempts take associated with fisheries operated in accordance with applicable state, National Park Service, and Native American Tribal laws and regulations. The USFWS considers fisheries supported by the WDFW and Tribal hatchery programs as meeting requirements for exemption under the 4(d) rule. Therefore, for the purposes of this consultation, effects from hatchery-supported fisheries are considered part of the baseline and not interrelated and interdependent effects of the hatchery operations.

Specific effects to and take of bull trout from fisheries in the Nooksack system were not evaluated or determined at the time of listing and 4(d) rule implementation. At least some of the fisheries that operate in the area overlap in time and space with bull trout presence, including recreational fisheries targeting hatchery EWS. By-catch of bull trout in commercial and Tribal fisheries is not reported, and creel surveys to evaluate fishing pressure and incidental capture of bull trout in recreational fisheries have not been performed. Thus, impacts from fisheries are likely, but cannot be determined with any certainty.

Hatcheries

The history of steelhead hatchery production in the Nooksack River watershed is described in the HGMP (WDFW 2014, p. 38). Winter run steelhead releases into the Nooksack River basin started in the 1900s. From 1909 to1939, the Kendall Creek Hatchery spawned small numbers of local steelhead broodstock, with a low of 6 females and a high of 76 females (Ernst 1950, cited in WDFW 2014, p. 38). Norgore and Anderson (1921, cited in WDFW 2014, p. 38) mention that a North Fork tributary near the hatchery named Racehorse Creek was a location of steelhead collection. There were few hatchery releases from the Kendall Hatchery in the 1940's. The Washington Department of Game began releasing Chambers Creek origin steelhead annually into the Nooksack watershed in 1972, primarily with smolts from Bellingham Hatchery (WDG 1984, cited in WDFW 2014, p. 38). The Washington Department of Game, in cooperation with sports clubs, began rearing natural origin Nooksack steelhead in 1981. From the 1970s through 2010, eggs originating from several facilities, including the Bellingham Hatchery, were transferred to the Kendall Creek Hatchery for incubation and distribution to off-station acclimation and release sites. Fish were released from the Kendall Creek Hatchery for the first time in 1998. The last egg transfer to the Kendall Creek Hatchery from an out-of-basin facility took place in 2010. Starting in 2008, the Whatcom Creek Hatchery was used as an additional rearing and release site and as a back-up broodstock collection site for the Kendall Creek program. The Whatcom Creek program was discontinued in 2014. Additionally, steelhead were released into the Samish River as late as 2008 but was discontinued after that time. Other WDFW and Tribal hatchery programs for various Pacific salmon species have also been operating in the Nooksack River basin for many years.

Other Restoration and Recovery Activities

The Pacific Coastal Salmon Recovery Fund (PCSRF) was established by Congress to help protect and recover native salmon and steelhead populations and their habitats (NMFS 2011c). The states of Washington, Oregon, California, Idaho, and Alaska, and the Puget Sound, Pacific Coastal and Columbia River tribes, receive PCSRF appropriations from NMFS each year. The fund supplements existing state, tribal and local programs to foster development of Federal-state-tribal-local partnerships in salmon and steelhead recovery. The PCSRF has made substantial progress in achieving program goals, as indicated in annual Reports to Congress, workshops, and independent reviews. Salmon and steelhead habitat restoration and protection projects in the Puget Sound region, including within the Nooksack River watershed action area, have been funded and implemented through the PCSRF process.

Current Condition of Bull Trout in the Action Area

The Nooksack core area comprises the Nooksack River and its tributaries, including the North, Middle, and South Fork Nooksack Rivers. Fluvial and anadromous are the most abundant life history forms in the Nooksack core area. Presence of the resident life history form is unknown (USFWS 2008a, Nooksack Core Area Chapter, p. 1). Bull trout spawning occurs in the North, Middle, and South Fork Nooksack Rivers and their tributaries. Post-dispersal rearing and subadult and adult foraging probably occur throughout most of the accessible reaches below barriers to anadromous fish. Overwintering likely occurs primarily in the lower mainstem reaches of the three forks and in the mainstem Nooksack River. Bull trout from the Nooksack core area are known to utilize marine waters at least as far south as the Swinomish Channel in Puget Sound, based on limited acoustic tagging efforts (Goetz et al. 2007, p. 9).

Bull trout and Dolly Varden (*S. malma*) co-occur in the Nooksack core area, but the level of interaction between the two species and degree of overlap in their distributions is unknown. However, limited genetic analysis and observational data suggest Dolly Varden in this core area inhabit stream reaches above barriers to anadromous fish, while bull trout primarily occupy the accessible stream reaches below the barriers. Other salmonids that are present in this watershed include coho (*Oncorhynchus kisutch*), steelhead/rainbow trout (*O. mykiss*), cutthroat trout (*Salmo clarki*), pinks (*O. gorbuscha*), chum (*O. keta*) (Currence 2007, pp. 3, 6), Chinook (*O. tshawytscha*) (USFWS 2008a, Nooksack Core Area Chapter, p. 2), and sockeye (*O. nerka*) (WSCC 2002, p. 50).

The Nooksack core area population is considered at "potential risk" for extirpation (USFWS 2008b, p. 35; USFWS 2015b). The status of the bull trout core area population can be summarized by four key elements necessary for long-term viability: 1) number and distribution of local populations, 2) adult abundance, 3) productivity, and 4) connectivity (USFWS 2004, Vol. I p. 215).

<u>Number and Distribution of Local Populations</u>

Ten local populations are recognized within the Nooksack core area (USFWS 2004, pp. 56-74; USFWS 2015a, pp. A-10 to A-11): 1) Lower Canyon Creek, 2) Glacier Creek, 3) Lower Middle Fork Nooksack River, 4) Upper Middle Fork Nooksack River, 5) Lower North Fork Nooksack River, 6) Middle North Fork Nooksack River, 7) Upper North Fork Nooksack River, 8) Lower South Fork Nooksack River, 9) Upper South Fork Nooksack River, and 10) Wanlick Creek. Spawning areas used by the local populations are believed to be small and dispersed. Core areas with 5 to 10 interconnected local populations are at an intermediate risk of local extirpation and adverse effects from random naturally-occurring events (USFWS 2004, pp. 216-218). Most, but not all, Nooksack core area local populations are interconnected (see Connectivity section below).

Adult Abundance

The Nooksack core area adult abundance is estimated between 250 to 1,000 individuals based on limited spawn survey data. Eight of the local populations likely have fewer than 100 adults each, based on the relatively low number of migratory adults observed returning to the core area. The North Fork has more confirmed spawning areas than the Middle or South Forks (Currence 2007, p. 5). In the North Fork, Thompson Creek has the most consistent and highest numbers of bull trout redds recorded of any stream in the Nooksack watershed (Currence 2007, p. 6). In the Middle Fork, the anadromous life history form is mostly or entirely blocked at the Bellingham Diversion Dam, and fluvial individuals are infrequently recorded in the upper portion of the system, although survey efforts are limited (USFWS 2008a, Nooksack Core Area Chapter, p. 2). Incidental observations of South Fork Nooksack River bull trout redds are occasionally noted during Chinook surveys in the upper river. More often though, incidental observations of staging anadromous adults are recorded during the Chinook surveys, usually between river miles 21 and 30. Although not complete counts, recorded numbers of adults are consistently in the single digits, suggesting a small population size (USFWS 2008a, Nooksack Core Area Chapter, p. 2). The Glacier Creek local population has approximately 100 adults, based on incidental redd counts and available spawning habitat. The Upper North Fork Nooksack River local population may support 100 adults, based on the persistent, small numbers of spawning adults observed in tributaries and available side channel habitat.

The Nooksack core area is at risk from genetic drift because it likely contains fewer than 1,000 spawning adults per year (USFWS 2004, pp. 218-224). Eight local populations are at risk from inbreeding depression because they are believed to contain fewer than 100 spawning adults per year (USFWS 2004, pp. 218-224). Only two local populations – the Glacier Creek and the Upper North Fork Nooksack River populations – are not at risk from inbreeding depression.

Productivity

Currently, there is insufficient information to determine a trend in the size of the core area population (USFWS 2008a, Nooksack Core Area Chapter, p. 4). Estimates of population growth rate that indicate a population is consistently failing to replace itself are at increased risk of extirpation. The Nooksack core area is considered at increased risk of extirpation until sufficient information is available to assess productivity.

Connectivity

There is connectivity among most of the local populations, except for the Middle Fork Nooksack River. The Bellingham Diversion Dam on the Middle Fork Nooksack River obstructs fish movement into and out from the reach occupied by the Upper Middle Fork Nooksack River local population (USFWS 2004, p. 190). High seasonal temperatures on reaches of the South Fork Nooksack River limit migratory movements into and out of this area, temporarily isolating the three local populations found here (Lower South Fork Nooksack River, Upper South Fork Nooksack River, and Wanlick Creek) (USFWS 2004, p. 160). There is a partial barrier limiting movement into and out of the Lower Canyon Creek local population due to previous Whatcom County flood control work (Nooksack Natural Resources et al. 2005, pp. 88-89), although

Whatcom County may improve passage as part of a restoration effort proposed in 2013. There are road culvert barriers in several local populations. For these reasons, the Nooksack core area is considered at intermediate risk of extirpation from habitat isolation and fragmentation.

Acoustic tagging studies have shown that anadromous bull trout have extensive and complex migrations throughout the nearshore areas of Puget Sound (Goetz et al. 2004; Goetz et al. 2007). These study results strongly indicate that connectivity within nearshore habitats and among major river basins within Puget Sound are necessary for the anadromous form to complete its life history.

<u>Changes in Environmental Conditions and Population Status</u>

Since the bull trout listing, federal actions occurring in the Nooksack core area have had short- and long-term effects to bull trout and bull trout habitat, and have both positively and negatively affected bull trout. These actions have included: statewide federal restoration programs with riparian restoration, replacement of fish passage barriers, and fish habitat improvement projects; federally funded transportation projects involving repair and protection of roads and bridges; and section 10(a)(1)(B) permits for Habitat Conservation Plans addressing forest management practices. Capture and handling during implementation of section 6 and section 10(a)(1)(A) permits have directly affected bull trout in the Nooksack core area.

The number of non-federal actions occurring in the Nooksack core area since the bull trout listing is unknown. Activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably negatively affect bull trout. Additionally, a significant number of mass wasting events have been associated with timber management and associated road construction in the Nooksack basin (WSCC 2002, pp. 91, 93, 117, 130).

Salmon recovery efforts are improving conditions for bull trout. Although directed toward salmonids other than bull trout, the regional salmon recovery plan under the Shared Strategy for Puget Sound (SSPS 2007) and watershed-scale implementation under the Puget Sound Partnership have resulted in general aquatic habitat improvements that are likely benefitting bull trout. Also, the Critical Areas Ordinance and Shoreline Management Plan were updated for Whatcom County, which may benefit bull trout. However, there are concerns with implementation of the ordinance, particularly with variances and enforcement of buffers within riparian areas (Currence, in litt. 2008).

Climate change is expected to have substantial adverse effects to bull trout in the Nooksack core area. The Nooksack core area is a glacier fed system except for the South Fork Nooksack River, which does not receive glacial melt (USFS 2006, p. 35). The North and Middle Forks are somewhat buffered against increases in high temperatures due to glacial melt. However, as glaciers continue to contract and recede with climate change, summer discharges are expected to decrease and temperatures increase (Snover et al. 2005). Glacier recession is also expected to increase the incidence of debris flows (Seattle Post Intelligencer 2008; Chiarle et al. 2007), negatively impacting spawning and rearing areas. Several debris flows from the Deming Glacier were documented in 2013. Such debris flows may occur in more Mount Baker drainages due to increased glacial contraction and exposure of the glacial moraines (MBVRC 2013a; MBVRC 2013b).

The South Fork Nooksack River is seasonally acutely temperature impaired, with peak temperatures in the 20 °C to 24 °C range (Smith 2002, pp. 172-173). Some impairment of water temperatures have also been observed within the North and Middle Forks. The mainstem Nooksack River is generally temperature-impaired throughout the summer months. The temperature criterion in this reach of the river is 16 °C. The annual 7-day average maximum water temperatures measured at the long-term monitoring station at Cedarville (WDOE station 01A120) between 2001and 2010 rarely exceeded 18 °C (19 °C in 2005 and 2009).

Climate change is expected to result in less annual snow pack and earlier loss of snow pack, which is likely to reduce summer low flow migration and rearing habitats. Climate change is also expected to increase fall and winter storm intensities and increase the amount of precipitation that is delivered as rain instead of snow. Thus, redd scour is likely to increase.

Additionally, as summer migrants, adults and sub-adults are exposed to annual minimum flows and maximum temperatures, and thus will likely be more prone to disease. In several recent years, pre-spawn mortalities of adult Chinook salmon have been determined to have *Columnaris* as the primary cause of death (Nooksack Natural Resources et al. 2005, p. 80). This disease becomes progressively more lethal with increased temperatures and has even been an issue in the North Fork, though less commonly than in the South Fork. The effects of this disease on bull trout are not currently known.

<u>Threats</u>

There are three primary threats to bull trout in the Nooksack core area (USFWS 2015a, p. A-10 to A-11):

Upland/Riparian Land Management: Legacy Forest Management and Agricultural Practices. Impacts associated with legacy forest management and agricultural practices have led to channelization and habitat degradation within lower river Foraging, Migration and Overwintering habitats, which are key to the persistence of the anadromous life history form.

Water Quality: Climate Change. Seasonal high water temperatures in the South Fork Nooksack River are expected to be exacerbated, likely impairing migration, especially for the anadromous life history form, and reducing available spawning and rearing habitat for South Fork Nooksack local populations.

Connectivity Impairment: Fish Passage Issues. Bellingham Water Diversion on Middle Fork Nooksack continues to limit access by the migratory life history form to habitats above the diversion and impairs connectivity between the Lower and Upper Middle Fork local populations.

Additional threats to the Nooksack core area bull trout population include the following:

- Depressed abundances of naturally-reproducing salmon and steelhead populations in the Nooksack River system likely limit important bull trout forage resources and bull trout abundance. Abundance of spawning anadromous salmonids has been found to influence abundance, growth rates, and size of bull trout (Kraemer 2003, pp. 5, 9-10; Zimmerman and Kinsel 2010, pp. 26, 30; Copeland and Meyer 2011, pp. 937-938), as well as other species (Bentley et al. 2012; Nelson and Reynolds 2014). Anadromous salmonids provide a forage resource in the form of eggs and freshwater-rearing juveniles, which can make up a substantial proportion of the bull trout diet in freshwater habitats (Lowery and Beauchamp 2015). Spawning fish and carcasses also increase ecosystem productivity, thereby increasing the abundance of aquatic invertebrates and resident fishes (e.g., Cederholm et al. 1999; Moore et al. 2008; Copeland and Meyer 2011; Rinella et al. 2012), which may also provide important components of the bull trout diet (Lowery and Beauchamp 2015). Recovering naturally-reproducing salmon and steelhead populations is an important component of bull trout recovery in the Puget Sound region.

- Past timber harvest and harvest-related activities, such as roads, have caused the loss or degradation of a number of spawning and rearing areas within local populations, as well as foraging, migration, and overwintering habitats. State forest practice regulations were significantly revised following the Forest and Fish Agreement (FFR 1999; WFPB 2001). These regulations are expected to significantly reduce the level of future timber harvest impacts to bull trout streams on private lands; however, most legacy threats from past forest practices will likely continue to be a threat for decades.

- Residential development, road networks, agricultural practices, and related stream channel and bank modifications have caused the loss and degradation of foraging, migration, and overwintering habitat in mainstem reaches of the major forks and in a number of tributaries. Stormwater runoff from residential development and urbanization continues to be a significant contributor of non-point source water pollution (WSCC 2002). Recent work by the National Oceanic and Atmospheric Administration suggests that the synergistic effects of pesticides found in the waters of the region may pose a greater risk to salmonids than previously estimated (Scholz et al. 2006). Impacts to marine foraging habitats have been, and continue to be, greatly affected by urbanization along nearshore areas in Bellingham Bay and the Strait of Georgia. For example, the Cherry Point herring stock was once a substantial prey resource, and its current diminished condition may appreciably affect bull trout.

- Fisheries pose a general threat to bull trout, as discussed in the Environmental Baseline: Fisheries Section above.

- Climate change is expected to negatively affect bull trout via elevated water temperatures during migration, spawning, and rearing periods; redd scour due to increased peak flows; and decreased habitat quantity as a result of lower summer flows. Climate change will exacerbate the low flow issues and elevated water temperature problems currently existing in the watershed.

- The potential for brook trout and brook trout/Dolly Varden hybrids, detected in many parts of the Nooksack core area, to increase their distributions is a significant concern. Brook trout are likely more widespread within the system than first suspected (Huddle pers. comm. 2003a in USFWS 2008a, Nooksack Core Area Chapter, p. 6). The magnitude of this threat is expected to increase over time if habitat continues to be degraded in the system, and migratory life history forms of bull trout remain in low abundance. Brook trout appear to adapt better to degraded habitats than bull trout (Clancy 1993; MBTSG 1996). Because elevated water temperatures and sediments are often indicative of degraded habitat conditions, bull trout may be subject to stresses from both interactions with brook trout and degraded habitat (MBTSG 1996). The low numbers of adult bull trout observed at known spawning sites may further allow brook trout to become more dominate within the core area.

- There is a potential for impact to subadult and adult bull trout from *Columnaris* outbreaks due to elevated water temperatures in the South Fork Nooksack River. *Columnaris* has been detected in upstream migrating and holding adult salmon (Nooksack Natural Resources et al. 2005, p. 80).

Factors Responsible for the Condition of the Species

The habitat conditions and threats detailed above are responsible for the condition of bull trout in the Nooksack River core area.

Current Condition of Bull Trout Critical Habitat in the Action Area

Anadromous-accessible portions of the Nooksack River watershed are either designated Critical Habitat or are considered Essential Excluded Habitat (75 FR 63898-63979, October 18, 2010). Upper watershed areas in the Nooksack River's three forks lie in the Mt. Baker-Snoqualmie National Forest. Middle and lower reaches of the three forks are mostly state or privately owned. The mainstem of the Nooksack River is almost exclusively in private ownership. Nearly all of the Essential Excluded Habitat (areas excluded from critical habitat designation) are waters adjacent to nonfederal lands covered by legally operative incidental take permits for habitat conservation plans (HCPs) issued under section 10(a)(1)(B) of the Act, including the Washington State Department of Natural Resources HCP and the Washington Forest Practices HCP.

Critical habitat not only includes designated freshwater habitats, but also extends offshore to the depth of minus 33 feet relative to the mean low low-water line, which is the photic zone and is considered to be the habitat most consistently used by bull trout in marine waters. Although the action area includes critical habitat within the North Puget Sound, effects to critical habitat from the proposed action are extremely unlikely to occur outside of the Nooksack River watershed. Therefore, we will focus our description of the critical habitat to that within the Nooksack River.

Within the critical habitat, the primary constituent elements (PCEs) of critical habitat for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. The PCEs and their baselines are as follows:

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

The action area contains springs, seeps, groundwater sources, and/or subsurface water in the hyporheic zone that provides cold water to the river. Springs and seeps occur in the basin as well as groundwater fed off-channel habitats. The effect of groundwater and surface water withdrawal in the lower watershed for residential, municipal, and agricultural purposes is not well understood, but most likely has a negative impact on this PCE.

In the Kendall Creek sub-basin, groundwater comes to the surface in the lower sub-basin and is the primary contributor to surface water flows in Kendall Creek (WDOC 1960, p. 87). A 1960 assessment of the Kendall Creek sub-basin by the Washington Department of Conservation indicated that the sub-basin has a limited supply of groundwater (WDOC 1960, pp. 28-30). There are several existing water rights issued for groundwater in the basin (Smith 2002, p. 183), including those for the Kendall Creek Hatchery wells. The Kendall Creek sub-basin is characterized by permeable, unconsolidated sub-surface materials (WDOC 1960, pp. 40, 87). Wells in the lower watershed likely intercept groundwater that would otherwise enter lower Kendall Creek and the North Fork Nooksack River in the vicinity of Kendall Creek. Therefore, groundwater withdrawals likely degrade this PCE in Kendall Creek and localized areas of the North Fork Nooksack River near the mouth of Kendall Creek, although the full extent of the degradation is not known.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

The general condition of this PCE in the Nooksack River watershed is as described in the Connectivity subsection in the Environmental Baseline: Current Condition of Bull Trout in the Action Area section above. In Kendall Creek, two permanent weirs associated with the Kendall Creek hatchery near the mouth of the creek are complete obstructions to bull trout movement into foraging habitat. Thus, this PCE in Kendall Creek is not currently functioning. Water withdrawals from Peat Bog Creek for operation of the McKinnon Pond can lower flows in a 300-foot reach of this stream during the summer months. This is not substantial enough to block fish movement.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Anadromous salmon and steelhead provide a critical forage resource to bull trout in coastal streams and rivers. In the Nooksack River watershed, the abundance and status of many species of salmon and steelhead are not known, although several stocks are believed to be depressed (Smith 2002, p. 44-51; WDFW 2016). Anthropogenic impacts to aquatic habitat and habitat-forming processes in the Nooksack River watershed are similar to those in other Puget Sound watersheds. These impacts are a primary factor for low and depressed abundances of salmon and steelhead in these watersheds. Therefore, it is likely that salmon and steelhead populations in the Nooksack River watershed are similarly low or depressed. Low abundance of naturally-spawning salmonids represents a substantial limitation in the bull trout forage base and general ecosystem productivity. Abundance of other forage resources, such as resident fishes and aquatic invertebrates, are likely also negatively affected by diminished abundance of salmon and steelhead. Ongoing habitat restoration and salmon recovery efforts are expected to improve the forage base for bull trout. Historical and persistent effects from hatchery programs may limit the abundance and long term viability of naturally-reproducing salmonid population. In the lower watershed, the construction and continued presence of levees and other shoreline armoring has decreased the contribution of terrestrial prey organisms to the river by reducing the amount of functioning riparian vegetation, large wood, and through other impacts to stream habitat such as reduced wetlands and floodplain connectivity. For these reasons, we expect that this PCE is moderately to severely impaired.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and substrates, to provide a variety of depths, gradients, velocities, and structure.

This PCE is severely impaired in the lower watershed, and moderately to severely impaired within the three forks, depending on location in the lower watershed. In the lower watershed, historical channel straightening (channelization), levee and dike construction, large wood removal, and riparian deforestation have greatly reduced and simplified aquatic habitats and continue to constrain the processes that create and maintain complex environments (Smith 2002). Similar impacts affect the sub-watersheds of the three forks, although these impacts are somewhat less than in the mainstem. Sedimentation from historical logging practices in the sub-watersheds of the three forks has also contributed to simplification of the aquatic environment.

PCE 5: Water temperatures ranging from 2 °C to 15 °C (36 °F to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

Smith (2002, pp. 163-173) performed an extensive analysis of water temperature throughout the Nooksack River watershed. Water temperatures appear suitable throughout the year in the upper reaches of the North Fork and Middle Fork Nooksack River subwatersheds (Smith 2002, pp. 166-173). Elevated water temperatures above 15 °C in the summer occur in the mainstem, in the South Fork Nooksack River, in the lower North Fork and Middle Fork Nooksack Rivers, and in tributaries throughout the three forks. The South Fork Nooksack River is acutely temperature impaired, with peak temperatures presently approaching in the 20 °C to 24 °C range. Some impairment of water temperatures have also been observed within the North and Middle Forks. The mainstem Nooksack River generally exceeds 16 °C during the summer months, but rarely exceeds 18 °C. The combined effects of riparian vegetation removal, wetland loss, and sedimentation (mostly from historical logging activities) contribute to water temperature problems throughout the basin. Surface and groundwater withdrawals also contribute to temperature impairments and loss of cold water refugia, especially in the lower watershed. As a result, this PCE is moderately degraded in the lower watershed and functional in upper watershed areas, except for some reaches of the South Fork where temperature impairments are more severe during summer months.

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival.

Smith (2002, pp. 90-145) performed an extensive analysis of factors contributing to streambed and sediment conditions throughout the Nooksack River watershed. Smith's (2002) analysis was based on such factors as road density, logging history, landslide frequency, channel stability, large wood abundance, and proportion of fine sediment, among other factors. Data on many of these factors were generally limited, which limited the analyses and certainty of conclusions. Based on the information presented in Smith (2002), this PCE appears to be unimpaired or minimally impaired in the uppermost reaches of the three forks that are in and near designated wilderness areas. Downstream of these areas, spawning and rearing habitat have been substantially affected by historical logging and logging road practices, which have delivered and continue to deliver large quantities of coarse and fine sediments to the rivers and their tributaries. This, combined with historical large wood removal, has resulted in unstable channels with high rates of scour and deposition which are detrimental to success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. As a result, this PCE is minimally to moderately impaired in the middle and lower reaches of the North Fork and Middle Fork mainstems and their tributaries. Bull trout spawn and rear in several tributaries to the South Fork, with the largest local population in Hutchinson Creek. Based on the limited available information on substrate conditions for spawning areas in tributaries to the South Fork of the Nooksack, we presume that this PCE is functioning, though some of the lower reaches are likely impaired.

PCE 7: A natural hydrograph, including peak, high, low, and base flows within historical and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

Smith (2002, pp. 173-189) performed an extensive analysis of factors contributing to hydrologic conditions throughout the Nooksack River watershed. Smith's (2002) analysis was based on such factors as channelization (channel straightening and confinement with levees), surface and groundwater water withdrawals, land cover and land use (e.g., mature conifer forest, impervious surface, etc.), and loss of wetlands, among other factors. Based on the information presented in Smith (2002), this PCE appears to be unimpaired or minimally impaired in the uppermost reaches of the three forks that are in and near designated wilderness areas. Downstream of these areas, this PCE rapidly becomes impaired. Channelization and loss of mature conifer forest cover alter the hydrograph and contribute to increased peak flows in the three forks. A diversion dam at RM 7.2 on the Middle Fork Nooksack River withdraws water for the City of Bellingham municipal water supply, affecting the hydrograph and diminishing flows. The mainstem below the three forks is affected by channelization, ground and surface water withdrawals, extensive loss of wetlands and forests, and impervious surface. This PCE is severely impaired in the lower reaches of the three forks and in the mainstem downstream to the mouth.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Smith (2002) performed an analysis of factors contributing to water quality (Smith 2002, pp. 163-173) and water quantity (Smith 2002, pp. 173-189) conditions throughout the Nooksack River watershed. The primary water quality concern throughout the basin is temperature, as described above for PCE 5. In addition, the mainstem Nooksack River has elevated levels of nitrogen (including ammonia and nitrate), phosphorus, turbidity, suspended solids, and metals. These are largely due to the expansive agricultural land uses and practices in the lower watershed, in addition to highway runoff, surface mining, and solid waste disposal. Extensive surface and groundwater withdrawals affect water quantity in the mainstem. In the South Fork Nooksack River, removal of large wood from the channel and sediment inputs from historical logging operations has created elevated rates of aggradation, filled pools, and diminished in-channel water quantity, particularly in the lower and middle reaches of the sub-watershed. Data on large wood and pool abundance in the North and Middle Forks are lacking, but these sub-watersheds have been subjected to similar historical logging operations and impacts as the South Fork. Thus, it is likely that water quantity conditions are similar. For these reasons, we conclude that this PCE is severely impaired in the mainstem, and is moderately to severely impaired in the middle and lower reaches of the three forks and their tributaries. This PCE is not impaired or is minimally impaired in upper watershed areas of the three forks in and near designated wilderness areas.

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Brook trout (*Salvelinus fontinalis*) are established in several lakes and outlet creeks in the Nooksack River watershed. They are established in the Upper North Fork downstream of Wells Creek and Nooksack Falls. Brook trout are present in Wells Creek, and have spawned with Dolly Varden to produce hybrids in Canyon Creek (USFWS 2004). Brook trout abundance and distribution throughout the Nooksack River watershed is not known.

Factors Responsible for the Condition of Critical Habitat

The factors responsible for the condition of critical habitat are as described above.

Conservation Role of the Action Area

The action area completely overlaps the Nooksack River core area. Maintaining and recovering bull trout at the core area level is considered essential to re-establishing a viable range-wide population (USFWS 2004; USFWS 2015a). Threats that need to be addressed in the action area to ensure recovery are as described above.

Climate Change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change. "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

As described above, climate change is a threat to bull trout in the Nooksack River, particularly as it interacts with and exacerbates effects of other anthropogenic impacts in the watershed that are already causing sedimentation, elevated water temperatures, and diminished water flows during seasonal low flow periods.

EFFECTS OF THE ACTION: Bull Trout and designated Bull Trout Critical Habitat

The effects of the action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

Direct effects are those effects from the project that immediately affect bull trout. Indirect effects are those impacts from the projects that are later in time and may occur outside of the areas directly affected by the actions. Indirect effects must be reasonably certain to occur before they can be considered as an effect of the actions. Indirect effects may occur from changes in habitat that affect bull trout ability to use habitat or through other changes such as decreased prey abundance and availability. In this section, we examine the response of bull trout to the various stressors and determine the effects these may have on individual bull trout, the core population, and the Recovery Unit. First we examine the elements of the action to which bull trout will be exposed. Then we assess which actions will result in beneficial effects to bull trout, followed by those aspects with insignificant and/or discountable effects. Lastly, we consider both the direct and indirect effects of actions which will result in adverse effects to bull trout.

Exposure Analysis

Bull trout are found throughout the Nooksack River watershed including the nearshore marine environment. Information on adult movement and distribution is known primarily through data documented in USFWS (2004) and USFWS (2008a). Spawning and early juvenile rearing is limited to the mainstems and tributaries of the three forks: in the North Fork, above RM 52 (Boulder Creek); in the Middle Fork, above RM 0 (confluence with North Fork at RM 41.5); in the South Fork above RM 10 (Hutchinson Creek). In reference to the EWS facilities, the Kendall Creek Hatchery is 6 miles downstream from North Fork spawning and early juvenile rearing areas. The McKinnon Pond facility is within bull trout spawning and early juvenile rearing habitat (4.4 miles above the lowest extent and 13.1 miles below the upper extent of spawning and early juvenile rearing in the Middle Fork). Water withdrawals from Peat Bog Creek affect rearing and foraging habitat for bull trout in that stream. There is little empirical data on spawn timing or post-spawning movements of Nooksack core area bull trout. However, these fish likely spawn from September through mid- to late-December similar to other Puget Sound rivers. After spawning, fluvial and anadromous fish move to lower sections of the three forks and into the mainstem Nooksack River to overwinter. Habitat degradation becomes more severe in the lower watershed. Therefore, most overwintering likely occurs in the middle reaches of the watershed.

Incubation time and fry emergence time in the Nooksack River are not known, although fry likely emerge from May through July or August. It is generally believed that bull trout fry and subyearlings remain relatively near spawning areas to rear, and that downstream movement does not begin until fish are yearlings or older (McPhail and Baxter 1996, p. 16). Some downstream movement of young juveniles can be expected due to density-dependent displacement and/or displacement from high flow events (Goetz 1989, p. 24-25; McPhail and Baxter 1996, p. 16; Bellerud et al. 1997, p. 36-49; Downs et al. 2006, p. 198). The possible existence of intentional downstream fry or subyearling outmigrations is unknown (e.g., Mesa et al. 2008, p. 71). In the Nooksack River basin, physical habitat conditions and summertime water temperatures become less favorable to young bull trout juveniles downstream of the lowest documented spawning areas in each of the three forks. Thus, most or all early juvenile rearing is expected to occur upstream from the lowest documented spawning areas in each of the three forks, although the possibility of some small degree of early juvenile rearing downstream cannot be discounted. Juveniles younger than smolt-aged are believed to remain in the upper watershed near spawning areas, and rear in main channels and side-channels.

Migration timings of Nooksack core area smolts, subadults, and adults are not known with certainty, but can be inferred from the very limited data available for the Nooksack basin (Goetz et al. 2007) and empirical data from other Puget Sound rivers (e.g., Ogg et al. 2008; Zimmerman and Kinsel 2010; Hayes et al. 2011; Goetz et al. 2012; WDFW 2015a). Bull trout smolts likely outmigrate from freshwater rearing areas to marine waters from mid-March through mid-August, with the peak likely occurring between mid-May and mid-July. Adult anadromous bull trout move to marine habitats from March through May. Anadromous adults likely return to freshwater from May through August. Anadromous and fluvial fish likely migrate upriver to spawning habitats from mid-July through mid- to late-December, and migrate downriver to overwintering habitats after spawning.

Bull trout have been observed in both of the creeks that the Nooksack River watershed EWS hatchery facilities are sited within (Kendall Creek and Peat Bog Creek). Each creek is also designated critical habitat: Kendall Creek is designated foraging, migrating, and overwintering habitat; Peat Bog Creek is designated spawning and rearing habitat. Kendall Creek is noted as a productive salmon stream important for seasonal foraging by migratory bull trout (USFWS 2010, p. 105). Peat Bog Creek is within the home watershed of a known bull trout local population (Lower Middle North Fork Nooksack River). Peat Bog Creek provides foraging and possibly overwintering habitat for bull trout, although its use of bull trout for these purposes has not been documented. Peat Bog Creek has not been extensively surveyed for juvenile bull trout (USFWS 2010, p. 103; Barkdull, in litt. 2016). The USFWS (2010, p. 103) indicated that Peat Bog Creek may provide spawning and rearing habitat. However, no adult bull trout spawners have been documented in the creek despite extensive spawner surveys for other species during times when bull trout would be expected to be spawning (Barkdull, in litt. 2016).

This exposure analysis is based on information provided above and in the following sections: Status of the Species; Status of the Species in the Core Area and Foraging, Migration, and Overwintering Area; and, Environmental Baseline.

Beneficial Effects

The EWS program may provide very limited direct forage benefits to bull trout. In freshwater, only large bull trout (> 500 mm) are likely to consume fish from the EWS program due to the relatively large body size of the released hatchery fish (198 to 210 mm FL) (Keeley and Grant 2001, p. 1126; Lowery 2009, p. 48, 57). In addition, the hatchery EWS program is designed to ensure that released EWS smolts rapidly outmigrate to marine waters. Thus, most hatchery-released EWS emigrate seaward within a few weeks of release (Goetz et al. 2008; Moore et al. 2010; NMFS 2016a; NMFS 2016b), which limits their temporal availability as bull trout prey in the river. In nearshore marine habitats, bull trout appear to rely primarily on surf smelt (*Hypomesus pretiosus*), Pacific herring (*Clupea pallasii*), and Pacific sand lance (*Ammodytes hexapterus*) for forage, although some juvenile salmonids, including coho salmon (*Oncorhynchus kisutch*), may also be consumed (Goetz et al. 2004, p. 101-114). Steelhead trout have not been documented in bull trout diets while in the nearshore (Goetz et al. 2004, p. 101-114).

The hatchery EWS program is designed to minimize the abundance of hatchery-origin spawners in the wild. Although some straying and natural spawning will occur, this is expected to be minimal, thus providing a very small degree of benefit to bull trout from eggs, carcass flesh, juveniles, and stimulation of ecosystem productivity.

Insignificant and/or Discountable Effects

The following effects are anticipated to be insignificant and/or discountable for the reasons described.

Genetic and Ecological Effects to Naturally-reproducing Steelhead Trout

It is generally recognized that hatchery programs and practices may, in some circumstances, suppress the abundance of naturally-reproducing salmon and steelhead populations (e.g., Araki 2008; Naish et al. 2008; Kostow 2009; HSRG 2014, p. 1). This is of concern to bull trout because naturally-reproducing populations of salmon and steelhead often provide critical forage resources to bull trout (e.g., Lowery and Beauchamp 2015). Persistent genetic and ecological hatchery influences that suppress naturally-reproducing salmon and steelhead populations may also suppress growth rates, survival, and abundance of bull trout.

The naturally-reproducing populations of steelhead trout in the Nooksack watershed are listed entities, belonging to the Puget Sound Steelhead Trout Distinct Population Segment, which was listed as threatened in 2007. As a listed entity under NMFS jurisdiction, the NMFS evaluated effects of the WDFW EWS hatchery program on these populations (NMFS 2016a). The NMFS concluded that the hatchery program will not appreciably reduce the likelihood of survival and recovery in the wild of these fish. Further, the NMFS consultation imposes mandatory Reasonable and Prudent Measures and Terms and Conditions that ensure the WDFW hatchery program minimizes the amount and extent of take of listed, naturally-reproducing steelhead trout in the Nooksack River watershed. In addition, the NMFS will monitor these activities, and data collected, to ensure that the activities viewed as having potentially negative effects on steelhead trout are reduced in effect or adjusted to further reduce effects. The NMFS will also monitor emerging science and information related to interactions between hatchery fish and fish from natural populations and will consider that re-initiation of consultation with the WDFW is required in the event that new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in the existing consultations. For these reasons, we conclude that any effects of the hatchery programs on limiting or suppressing the abundance of naturally-reproducing populations of steelhead trout, and by extension the bull trout forage base, are insignificant.

Effects to Bull Trout Forage Base and Foraging Opportunities

The presence and operation of the lower weir prevents bull trout from accessing the majority of Kendall Creek, a productive salmon stream which bull trout would likely forage in if they could. However, based on catch records of bull trout at the hatchery off-channel trap, few bull trout attempt to access the creek. This may be due to several reasons: 1) low numbers of bull trout in the Nooksack River watershed that utilize this area of the basin; 2) suppressed salmonid production in the Kendall Creek sub-basin from habitat degradation and/or effects of the hatchery infrastructure and operations; and/or 3) reluctance of bull trout to enter the fish ladder and off-channel pond. Bull trout that are prevented from foraging upstream of the facility have access to other foraging habitat nearby. For these reasons, we expect the obstructions caused by the weirs to have insignificant effects to bull trout.

The hatchery weirs and their operation also prohibit or present partial obstructions to adult salmonids migrating upstream. Limiting access to spawning habitat may reduce the bull trout forage base provided by juvenile salmonids in the North Fork and mainstem Nooksack River. Natural-origin chum salmon are used for broodstock in the hatchery's integrated production program to provide fish for harvest. Non-target, natural-origin species are either passed upstream into the stream reach between the two weirs (coho salmon, cutthroat trout), or are placed back in Kendall Creek below the lower weir (bull trout, steelhead trout, Chinook salmon, pink salmon). Stream flows are typically quite low during the Chinook and pink salmon migration and spawning seasons making the stream unsuitable for migration and spawning. During the last 10 years no pink salmon have entered the hatchery trap. Flows during steelhead spawning period are adequate for migration and spawning, however, steelhead do not appear to utilize Kendall Creek for spawning upstream of hatchery weirs. WDFW hatchery records indicate that during the last 10 years no natural-origin steelhead have entered the hatchery trap.

Hatchery water withdrawals, which reduce flows in source streams between the withdrawal and discharge points, may also reduce the quantity of rearing habitat and juvenile abundance in these partially dewatered reaches. Hatchery surface water intake screening meet 1995 and 1996 guidelines (NMFS 1995; NMFS 1996), but do not meet current guidelines (NMFS 2011a) and may therefore not adequately protect juvenile salmonids.

These limitations to abundance and productivity of juvenile salmonids are expected to represent a small proportion of the overall abundance and productivity within the Nooksack River watershed for the following reasons: 1) the proportion of salmonid spawning and rearing habitat upstream of the weirs is small compared to the abundance of spawning and rearing habitat in the entire Nooksack River watershed; 2) many species either cannot (Chinook, pink) or do not (steelhead) utilize the creek for spawning and rearing; and 3) effects of the weirs are partially mitigated by passing adult coho salmon above the weirs, where they spawn and contribute juvenile offspring to the bull trout forage base in the creek and river below the weirs. Because few bull trout attempt to enter Kendall Creek for foraging, and because the overall reduction in the Nooksack River watershed forage base is small, effects to bull trout associated with lack of access to foraging habitat and reductions in their forage base associated with hatchery infrastructure and water withdrawals are considered insignificant.

Pathogen Risk

Naish et al. (2008, p. 141-149) identify several mechanisms by which salmonid hatchery operations may affect pathogen risk to and disease status of naturally-reproducing or wild fish. Although these risks exist in theory, the authors note that:

> …there are but a few well-documented cases in which hatchery fish have been shown to affect directly the health or infectious disease status of wild stocks. Nevertheless, this remains a considerable area of debate and a major source of scientific uncertainty requiring additional research. (Naish et al. 2008, p. 143)

Many of these risks, including the most severe, are precluded when hatcheries follow good fish health protocols and do not transfer fish to or from distant watersheds (Naish et al. 2008, p. 141-149). The WDFW EWS program implements such measures. The hatchery program is operated in compliance with “The Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State” protocols (WSTIT and WDFW 2006). These are science-based protocols for pathogen prevention, diagnosis, treatment, and control, and corresponding BMPs for hatchery operations and sanitation practices. When implemented, these protocols help contain any pathogen outbreaks at hatchery facilities, minimize release of infected fish from hatcheries, and reduce the risk of fish pathogen transfer and amplification to natural-origin fish (NMFS 2011b). High egg-to-smolt survival rates at the hatchery facilities - as reported in sections 9.1.1 and 9.2.1 of the HGMPs – are an indicator that these protocols are successful at containing disease outbreaks.

Disease and pathogen dynamics between hatcheries and naturally-reproducing fish is not well studied or understood (Naish et al. 2008, pp. 141-149, 166-167). However, the current balance of evidence suggests that hatchery operations managed in accordance with current science-based protocols (e.g., WSTIT and WDFW 2006) do not result in an increased risk of disease and pathogens to bull trout. For these reasons, we conclude that fish pathogen transmission and amplification risks are insignificant.

Discharge of Hatchery Effluent

<u>Assumptions</u>

The following assumptions apply to our analysis of hatchery effluent discharge:

- Hatchery effluent discharge at the Kendall Creek Hatchery is implemented consistent with NPDES permit number WAG 13-3007 issued by the Washington Department of Ecology (WDOE).

- Chemotherapeutic agents are used in accordance with Food and Drug Administration and American Fisheries Society guidelines.

- Cleaning agents are used at lowest effective concentrations.

<u>Factors considered, species response, and risk of harm or mortality</u>

Hatchery operations require the use and discharge of surface and well water into streams adjacent to the operating facilities. Hatchery water discharge may affect several water-quality parameters in the aquatic system. Hatchery facility waste products may include uneaten food, fish waste products (i.e., fecal matter, mucus excretions, proteins, soluble metabolites such as ammonia), chemotherapeutic agents (e.g., Formalin), cleaning agents (e.g., chlorine), drugs and antibiotics, nutrients (e.g., various forms of nitrogen and phosphorus), parasitic microorganisms, and algae. Some of these waste products are in the form of suspended solids and settleable solids, while others are dissolved in the water. Water temperature may increase and dissolved oxygen decrease as water flows through hatchery raceways and holding ponds. Maintenance activities, such as vacuuming and removal of accumulated sediment on the bottoms of hatchery ponds and raceways, may temporarily elevate the concentration of some contaminants in the hatchery water system.

Under its NPDES permit, the Kendall Creek Hatchery operates an off-line settling pond to remove suspended solids and settleable solids before the water is released back into the Kendall Creek. Required monitoring indicates that these measures are effective at substantially minimizing the release of uneaten food, fecal matter, and associated nutrients. The McKinnon Pond facility produces less than the threshold of 20,000 pounds of fish per year set by the WDOE as the limit for concern regarding hatchery effluent discharge effects. Nonetheless, the WDFW operates a settling box and allows effluent to flow through a heavily vegetated channel to remove suspended solids and settleable solids before water is released into Peat Bog Creek. In addition, the number of fish being reared in the ponds is relatively small (50,000 fish at 8 fish per pound or smaller); therefore, the quantity of feces, uneaten food, and other pollutants in the effluent is correspondingly small. Flows in Peat Bog Creek and the Middle Fork Nooksack River are generally high when fish are being reared in the ponds and effluent is being discharged. Thus, the effluent would be diluted rapidly near the point of discharge. For these reasons, we do not expect suspended solids or settleable solids to measurably degrade or diminish habitat functions such as water quality or prey resources used by individual bull trout.

The existing NPDES permits do not specify discharge levels or monitoring requirements for dissolved oxygen. Dissolved oxygen must be maintained within the facilities at levels sufficient to support rearing salmonids. Thus, dissolved oxygen is not depleted to levels detrimental to juvenile salmonids. Furthermore, any decrease in dissolved oxygen is expected to be restored near the point of discharge because the discharge water volumes are relatively small compared to the volume of water in the receiving waterbodies where bull trout may occur.

The Kendall Creek Hatchery and McKinnon Pond facilities are relatively small. Water temperatures must be maintained within the hatchery facilities at cold enough levels to support rearing juvenile salmon. Thus, temperatures in the hatchery facilities do not rise to levels that are detrimental to juvenile salmonids. The opportunity for warming prior to the water being discharged into the receiving waterbody is also very minor. In addition, the discharge volume is relatively small compared to the volume of the receiving waters. For these reasons, warming is expected to be very minor and the effect of any warming is expected to be ameliorated very near the point of discharge.

Most, if not all, chemicals used at hatcheries are used sporadically and in relatively low volumes. This is particularly true for chemotherapeutic agents, which must be used at levels that will not appreciably affect the fitness or survival of juvenile salmonids rearing at the hatchery. Although potentially more harmful, cleaning agents are also used sporadically, but are diluted prior to being discharged. Hatchery effluent is anticipated to be rapidly diluted near the point of discharge to the receiving waterbody, but bull trout may detect and be attracted to the effluent. The likelihood of injury to bull trout from exposure to effluent is related to the frequency of occurrence, length of time they are exposed (e.g., how long bull trout remain in the immediate vicinity of the effluent discharge points), and concentration of substances within the effluent water. Due to the sporadic nature of chemical and chemotherapeutic use, and the low concentrations that are commonly achieved at or very near the point of discharge, we expect that deleterious effects to bull trout are minimal.

Bull trout are opportunistic predators that feed on the eggs and juveniles of anadromous salmon and resident fish. They likely locate profitable feeding areas using chemical cues left in the water by their prey. Effluent from the hatchery likely contains relatively high concentrations of these cues, and could serve as a feeding attractant to bull trout, which is rewarded during the time when smolts are released, but may not be rewarded at other times. This "attractive nuisance" effect may keep bull trout from feeding as efficiently as they might if they were responding to feeding cues from natural food resources. Bull trout are regularly documented below other hatchery facilities during the time of year when hatchery fish are released. However, beyond these anecdotal observations, there are no data or evaluations documenting the scope and magnitude of these effects, or the extent to which this phenomenon may be detrimental to bull trout.

Bull trout may be attracted to or deterred from hatchery effluent at various times depending on the exact physical and chemical properties of the effluent, which is determined by numerous factors including, but not limited to, chemicals in use at the hatchery, usage patterns, and volume of rearing fish present. These behavioral responses and the effects of exposure are not well studied, but appear to be minor. Therefore, we conclude that effects to bull trout growth, reproduction, and survival from discharge of hatchery effluent are insignificant.

Surface Water and Groundwater Withdrawals and Diversions

In Kendall Creek, surface water and groundwater withdrawals will not affect water quantity in reaches of the creek accessible to bull trout. All water used at the hatchery is discharged to the creek immediately below the lower weir. Bull trout are currently not provided passage above the lower weir. Water that passes through the hatchery may experience a very small increase in temperature which would otherwise occur. Any small increase in temperature is expected to be buffered at the point of discharge by streamflow in Kendall Creek and would not be measureable. Groundwater extraction may intercept cold groundwater that would otherwise have entered the North Fork Nooksack River through upwelling. However, groundwater extraction for the EWS program is relatively small (7.7 cfs) compared to North Fork Nooksack River flows ($\geq$ 300 cfs during seasonal low flow). In addition, extracted water enters the North Fork Nooksack River at the mouth of Kendall Creek. Therefore, it is unlikely that water quantity will be diminished in any part of the river, although less groundwater may enter the river via upwelling. Any effects to groundwater upwelling into the river are expected to be small and localized. For these reasons, effects of Kendall Creek Hatchery water withdrawals are considered insignificant.

Bull trout will not be exposed to the water diversion structure (upper weir) and fish ladder on Kendall Creek because bull trout are not passed above the lower weir. However, these structures may be an impediment to upstream migration of other adult anadromous salmonids that are passed above the lower weir (coho salmon). Such an impediment may reduce the abundance of adult spawning coho above the upper weir, and reduce the abundance of juvenile coho salmon available for forage to bull trout. These effects were discussed in the section Insignificant and/or Discountable Effects: Effects to Bull Trout Forage Base and Foraging Opportunities above.

The McKinnon Pond facility withdraws up to 2 cfs of water from Peat Bog Creek. McKinnon Pond water withdrawals do not inhibit fish passage through the affected reach of Peat Bog Creek, as evidenced by passage of adult Chinook salmon and steelhead trout. Visual inspection also suggests that the discharge of Peat Bog Creek is much greater than the water withdrawal, although this has not been quantified. In addition, extensive spawner surveys by the WDFW for other species that spawn at similar times a bull trout have not documented any spawning bull trout in Peat Bog Creek. Therefore, we assume that vulnerable life stages (spawning adults, incubating embryos, and post-emergent fry) are not exposed to effects of water withdrawal. For these reasons, effects of McKinnon Pond water withdrawals are considered insignificant.

The risk of entrainment and impingement are discountable for the following reasons: 1) bull trout will not be exposed to screening at Kendall Creek because the intake and screening are above the upper dam where bull trout are not passed; and 2) surface water intake at the McKinnon Pond is screened according to current NMFS (2011a) guidelines which prevents entrainment and/or impingement.

Maintenance Activities

Maintenance of hatchery equipment and infrastructure (e.g., weirs, fish ladders, holding ponds, raceways) occurs intermittently and during short time periods. Such maintenance may generate some disturbance from noise (equipment operation) and resuspension of fine sediments localized near the operation. The life history stages of bull trout exposed to these project effects are adults, subadults, and larger juveniles. These fish are highly mobile and able to detect and avoid areas of disturbance. Any bull trout that may be in the vicinity can easily move around or pass through the sediment plume. Individuals that pass through the sediment plume will only be exposed to elevated levels of turbidity for a brief period (less than 1 hour), and are not expected to be measurably affected. Noise from heavy equipment is not expected to reach levels that would be harmful to bull trout. Therefore, direct effects to bull trout associated with short-term exposure to elevated levels of turbidity and/or noise from maintenance activities are considered insignificant.

Other hatchery maintenance includes building and grounds maintenance, which includes painting, minor building repairs, security repairs such as lighting and fence repair, and weeding and mowing. No landscaping chemicals are used at McKinnon Pond. Typical chemicals that are used during ground maintenance at the Kendall Creek Hatchery include Roundup Promax or a similar aquatic-approved herbicide. Herbicide application is small in scale, follows manufacturer’s label guidelines, and occurs during dry weather conditions (i.e., not raining or windy) to prevent runoff into surface waters. Roundup is used around buildings and landscape that are greater than 200 feet from the river. A backpack sprayer is used for all applications. On an annual basis, approximately 2.5 gallons of Roundup is used.

Other maintenance activities (e.g., building and grounds maintenance, painting, minor building repairs, lighting and fence repair, weeding and mowing) do not occur near water and are not expected to have any adverse effects to bull trout. Maintenance activities that may affect water quality of effluent (e.g., vacuuming and removal of accumulated sediment on the bottoms of hatchery ponds and raceways) are included in the subsection entitled *Discharge of Hatchery Effluent* above.

Artificial Lighting

Artificial lighting at night is known to attract and concentrate juvenile salmonids and expose them to increased rates of predation. The response of juvenile bull trout to artificial lighting at night is not known. There is outdoor lighting at the Kendall Creek Hatchery, which has the potential for light to hit the water surface at the lower dam, and the fish ladder into the adult pond. However, this light source is not used in regular hatchery operations, but rather exists for emergency situations. These are rare and infrequent, which limits fish exposure. Fry and young juveniles would be most susceptible to predation at night, but the Kendall Creek Hatchery is located downstream of early juvenile rearing areas. There are no lights associated with the McKinnon Pond. For these reasons, effects to bull trout from artificial lighting at night are considered insignificant.

Adverse Effects

The following effects are likely to adversely affect bull trout for the reasons described.

Broodstock Collection Infrastructure

Description of Specific Factors Considered

This section pertains only to the presence and operation of the Kendall Creek Hatchery weir as it affects bull trout in Kendall Creek. Effects of capture and handling associated with bull trout entering the off-channel collection pond and with off-site broodstock collection activities (i.e., angling) are discussed in the section Adverse Effects: Incidental Capture and Handling below.

Impacts on bull trout can occur as a result of hatchery broodstock collection activities. Of these collection methods, full river-spanning weirs/traps located in the mainstem river or tributary migration areas may have the greatest impact on fish, as they effectively block upstream and downstream migration, and force adult fish to enter a trap and holding area. The Kendall Creek Hatchery weir is a permanent structure that blocks all fish movement. Blocked fish may volitionally enter an off-channel adult collection pond from late-May through mid-March. During the remainder of the year, the entrance to the off-channel collection pond is closed and fish that are blocked by the weir may hold near the weir or move back downstream. Weir and pond operation from December through March 15 are associated with the EWS program. The weir is also operated from late May to December for other hatchery salmon programs, which are not being addressed in this EWS consultation.

Broodstock collection infrastructure and activities are not in areas where bull trout spawn or small juveniles rear. Therefore, these life history stages will not be exposed to effects of broodstock collection infrastructure and activities.

Kendall Creek is a productive salmon stream with several miles of coho salmon spawning and rearing habitat. Migratory adult and subadult bull trout would likely forage and possibly overwinter in Kendall Creek in the absence of the blockage posed by the hatchery weir. There is no bull trout spawning habitat in Kendall Creek.

Species Response

The physical presence of a weir in migratory corridors that lead to foraging and overwintering habitat, such as Kendall Creek, can affect salmonids by:

- Contributing to impingement, injury, or mortality as fish attempt to pass through or over the weir;

- Injuring or killing fish that attempt to jump over the weir;

- Increasing fish vulnerability to predation through corralling effects and fish holding behaviors at the weir.

Risk of Injury or Mortality

Risks associated with bull trout entering the off-channel pond, and capture and handling to remove them from the pond are addressed separately. Though the effects described below may not occur in each year, the extended term of this consultation (years to decades) makes it reasonably certain that such effects will occur. Weirs can interfere with and disrupt normal behaviors such as feeding and sheltering. They can also cause stress and could injure or kill adult or subadult fish, or cause fish to be concentrated or confined. Concentration, confinement, and injury may subject bull trout to potential predation from mammalian and avian predators. Prolonged exposure to elevated water temperatures can cause stress and could injure or kill adult or subadult fish.

Based on known behaviors of salmonids at weirs, some bull trout that encounter the weir are expected to hold in areas below the weir for some period of time prior to entering the collection pond or moving back downriver to alternative foraging and/or overwintering areas. Some of these fish may be subject to injury or mortality while seeking alternative pathways past the weir, or from encounters with predators. Up to 1 bull trout may be directly injured or killed while attempting to avoid the weir structure, or as a result of predation caused by delays or injury at the weir. There are no data quantifying the degree to which these types of effects occur at the Kendall Creek weir, nor at any other similar type of operation. Therefore, the estimate is our best professional judgment based, in part, on the number of bull trout that are expected to enter the off-channel collection pond, as described in the Adverse Effects: Incidental Capture and handling section below. We expect that the number of bull trout holding below the weir and subject to effects of the weir in this area is proportional to the number of bull trout that enter the off-channel pond.

Incidental Capture and Handling

Assumptions

The following assumptions apply to our analysis of incidental capture and handling:

- Capture and handling can result from broodstock collection and fish rescue efforts (e.g., at the off-channel adult collection pond).

- Bull trout captured at the Kendall Creek weir and off-channel trap will be released back into Kendall Creek below the lower weir within 24 hours of capture.

- Prior to conducting activities that may involve handling of fish, personnel ensure that hands are free of harmful and/or deleterious products, including but not limited to sunscreen, lotion, and insect repellent.

- Effects to bull trout from capture and handling will be minimized by maintaining fish in water as much as possible between capture and release, releasing incidentally captured fish as soon as practicable after capture, and holding fish in areas and using equipment that maintains their health and safety.

- Hook-and-line equipment will be used with selective gear (i.e., barbless hooks).

Description of Specific Factors Considered

The Kendall Creek Hatchery weir is a permanent structure that blocks all fish movement year-round. Blocked fish may volitionally enter the off-channel adult collection pond from late-May through mid-March. During the remainder of the year, the entrance to the off-channel collection pond is closed and fish that are blocked by the weir may hold near the weir or move back downstream. Weir and pond operation from December through March 15 are associated with the EWS program. The weir is operated from late May to December for other hatchery salmon programs, which are not being addressed in this consultation. The pond is checked daily for presence of fish when it is being operated for EWS broodstock collection, and is monitored for debris and/or flow issues. Non-target, natural-origin species captured in the pond are manually removed by hatchery staff. Removed fish are either passed upstream into the stream reach between the two weirs (coho salmon, cutthroat trout), or are placed back in Kendall Creek below the lower weir (bull trout, steelhead trout, Chinook salmon, pink salmon). Passage above the upper weir is provided by a fish ladder. Two adult bull trout were captured in the Kendall Creek Hatchery off-channel adult collection pond in 2000, and one was captured in 2014. Bull trout that enter the pond would be removed using a seine or soft-mesh dip net and placed back in Kendall Creek below the weir.

Collection efforts infrequently (two times in last ten years) include hook-and-line capture of returning adult EWS during open seasons and in open waters. These efforts are in the North Fork Nooksack River below the hatchery, lower reaches of the South Fork Nooksack River, and the mainstem Nooksack River, from December 1 through January 31. Overwintering bull trout are likely present in these areas during this time. To date, no bull trout have been captured during angling. Bull trout that encounter but are not captured by anglers may exhibit minor avoidance behaviors to evade personnel. No broodstocking occurs at McKinnon Pond.

Species Response

All weir and adult trapping and collection actions can stress, injure, or kill fish if improperly designed and implemented. Measures can be implemented to minimize these types of impacts. Collections ponds can be checked frequently to minimize effects of crowding and to ensure that predator exclusion systems are functioning and in good repair. The netting or capturing, handling, and releasing of bull trout can result in injury by increasing the potential for disease by removing the protective mucus coating on the skin, as well as increasing stress in affected individuals which can cause it to become susceptible to disease (and predators and competitors when released), and it can cause potential direct injury. Death can result if fish are handled roughly or kept out of water for extended periods of time. Bull trout protocols for handling stipulate ways to minimize harm associated with handling fish, which include minimizing handling time, using clean hands free of sunscreen, insect repellent, and other contaminants, and stipulating appropriate types of containers for transferring bull trout.

Bull trout are particularly susceptible to capture by angling. Capture by angling causes exhaustive physical exertion, stress, and injury to the fish. Hooking mortality may occur at the time of capture, or may be delayed. Very limited data exist on hooking mortality for bull trout. Estimates of hooking mortality for salmonids vary widely, from less than 5 percent to 30 percent or more. Capture by angling may also cause temporary alterations in post-release behavior, such as rapid downstream movement.

Handling of fish has some potential to result in injury or death. Mortality may be immediate or delayed. Handling of fish increases their stress levels and can reduce disease resistance, increase osmotic-regulatory problems, decrease growth, decrease reproductive capacity, increase vulnerability to predation, and increase chances of mortality (Kelsch and Shields 1996). Fish may suffer from thermal stress during handling, or may receive subtle injuries such as de-scaling and loss of their protective slime layer. Handling can contribute directly or indirectly to disease transmission and susceptibility, or increased post-release predation. Fish that have been stressed are more vulnerable to predation (Mesa et al. 1994; Mesa and Schreck 1989).

In most cases, handling time required to release captured bull trout will be short, minimizing stress. However, some injury or deaths may occur during the handling and/or transfer process.

Risk of Injury or Mortality

Impacts that may be associated with capture:

- Injuring or killing fish during confinement in the pond due to stress or predation;
- Physically harming the fish during their capture and retention;
- Harming fish by holding them improperly or for long durations;
- Physically harming fish during handling;
- Increasing fish susceptibility to displacement downstream following release;
- Increasing fish susceptibility to predation following release; and
- Latent effects associated with stress.

Bull trout that enter the pond are expected to be adult, subadult, and larger juveniles seeking foraging opportunities and overwintering habitat. Routine hatchery operations suggest that bull trout that enter the pond will likely be removed and placed back in the river within 24 to 48 hours of entrance. Bull trout are believed to forage and overwinter in nearby areas of the North Fork Nooksack River and in Kendall Creek below the lower weir. Therefore, bull trout removed from the pond are expected to locate other suitable foraging and overwintering habitat nearby fairly quickly. Although we expect significant disruptions to the normal behavior for fish that enter the off-channel pond, we do not expect significant impairment of essential behaviors. Based on historical observations of bull trout in the pond, we anticipate that up to 2 adult, subadult, or large juvenile bull trout may enter the off-channel pond during any 5-year period.

Incidental handling of migrating bull trout may result from implementation of broodstock collection actions. Bull trout may be incidentally captured, handled, and released at the Kendall Creek Hatchery weir off-channel collection pond. Angling may also result in capture and handling.

As described above, we anticipate that up to 2 adult, subadult, or large juvenile bull trout may enter the adult collection pond during any 5-year period and be removed from the pond using nets. There are no studies of immediate or post-release (delayed) mortality of bull trout associated with capture in off-channel ponds and net removal. Bull trout captured in the off-channel pond are released with very minimal handling. The fish are not anesthetized, marked or tagged, or tissue sampled. Immediate mortality of adult salmonids captured in various types of nets is usually low, often less than 5 percent (e.g., Donaldson et al. 2011, p. 138; Donaldson et al. 2012, p. 733; Raby et al. 2014, p. 1810). For post-release mortality, Raby et al.'s (2014) results for adult coho salmon captured in lower Fraser River beach seine fisheries most closely approximate the conditions that Nooksack River bull trout captured in the off-channel collection pond experience (freshwater capture, short time spent in net, immediate release with no tagging). After accounting for natural mortality and effects of tagging, Raby et al. (2014, p. 1813) estimated that post-release mortality associated with capture in beach seines was approximately

17 percent. Applying these estimates to Nooksack River bull trout captured in the off-channel collection pond, we anticipate that up to 1 bull trout will suffer immediate or delayed mortality during any 5-year period.

We anticipate that up to 2 bull trout may be captured during any 5-year period by angling for broodstock collection, and that up to 1 of these fish will suffer immediate or delayed mortality as a result of this capture. While no bull trout have been captured to date using these techniques, there is a possibility of capture due to the nature of the techniques, their time and place of deployment, and known susceptibility of bull trout to angling. These techniques may also be used more frequently in the future, increasing the probability of bull trout capture. Our estimate is based on best professional judgment given these facts and assumptions. We anticipate that the actual number captured and killed will be less during most years.

In total, we have described the capture of 4 individual adult, subadult, and large juvenile bull trout during any 5-year period associated with various broodstock collection activities. These captures result in significant disruption of normal behaviors, and non-lethal effects from minor injuries and stress. However, based on historical observations, we do not anticipate that all of these captures will occur. We anticipate that in total, up to 2 bull trout will be captured during any 5-year period as a result of all broodstock collection activities combined.

We have also described associated immediate and delayed mortality to 2 adult, subadult, and large juvenile bull trout (1 from the collection pond, and 1 from angling) during any 5-year period. However, we do not anticipate that all of these mortalities will occur in any one year. We anticipate that in total, immediate and delayed mortality will affect 1 bull trout during any 5-year period due to all broodstock collection activities combined.

Inter-specific Competition and Predation

Although bull trout evolved with and continue to coexist with anadromous salmonids (Ratliff and Howell 1992), hatchery releases of anadromous salmonids may impose predation, competition, and other pressures on bull trout that are above previous levels. The expected rapid outmigration of EWS smolts released from the hatchery minimizes the potential for predation and competitive interactions with bull trout. Some hatchery-released EWS may remain in freshwater instead of migrating to marine habitats (a phenomenon known as residualization) increasing potential for interactions with bull trout. In addition, some returning adult hatchery-origin EWS may not be captured in fisheries or return to the hatchery facility. Instead, these fish may seek out spawning habitat and mates, and may spawn in the wild (a phenomenon known as straying). This presents the possibility of disturbance to pre-existing bull trout redds. The degree to which hatchery-origin salmonids and their progeny interact with bull trout depends upon their characteristics which include: 1) size; 2) behavior; 3) habitat use; 4) relative abundances; and 4) movement patterns. Interaction potential between salmon and steelhead and bull trout can also depend on habitat structure and system productivity. System productivity determines the degree to which fish populations may be food limited, and thus negatively impacted by limited resources. The type and level of interaction between these fish involve complex mechanisms.

Predation

Large releases of hatchery fish may result in direct predation to bull trout, whereby the hatchery fish themselves consume small bull trout, or indirect predation to bull trout, whereby the large concentrations of released hatchery fish attract predators that prey on bull trout. The magnitude and vulnerability to predation from hatchery releases result from a combination of prey and predator abundance, size of bull trout in relation to the size of the hatchery fish, and feeding habitat of hatchery-origin fish.

There are very few studies of predation on juvenile bull trout by piscivorous fishes. In a study focused on lake trout and northern pikeminnow (*Ptychocheilus oregonenesis*) , Zollweg (1998, p.41) did not observe any juvenile bull trout in the stomachs of 7 rainbow trout (*O. mykiss*) sampled in the Flathead River, Montana. We are not aware of any other studies that have evaluated predation on juvenile bull trout by the species released from the hatcheries. Bull trout fry are the most susceptible life stage to predation due to their small size. However, they tend to be cryptic and hide in the substrate during the day, which helps them avoid predation. Juvenile bull trout typically occupy different habitats than other, larger salmonids, which is believed to minimize predation risk from these other species (Saffel and Scarnecchia 1995, pp. 312-313, and references therein). Bull trout fry typically remain in close proximity to and within the interstitial spaces of gravel and cobble substrates to a much greater extent than other salmonids (Pratt 1992; Rieman and McIntyre 1993), where the potential for predation by salmon and trout would be limited.

With hatchery-released fish, predation on naturally-produced juvenile salmonids and other fishes is a potential concern when the hatchery fish are large enough to be piscivorous, and when there is spatial and temporal overlap of predator and prey (Naman and Sharpe 2012). In general, salmonids become primarily piscivorous at lengths of 310 mm (Keeley and Grant 2001, p. 1126). At lengths of 198 to 210 mm, about 30 percent of salmonids would be expected to have some fish in their stomachs, but fish would not be a primary component of their diet (Keeley and Grant 2001, p. 1125).

There is very little spatial and temporal overlap of outmigrating EWS smolts and bull trout that are of a size to be vulnerable to predation. EWS smolts are released 6 miles downstream from early juvenile bull trout rearing areas in the North Fork Nooksack River. Released EWS smolts migrate past the Middle and South Forks which are used by bull trout for spawning and early juvenile rearing. Early juvenile rearing bull trout may occur in the vicinity of the confluence of the North and Middle Forks because spawning occurs very low in the Middle Fork. In the South Fork, early juvenile rearing bull trout are 10 miles or more upriver from its confluence with the North Fork. EWS smolts are typically released between mid-April and early-May when bull trout fry are just beginning to emerge from redds, and most EWS smolts emigrate seaward within a few weeks of release (Goetz et al. 2008; Moore et al. 2010; NMFS 2016a; NMFS 2016b). Most fry likely emerge from mid-May through July after most hatchery EWS have moved into marine habitats. Additional research indicates that EWS smolts typically do not feed during the first week after release. Juvenile outmigrant trapping from other Puget Sound watersheds (e.g., Zimmerman and Kinsel 2010; Topping 2014) indicate that outmigrating bull trout smolts are 120 mm FL and greater, too large to be preyed upon by EWS smolts (198 to 210 mm FL). For these reasons, we expect that exposure of bull trout juveniles to outmigrating EWS smolts is minimal.

There are no data on residualization, movement, or predation data for hatchery-released steelhead in the Nooksack River watershed. A meta-analysis of steelhead hatchery programs (mostly in the Columbia River basin) found that steelhead yearlings residualize at an average rate of 5.6 percent, with a range of 0 to 17 percent (Hausch and Melnychuk 2012). Lower rates were associated with the following: hatchery-derived broodstock; intermediate size of released fish (approximately 213 mm FL); and volitional release. The EWS program implements these and other measures to minimize risk of residualization. In addition, the closest bull trout early juvenile rearing areas in the North Fork Nooksack River are 6 miles upstream of the EWS release point. In the South Fork Nooksack River, the nearest bull trout early juvenile rearing areas are 10 miles upstream of the confluence with the North Fork, which is 7.5 miles downstream of the EWS release point. Available information suggests that most residual hatchery-origin steelhead remain relatively near their release point into the watershed (Partridge 1986, p. 29; McMichael and Pearsons 2001, p. 945; Brostrom 2006). Thus, few residualizing steelhead are likely to move upstream into early juvenile bull trout rearing areas in the North and South Forks. In the Middle Fork, early juvenile rearing bull trout may be vulnerable to residual EWS in the lowest reaches of the river. However, most early juvenile rearing is believed to occur upstream of areas where residual EWS would be expected to forage. In addition, the confluence of the Middle Fork with the mainstem is 4.5 miles downstream of the EWS release point. Based on existing evidence, relatively few residual EWS would be expected in this area. For these reasons, we expect only a very small degree of predation from residual EWS.

Returning adult salmon and steelhead are not known to prey on fish upon entering freshwater habitats. Therefore, the threat of predation to bull trout from returning adult hatchery-origin fish is considered discountable.

Juvenile bull trout behavior and habitat use is likely to limit their exposure to predation. However, we cannot rule out the possibility that some number of bull trout may be eaten by hatchery-origin fish and their progeny. Our anticipation that some bull trout may be eaten by hatchery-origin EWS is theoretical, and is based on their relative sizes, known behaviors and piscivory, and partial temporal and spatial overlap at the reach-scale. Based on these factors, and the known locations, sizes, numbers, and behaviors of released hatchery fish, our best professional judgement leads us to conclude that no more than 100 bull trout fry or small juveniles may be consumed during any 5-year period by hatchery-origin EWS.

Competition

Competition for food and space between anadromous salmonids and bull trout may occur in spawning and/or rearing areas, the migration corridor, and in the marine habitat. Competition may result from direct interactions, in which salmon and steelhead interfere with access to limited resources by bull trout, or indirect interactions, in which utilization of a limited resource reduces the amount available for bull trout.

Newly released EWS smolts might encounter larger juvenile or subadult bull trout in the migratory corridor; however, any effects of these potential encounters are expected to be insignificant due to the larger size of bull trout and their diet preference differences at that age (Lowery and Beauchamp 2015; Davis 2015). Juvenile bull trout prefer colder water and are more-closely associated with the deeper portions of rivers. A substantial degree of overlap in habitat use by juvenile bull trout and EWS is not anticipated. In the stream environment, microhabitat selection for water depth, water velocity, and substrate generally differs between juvenile bull trout and EWS (Keeley and Slaney 1996, p. 7). In addition, bull trout are more closely associated with the channel bottom of streams than other salmonids (Goetz 1989; Pratt 1992; Rieman and McIntyre 1993). For these reasons, substantial competitive interactions between anadromous salmonids and bull trout in stream environments are likewise not anticipated.

Some returning adult hatchery-origin EWS may stray and spawn naturally in the watershed. Winter steelhead spawn later in the season than bull trout; therefore, there is no threat of spawning ground competition. However, should any steelhead spawn in the same areas as bull trout, bull trout redds may be disturbed or destroyed prior to fry emergence. Hatchery-origin fish that spawn naturally generally do so in close proximity to their release point or the facility where they were acclimated or imprinted on, usually a hatchery or acclimation pond (Quinn 1993; Mackey et al. 2001; Hoffnagle et al. 2008; Dittman et al. 2010; Williamson et al. 2010). For example, Mackey et al. (2001) observed that 75 percent of steelhead hatchery strays in a Willapa River, Washington tributary stayed within 1 mile of their smolt release point. In the North Fork Nooksack River watershed, the closest bull trout spawning habitat is 6 miles upriver from the EWS release point. Hatchery practices that minimize the abundance and spatial extent of strays to the greatest extent possible are implemented by the EWS program and include the following: 1) rearing and releasing the fish at the same location; 2) keeping adult collection ponds open for the entire run time to remove all returning hatchery steelhead; and, 3) using only hatchery-origin fish for broodstock. In addition, the Kendall Creek Hatchery rears EWS in surface water from Kendall Creek and on-site wells. Imprinting by EWS on these sources is expected to further minimize the potential for straying into the upper watershed where bull trout spawn.

EWS are reared at McKinnon Pond for a few months after initial rearing at the Kendall Creek hatchery, and are transferred back to the Kendall Creek Hatchery for the last few months of rearing prior to release. Nonetheless, the months spent rearing in water from Peat Bog Creek, a Middle Fork Nooksack River tributary situated within bull trout spawning habitat, may induce some degree of adult straying and spawning in the Middle Fork. These strays would most likely spawn in relatively close proximity to Peat Bog Creek because imprinting would have occurred with water from this creek, and because there is documented winter steelhead spawning habitat within this reach of the river. We expect only a minor degree of bull trout redd disturbance from EWS strays into the Middle Fork because a relatively small number of EWS juveniles are reared at McKinnon Pond, most strays are expected to seek out the Kendall Creek area (which is not in bull trout spawning habitat), and because EWS spawning is expected in a localized area near Peat Bog Creek.

For the reasons described above, some destruction of bull trout redds via superimposition, and loss of deposited eggs is expected, although this loss is expected to be small. We anticipate that no more than 2 redds during any 5-year period will be affected, based on our best professional judgment considering the following: the abundance of hatchery releases; acclimation to tributary and well water instead of mainstem surface water; acclimation and release in areas away from bull trout spawning habitat; and variability in spawner microhabitat selection.

Effects to Bull Trout Critical Habitat

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

Groundwater withdrawal for the EWS program at the Kendall Creek Hatchery (7.7 cfs) represents a small proportion (less than 3 percent) of the in-stream flow during seasonal low flow periods in the North Fork Nooksack River (USGS 2016). Groundwater used at the hatchery is discharged to the creek near the point of withdrawal. Surface water withdrawals for the EWS program from Kendall Creek (6.7 cfs) and Peat Bog Creek (2.0 cfs) are non-consumptive. Water withdrawn for these facilities is returned relatively close to the points of withdrawal. Because all of the water used at the EWS facilities is returned to the streams of origin close to where it is withdrawn, water use from these streams will have minimal, if any, effect on groundwater recharge. Hatchery water used in rearing ponds may contribute to minor warming of the receiving water body at the point of discharge. However, given the relatively small area of the mixing zone, effects to thermal refugia are not expected to be measurable. Because hatchery operations will not measurably affect groundwater sources, springs, or thermal refugia, effects to this PCE are considered insignificant.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

The Kendall Creek Hatchery weirs are permanent full channel-spanning structures located within designated bull trout foraging, migration, and overwintering habitat. Operation of the lower weir results in a permanent and complete barrier to bull trout migration into foraging and potential overwintering habitat. The weir blocks access to 2 miles of designated bull trout critical habitat. The migratory function of this PCE is permanently and completely impaired as bull trout cannot access upstream foraging and overwintering habitat. Therefore, the effects to this PCE from the presence and operation of the weirs are considered adverse.

The McKinnon Pond facility withdraws up to 2 cfs of water from Peat Bog Creek. McKinnon Pond water withdrawals do not inhibit fish passage through the affected reach of Peat Bog Creek, as evidenced by passage of adult Chinook salmon and steelhead trout. Visual inspection also suggests that the discharge of Peat Bog Creek is much greater than the water withdrawal, although this has not been quantified. Therefore, effects to this PCE associated with water withdrawals for the McKinnon Pond are considered insignificant.

PCE3: An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Effects to this PCE are as described in the following sections and subsections above: Beneficial Effects; Genetic and Ecological Effects to Naturally-reproducing Steelhead Trout; and Effects to Bull Trout Forage Base and Foraging Opportunities. For the reasons described in these sections, effects to this PCE are considered insignificant.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

Maintenance of bank armoring or construction activities that impact aquatic environments, shorelines, substrates or riparian vegetation are not routine hatchery operation and maintenance activities and are not proposed under this action. None of the normal operation and maintenance activities conducted at the EWS facilities will alter or affect this PCE.

The upper weir is a concrete and wood structure which spans the entire width of Kendall Creek. There is a supporting concrete wall approximately 24 feet long armoring one bank of the creek. The intake structure is a concrete and iron sheet pile structure, approximately 18 feet long. The intake is faced with a wood trash rack. The upper weir includes a wooden fish ladder, approximately 20 feet long on the hatchery side of the creek. The lower weir is a concrete and wood structure which spans the entire width of Kendall Creek. Supporting concrete walls armor both banks of the creek, approximately 24 feet along one bank and 14 feet along the other. Directly below the lower weir is the entrance to the fish ladder and off-channel collection pond. The entrance structure is anchored to a 24 foot long concrete wall structure along the creek bank.

The weirs and affiliated structures and bank armoring are permanent alterations that have diminished habitat complexity and impaired processes that establish and maintain natural habitat features and complexity. Bank armoring simplifies the shoreline and prevents large wood recruitment, undercut bank formation, formation of side channels and pools, and growth of natural riparian vegetation. Weir structures simplify the hydraulic environment in immediately adjacent downstream areas. Effects to this PCE from the weirs and affiliated structures and bank armoring are therefore considered adverse, although their effects are relatively small and localized.

PCE 5: Water temperatures ranging from 2 °C *to 15* °C *(36 °F to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; stream flow; and local groundwater influence.*

Water temperatures at all of the EWS facilities must be cold enough to support rearing juvenile salmonids. Thus, temperatures in the hatchery facilities do not rise to levels that are detrimental to juvenile salmonids. Minor warming may occur in rearing ponds prior to the water being discharged into the receiving waterbody. However, the volume of water discharged from the hatchery facilities is relatively small compared to the volume of the receiving waters and any incremental increase in temperature is not expected to be measurable beyond the mixing zones at the point of discharge. For these reasons, warming is expected to be very minor and will not impair or significantly affect this PCE.

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young of the year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

The Kendall Creek Hatchery and associated operations are not within bull trout spawning and rearing areas. The McKinnon Pond facility is in spawning and rearing habitat. Certain maintenance activities may temporarily release small amounts of sediment into the water column which may settle downstream. Because these effects will be infrequent, very short in duration, and limited in extent, they are not expected to measurably affect suitable spawning and rearing habitat downstream of the facility. Short- and long-term effects to substrate conditions associated with minor maintenance activities will not impair or degrade the function of this PCE. Therefore, effects to this PCE are thus considered insignificant.

PCE 7: A natural hydro graph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

Surface water withdrawals for the EWS program at Kendall Creek and Peat Bog Creek are returned within 1,500 feet and 300 feet of withdrawal, respectively. There are no data or anecdotal accounts to suggest that these water withdrawals affect the hydrographs within these small areas to the extent that this PCE would be adversely affected. Therefore, effects to this PCE from surface water withdrawals are considered insignificant. Similarly, groundwater withdrawal for the EWS program at the Kendall Creek Hatchery is not expected to diminish instream flows or affect the hydrograph of Kendall Creek or the North Fork Nooksack River, for the reasons identified in PCE 1.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

An insignificant decrease in water quality may result from the discharge of hatchery effluent into surface waterbodies. The area affected by discharges is relatively small and will not measurably impair water quality in the receiving water body. Chemicals and other hatchery-related pollutants in the effluent, slightly reduced dissolved oxygen levels, and minor increases in temperature (see PCE 5) will not alter water quality downstream of the facilities to a degree that would inhibit or measurably affect reproduction, growth or survival of bull trout or other salmonids downstream of any of the facilities. In addition, the discharge volumes are relatively small compared to the volumes of the receiving waterbodies in critical habitat. Surface water and ground water used for EWS programs are expected to have insignificant effects to water quantity in critical habitat for the reasons described in PCE 7. For these reasons, effects to this PCE from the EWS programs are considered insignificant.

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The proposed actions are not expected to cause any increase or decrease in the presence of non-native predators or competitors. Therefore, the proposed actions will have no effect to this PCE.

Summary of the Effects of the Action

Summary of Effects to Bull Trout

<u>Effects to Individuals</u>

The hatchery EWS program and facilities will have effects that are both positive and negative to the bull trout forage base and bull trout access to foraging habitat. These include the following: hatchery-origin EWS juveniles (positive); carcasses, eggs, and juveniles from naturally-spawning hatchery-origin strays (positive); and passage obstruction to Kendall Creek salmonid spawning and rearing habitat and bull trout foraging and overwintering habitat (negative). However, these effects are expected to be relatively minor. Any negatively affected bull trout have access to other forage resources nearby. Therefore, effects to forage resources and access to the habitat and resources that are blocked by weirs associated with the hatchery programs and facilities are considered insignificant. Because of the large size of juvenile EWS and short duration they spend in the rivers before entering marine areas, beneficial effects to bull trout prey resources are relatively minor.

Some bull trout may have their normal behaviors disrupted if they enter the adult collection pond. Because such disruptions will be short in duration, these effects are not expected to kill bull trout or have long-term effects on those individuals, although they may be exposed to increased predation risk in some areas. Bull trout are likely to be captured and handled for removal from the off-channel collection pond and during angling for broodstock collection. Injury or mortality to a small number of bull trout may occur as a result of impairment to normal behaviors at the weir, during confinement in the collection pond, during or after collection and removal from the pond, or from hook-and-line capture.

Some adult returning hatchery-origin EWS are expected to stray and spawn in areas where bull trout spawned, and disturb or destroy bull trout redds as a result. Hatchery practices are expected to both minimize stray rates and minimize the distance that strays spawn from the Kendall Creek Hatchery. In addition, few EWS are expected to stray and spawn in bull trout spawning areas because these areas are not near the Kendall Creek Hatchery. Stray hatchery EWS that spawn in the same reaches as bull trout may not necessarily spawn on top of existing bull trout redds due to variability in microhabitat selection. Thus, few bull trout redds are expected to be disturbed or destroyed.

Some mortality to small juveniles (e.g., fry) are expected as a result of predation. However, the release timing, location, and behavior of EWS smolts in relation to bull trout rearing areas, fry emergence timing, and fry behavior suggests that relatively few bull trout fry will be consumed.

Effects of these hatchery actions are most likely to affect the Lower North Fork and Lower Middle Fork local populations because these are the ones in closest proximity to the hatchery operations. For example, inter-specific effects from residual EWS and naturally-spawning stray adult EWS are most likely to occur within these areas. However, Nooksack core area bull trout are migratory. Therefore, bull trout from any of the 10 local populations could be exposed to some of the hatchery effects, including effects of the weirs at Kendall Creek and capture in the adult collection pond.

Quantification of Affected Bull Trout

Table 1 provides a summary of the number of bull trout expected to be negatively affected. We anticipate that normal behaviors of up to 2 adult, subadult, or large juvenile bull trout may be disrupted during any 5-year term of the consultation (i.e., five-year rolling average) as a result of entering the adult collection pond.

When individual broodstock collection activities are considered separately, we anticipate that up to 4 adult, subadult, or large juvenile bull trout will be captured during any 5-year period (2 in the adult collection pond, and 2 during angling). However, we do not anticipate that all of these captures will occur during any 5-year period because of the sporadic nature of historical bull trout observations in the off-channel collection pond, and the infrequency that angling is use for broodstock collection and lack of historical bull trout captures during angling. Therefore, we anticipate that up to 2 adult, subadult, or large juvenile bull trout will be captured during any 5-year period due to all broodstock collection activities combined.

The following three sources of mortality were each considered: 1) capture and handling in the off-channel pond; 2) capture and handling during angling; 3) predation or other effects from the lower weir that are not associated with capture in the off-channel pond). For each of these, we anticipate the potential immediate or delayed mortality of up to 1 adult, subadult, or large juvenile bull trout during any 5-year period. However, based on historical observations, we do not anticipate that in any 5-year period all of these sources of mortality will occur. Instead, we anticipate that all sources of mortality combined will result in the immediate or delayed mortality of up to 1 adult, subadult, or large juvenile bull trout during any 5-year period.

The preceding paragraphs describe our quantification of affects to adult, subadult, and large juvenile bull trout. Combining these, up to a total of 3 adult, subadult, or large juvenile bull trout will be subject to capture, injury, death, or disruption of normal behaviors during any 5-year period.

We anticipate that eggs and fry of up to 2 adult female bull trout will be injured or killed during any 5-year period as a result of redd destruction by hatchery EWS strays that spawn in bull trout spawning areas. In addition, we anticipate that up to 100 juvenile bull trout will be killed during any 5-year period as a result of predation from hatchery-origin EWS.

Table 1. Summary of estimates for adverse effects to bull trout as a result of the WDFW EWS hatchery programs in the Nooksack River during any 5-year period (i.e., 5-year rolling average) of this consultation.

Action / Stressor	Indirect Effects / Impairment	Non-lethal Capture [1]	Injury / Death [1]
Broodstock Collection Infrastructure			
Weir and collection pond			1
Incidental Capture and Handling			
Collection pond		2	1
Angling		2	1
Inter-species competition and predation			
Predation			100 juveniles
Redd destruction	2[2]		
Total	2[2]	2[3]	1[3] 100 juveniles

[1] Estimates provided are individual adult, subadult, or large juvenile bull trout, unless indicated otherwise.
[2] Estimates provided are number of adult spawning females for which effects would occur to their eggs and/or fry. This may include 1,000 to 10,000 eggs or fry per spawning female.
[3] Because individual capture and mortality is not likely to occur each year for each effect, the total number of bull trout anticipated to be captured and killed each year is less than the sum of all estimates.

Effects to Nooksack River Local Populations

The effects to individuals are not expected to have measureable effects on Nooksack River local populations because a small number of individuals will be affected, and these individuals are likely to be from different local populations. We anticipate the potential loss of up to 1 individual adult, subadult, or large juvenile bull trout, 100 small juvenile bull trout, and eggs and fry from 2 redds during any 5-year period. Local populations with the highest probability of being affected include the Lower North Fork Nooksack River and Lower Middle Fork Nooksack River because these are the closest to the hatchery activities. However, migratory bull trout from any nearby local population could be exposed to effects from the EWS programs. It is possible, but very unlikely, that the affected bull trout will all be from the same local population because of the migratory nature of Nooksack River bull trout (bull trout from any local population could enter Kendall Creek and be exposed to effects of the weir and off-channel adult collection pond), and the possibility that residual EWS smolts and stray adults may affect both the Lower North Fork Nooksack River and Lower Middle Fork Nooksack River local populations. Therefore, the relatively minor effects of the hatchery operations are most likely to be distributed across multiple local populations. Because very few bull trout will be affected, we do not anticipate any decline in the abundance, reproduction, survival, or distribution of bull trout at the scale of the local populations as a result of the overall net effects of the hatchery facilities and operations. Furthermore, we do not anticipate any long-term changes in habitat or function as a result of this proposed action that would affect the numbers, reproduction, survival, or distribution of individual bull trout at the scale of the local population.

Effects to Nooksack River Core Area

Because there are no net effects to bull trout at the scale of the local populations, there are also no effects to bull trout at the scale of the core area.

Summary of Effects to Bull Trout Critical Habitat

Adverse effects are anticipated for PCEs 2 and 4. The lower weir completely blocks access to 2 miles of designated bull trout foraging and overwintering critical habitat. The weirs and affiliated structures and bank armoring are permanent alterations that have diminished habitat complexity and impaired processes that establish and maintain complexity within a relatively small and localized area.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Cumulative effects are limited to the middle to lower reaches of the three forks and the mainstem because upper watershed areas are federally owned (Mt. Baker - Snoqualmie National Forest). Therefore, approximately half of bull trout spawning and early rearing habitat in the watershed will not be subject to cumulative effects.

Entities such as the Nooksack and Lummi Tribes and local conservation organizations have been and are expected to continue to seek and implement restoration projects for the specific benefit of fish and aquatic habitat in the Nooksack River watershed. These actions are expected to be targeted specifically to anadromous Pacific salmon and steelhead trout rather than bull trout. However, these actions will benefit bull trout because their habitat needs are similar to Pacific salmon and steelhead trout. Thus, minor to moderate improvements are expected in habitat quality and quantity for foraging, migrating, and overwintering bull trout. In addition, by benefitting anadromous Pacific salmon and steelhead, these actions will benefit bull trout by increasing the forage base represented by these species.

Human population growth is projected for the Nooksack River watershed and is likely to result in increasing habitat degradation, particularly to riparian areas and water quality, and diminished opportunities for substantial restoration. Despite some local permitting requirements and regulations, our observations are that these activities tend to remove riparian vegetation, interrupt groundwater-surface water interactions, reduce stream shade (and increase stream temperature), reduce the opportunity for large wood recruitment, and increase water pollution. These effects may further degrade in-stream conditions for bull trout foraging in and migrating through the lower watershed. Each action by itself may have only a small incremental effect, but taken together they may substantively degrade the watershed’s environmental baseline and undermine the improvements in habitat conditions necessary for listed species to survive and recover.

Watershed assessments and other education programs may reduce these adverse effects by continuing to raise public awareness about the potentially detrimental effects of residential development on salmonid habitats and by presenting ways in which a growing human population and healthy fish populations can co-exist.

We expect that negative effects from future habitat degradation and increased demand for surface and groundwater will be partially offset by beneficial effects from restoration and conservation efforts. Therefore, during the term of this consultation, we anticipate that baseline conditions will become further degraded from cumulative effects, but the degradation will not be substantial.

INTEGRATION AND SYNTHESIS OF EFFECTS: Bull Trout and designated Bull Trout critical habitat

The Integration and Synthesis section is the final step in assessing the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action and the cumulative effects to the status of the species and critical habitat, and the environmental baseline, to formulate our biological opinion as to whether the proposed action is likely to: (1) appreciably reduce the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated critical habitat for the conservation of the species.

Bull Trout

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation, and alteration. Six segments of the coterminous United States population of the bull trout are essential to the survival and recovery of this species and are identified as Recovery Units. The WDFW hatchery activities are located in the Coastal Recovery Unit's Nooksack core area, which supports ten local populations of bull trout. As described in the summary of effects to bull trout, effects of the hatchery actions are most likely to affect 2 local populations, although bull trout from any of the Nooksack core area local populations could be affected due to their migratory nature. The core area and the local populations are at increased risk of extirpation from natural, randomly occurring events because of the moderate number of interconnected local populations, low adult abundance of most local populations, persistence of critical threats, and uncertainties associated with watershed restoration and recovery. Some of the activities considered in this consultation marginally contribute to or increase this risk.

Bull trout spawn, rear, forage, migrate, and complete other aspects of their life history in the Nooksack River basin. The conservation role of the Nooksack River basin is to maintain the genetic components of the species and maintain the geographic range of the species. Nooksack River bull trout represent an important component of the Coastal Recovery Unit's geographic range. The Nooksack is one of only 10 core areas that currently exhibit the anadromous life history form. In addition, it is one of only 5 core areas connected to the Puget Sound. There are no cumulative effects in large areas of the upper watershed because much of it is in federal ownership. Ongoing issues in the middle and lower watershed due to water withdrawals, and low instream flow and elevated water temperature during late summer and early fall will continue to present challenges to bull trout migration and survival. Baseline conditions are severely degraded, primarily as a result of historical land and river management practices. This baseline is somewhat dynamic due to climate change, increasing urbanization, and habitat restoration and salmon recovery efforts.

Since the time of the coterminous United States bull trout listing in 1999, the hatchery infrastructure and operations have not been identified as a primary cause of the "potential risk" status of Nooksack bull trout for extirpation. Hatchery programs and infrastructure, including those included in this consultation, have existed for many years or decades in the Nooksack River watershed. Some aspects have changed over the years (e.g., species and numbers released have changed), but most if not all of the changes have benefitted bull trout. For example, the Hatchery Scientific Review Group and NMFS 4(d) authorization processes have identified ways that hatchery operations can minimize deleterious effects to aquatic habitats and naturally-reproducing fish species. Nooksack River watershed hatcheries have and are part of these processes, and have been implementing improvement measures. Other improvements in recent decades have included installing water intake screening to prevent fish entrainment and impingement, and meeting NPDES permit requirements for reducing discharge of pollutants into the surface waters. To the extent that the hatchery infrastructure and operations have exacerbated existing threats and/or presented additional pressures inhibiting bull trout recovery, these have been reduced in recent years due to these modifications.

Some hatchery activities will adversely affect bull trout, including the following: 1) blocked access to bull trout forging and overwintering habitat presented by the Kendall Creek weir; 2) broodstock collection activities resulting in incidental capture of bull trout; 3) release of hatchery juvenile EWS resulting in inter-specific competition with and predation on bull trout. As many as 3 adult, subadult, or large juvenile bull trout may be affected during any 5-year period by the project, and these effects are likely to cause the death of up to 1 adult, subadult, or large juvenile bull trout. These figures for capture and mortality represent a very small proportion of the current Nooksack core area population. In addition, we anticipate that up to 100 juvenile bull trout, and eggs and fry of up to 2 adult female bull trout will be killed during any 5-year period as a result of the project. It is possible, but very unlikely, that the affected bull trout will all be from the same local population for the following reasons: 1) Nooksack River bull trout are migratory (i.e., bull trout from any local population could enter Kendall Creek and be exposed to effects of the weir and off-channel adult collection pond); and, 2) residual EWS smolts and stray adults may affect both the Lower North Fork Nooksack River and Lower Middle Fork Nooksack River local populations. Therefore, the relatively minor effects of the hatchery operations are most likely to be distributed across multiple local populations, affecting relatively few bull trout within each. For these reasons, we conclude that the combined effects of the action will have no net effect on the reproduction, abundance, or distribution of bull trout at the scale of the local populations or the core area.

Drawing from the above discussion, we conclude that the effects of the determinations by NMFS and associated actions relative to WDFW EWS hatchery activities in the Nooksack River basin, considered with cumulative effects, and in the context of the degraded and changing baseline conditions, will not affect bull trout reproduction, abundance, or distribution within the

Nooksack core area. Therefore, the action also will not affect reproduction, survival, or distribution, or the survival and recovery potential of bull trout, at the scale of the Coastal Recovery Unit or the coterminous listed range.

Bull Trout Critical Habitat

The range-wide status of designated critical habitat for bull trout is variable among and within Critical Habitat Units (CHUs), which were designated in five states in a combination of reservoirs/lakes and streams/shoreline. Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing; and, 2) foraging, migration, and overwintering. The conservation role of bull trout critical habitat is to support viable core area populations. The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. Thirty-two CHUs and 78 associated subunits are designated as critical habitat under the 2010 final rule.

The status of habitat conditions and the PCEs of designated critical habitat in the action area vary throughout the watershed. Upper watershed areas where spawning and rearing critical habitat is located, is in fair to good condition. In contrast, 7 of the 8 PCEs that exist in lower watershed foraging, migration, and overwintering critical habitat are moderately to severely impaired. These include the following: PCE 1 (groundwater), PCE 2 (migration barriers), PCE 3 (food base), PCE 4 (complex habitat), PCE 5 (water temperature), PCE 7 (hydrograph), and PCE 8 (water quality and quantity). The degradation of these PCEs in the lower watershed is caused by surface water and groundwater withdrawals, historical land and river management practices (channelization, levee and dike construction, large wood removal, riparian and upland deforestation, and historical timber extraction activities in the upper watershed), and road crossings.

None of the hatchery infrastructure or activities are a primary cause of the degraded condition of critical habitat in the watershed. However, the proposed action does, to varying degrees, exacerbate the degraded conditions. The Kendall Creek Hatchery lower weir is a permanent structure that completely blocks bull trout movement into 2 miles of foraging habitat in Kendall Creek (PCE 2). This PCE currently does not and will not function in Kendall Creek unless the weir is removed. Some degree of functioning may also be restored if fish are manually transported upstream of the weir. Kendall Creek represents a relatively small proportion of foraging and overwintering habitat within the Nooksack River watershed. Other accessible foraging and overwintering habitat is located nearby and throughout the watershed. There is no bull trout spawning and rearing habitat in Kendall Creek. Therefore, at the scale of the watershed or core area, the effects to this PCE are minor and not expected to affect the overall functioning of this PCE. The weirs and affiliated structures and bank armoring diminish habitat complexity (PCE 4). However, their effects are relatively small and localized, and are not expected to affect the functioning of this PCE at the scale of the watershed or core area. All other effects to critical habitat from hatchery facilities and operations are considered insignificant.

Historical habitat degradation, combined with surface and groundwater water withdrawals, are the dominant and primary factors contributing to degraded habitat conditions and PCEs throughout the watershed. The effects of the action exacerbate these, but represent only incremental declines at small spatial scales, and do not preclude bull trout from foraging, migrating, or overwintering within the action area. Within the action area, bull trout critical habitat will retain its current ability to establish and maintain functioning PCEs. The anticipated effects of the action, combined with the effects of interrelated and interdependent actions, and the cumulative effects associated with future State, tribal, local, and private actions will not prevent the PCEs of critical habitat from being maintained, and will not degrade the current ability to establish functioning PCEs at the scale of the action area. Critical habitat within the action area will continue to serve the intended conservation role for the species at the scale of the core area, Coastal Recovery Unit, and coterminous range.

CONCLUSION: **Bull Trout and Designated Bull Trout Critical Habitat**

After reviewing the current status of bull trout, the environmental baseline for the action area, the effects of the proposed hatchery activities and the cumulative effects, it is the USFWS' Opinion that the hatchery operations, as proposed, is not likely to jeopardize the continued existence of the bull trout and is not likely to destroy or adversely modify designated critical habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. *Harm* is defined by the USFWS as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). *Harass* is defined by the USFWS as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the NMFS so that they become binding conditions of any grant or permit issued to the (applicant), as appropriate, for the exemption in section 7(o)(2) to apply. The NMFS has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the NMFS 1) fails to assume and implement the terms and conditions or 2) fails to require the WDFW to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the NMFS and the WDFW must report the progress of the action and its impact on the species to the USFWS as specified in this Incidental Take Statement [50 CFR 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

The USFWS anticipates that incidental take of up to 3 adult, subadult, and large juvenile bull trout, offspring of up to 2 adult female bull trout, and 100 juvenile bull trout during any 5-year period is reasonably certain to occur as a result of this proposed action. The incidental take is expected to be in the form of harm and harass as detailed below and summarized in Table 1.

Some forms of incidental take will be difficult to detect or quantify for the following reasons: the species is wide-ranging in habitats that are difficult to access; eggs, fry, and juveniles are small and exhibit cryptic behaviors; and some effects will result in delayed injury or mortality.

Pursuant to the authority of section 402.14(i)(1)(i) of the implementing regulations for section 7 of the ESA, a surrogate can be used to express the amount or extent of anticipated take if the following criteria are met: the causal link between the surrogate and take is described; an explanation is provided as to why it is not practical to express the amount or extent of take or to monitor take-related impacts in terms of individuals of the listed species; and a clear standard is set for determining when the level of anticipated take has been exceeded. When it is not practical to monitor take impacts in terms of individual bull trout due to the extremely low likelihood of 1) finding dead or injured individuals in the aquatic environment or 2) detecting significant behavior changes, we use operational criteria or capture rates as a clear standard for take exceedance. Therefore, where appropriate, we have identified surrogates for monitoring and reporting the incidental take of bull trout.

The following incidental take is anticipated due to the proposed action:

1. Incidental take of bull trout in the form of *harm* resulting from the presence of the Kendall Creek Hatchery lower weir, and associated blockage of access to foraging and overwintering habitat. This does not include bull trout that enter the off-channel pond, which are included in numbers 2 and 3 below. We estimate that up to 1 adult, subadult, or large juvenile bull trout would be harmed during any 5-year period as a result of these activities. It is not feasible to monitor the actual number of bull trout that will be affected by the weir because most dead fish at the weir site would not be detected because their carcasses would get washed downstream with the current and/or be carried away by predators. However, the incidental take that was evaluated was based on the number of bull trout reported by the WDFW that entered the off-channel adult collection pond, which serve as an indicator of the relative number of bull trout entering Kendall Creek and encountering the weir. That is, larger numbers of bull trout that enter the off-channel pond would suggest that larger numbers of bull trout are holding below the weir and

being exposed to effects of the weir. Therefore, detecting and monitoring the number of bull trout that are captured in the off-channel trap provides some estimate of the number of individuals that are not detected, but still adversely affected by the weir.

2. Incidental take of bull trout in the form of *harassment* resulting from capture in the off-channel pond or during angling. We estimate that up to 2 adult, subadult, or large juvenile bull trout will be captured during any 5-year period as a result of operations at the weir and during angling for adult broodstock collection.

3. Incidental take of bull trout in the form of *harm* resulting from capture, handling, captivity, and confinement related to broodstock collection infrastructure and activities. We anticipate that capture, captivity, confinement, and handling from all broodstock collection activities combined will result in immediate or delayed mortality of up to 1 adult, subadult, or large juvenile bull trout during any 5-year period of this consultation. It is not feasible to monitor delayed mortality. Therefore, capture rates identified in number 2 above, and immediate mortality, will serve as surrogates for monitoring and reporting immediate and delayed mortality. Exceedances of either the capture rates identified in number 2 or immediate mortality will be considered an exceedance of take from immediate and delayed mortality.

4. Incidental take of bull trout in the form of *harm* resulting from interspecies interactions, including predation and red destruction. We estimate that up to 100 juvenile bull trout and the offspring of up to 2 adult female bull trout will be harmed as a result of these activities during any 5-year period of this consultation. It is not feasible to monitor the actual number of bull trout that will be affected because attempting to monitor redd destruction by hatchery-origin fish, and predation on juvenile bull trout is not practical. However, the incidental take anticipated is based on hatchery production goals (number of fish released per year), fish size at release, and specific time and place of fish release. Therefore, these operational criteria serve as our surrogate for establishing limits on the take of the number of bull trout described above.

EFFECT OF THE TAKE

In the accompanying Opinion, the USFWS determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

Bull Trout

The USFWS believes the following reasonable and prudent measure(s) (RPM) are necessary and appropriate to minimize the impacts (i.e., the amount or extent) of incidental take of bull trout:

1. Minimize and monitor adverse effects to bull trout associated with hatchery broodstock collection activities, including incidental capture and handling.

2. Monitor effects of adverse inter-species interactions of hatchery-released fish on Nooksack River bull trout.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the NMFS and the WDFW (the applicant) must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

Bull Trout

Terms and Conditions associated with RPM 1:

1. Individuals engaged in broodstock collection activities and/or may handle bull trout shall be trained and knowledgeable in bull trout identification and safe bull trout handling procedures.

2. All bull trout shall be released as soon as possible and as close as possible to the point of capture. All captured bull trout shall be released with the minimum handling necessary to liberate the fish from the capture gear and safely return it to the river.

3. Ensure that any bull trout that enter the adult collection pond are released back to Kendall Creek as soon as practicable, preferably within 24 hours.

4. All captured bull trout shall be reported to the USFWS. Reports shall include the following: date and location of capture, capture method, approximate size of the fish, condition of the fish at release (including any obvious injuries or descaling, and whether these were the result of WDFW’s incidental capture and handling associated with broodstock collection), and whether the fish was released alive or died.

5. Bull trout mortalities shall be kept whole and put on ice or frozen. Frozen specimens shall be wrapped directly in aluminum foil to preserve the specimen in a manner that allows for future analysis. Alternative arrangements regarding the preservation or use of mortalities are allowed if coordinated with the USFWS. The USFWS office listed below must approve of the request in writing prior to the permittee implementing any alternative:

    Jeff Chan, Bull Trout Lead
    Listing and Recovery Division
    U.S. Fish and Wildlife Service
    510 Desmond Dr. SE, Suite 102
    Lacey, Washington 98503
    360-753-9440

6. All incidental visual observations of bull trout shall be reported to the USFWS. Reports shall include the following: date and location of each fish observed, and approximate size and condition of each fish observed, including any obvious signs of injury.

Terms and Conditions associated with RPM 2:

7. The WDFW shall annually report to the USFWS the following information regarding releases of hatchery EWS from Nooksack River watershed hatchery facilities: location(s) of fish releases, number of fish released at each location, average size of released fish (in mm FL), and date(s) of release at each location.

Terms and Conditions associated with RPMs 1 and 2:

8. The WDFW shall annually report to the USFWS all information described in Terms and Conditions 4, 6, and 7. Reporting requirements may be included in the WDFW annual bull trout observation reports that are provided to the USFWS under Section 6 of the Act, provided that: a) the reports clearly differentiate between observations associated with Nooksack River watershed hatchery operations and those associated with Section 6 or other activities (restoration and recovery actions that benefit bull trout); and b) the report transmittal to the USFWS indicates that reporting requirements pertaining to USFWS Consultation No. 01EWFW00-2015-F-0366, Nooksack River Watershed Hatchery Operations (EWS) are included in the report. A copy of the report shall be provided to:

    Mark Celedonia
    Federal Activities Branch
    Division of Consultation and Conservation Planning
    U.S. Fish and Wildlife Service
    510 Desmond Dr. SE, Suite 102
    Lacey, Washington 98503
    360-753-9440

Any reporting requirements that are provided separately from the Section 6 report shall reference the same consultation number and be sent to the same address above. All reporting requirements shall be provided by June 30 for the previous calendar year. This timeline may be adjusted with USFWS approval.

The USFWS believes that no more than 3 bull trout adults, subadults, or large juvenile, offspring of 2 adult female bull trout, and 100 small juvenile bull trout will be incidentally taken during any 5-year period as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the USFWS the need for possible modification of the reasonable and prudent measures.

The USFWS is to be notified within three working days upon locating a dead, injured or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death, if that occurs. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact the U.S. Fish and Wildlife Service Law Enforcement Office at (425) 883-8122, or the USFWS' Washington Fish and Wildlife Office at (360) 753-9440.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. The steelhead hatchery program produces fish that support fisheries which overlap in space and time with bull trout presence. Bull trout are known to be highly susceptible to incidental capture in some fisheries[2]. However, by-catch of bull trout in the Nooksack

[2] The bull trout 4(d) rule, implemented at the time of bull trout listing in 1999, exempts take associated with fisheries operated in accordance with applicable state, National Park Service, and Native American Tribal laws and regulations. The USFWS considers fisheries supported by the WDFW's Nooksack River watershed EWS hatchery programs as meeting requirements for exemption under the 4(d) rule.

EWS fisheries is not currently monitored. Therefore, we recommend that the NMFS and the WDFW monitor and evaluate the scope and magnitude of incidental and illegal take of bull trout associated with these fisheries, including:

a) Instituting reporting requirements for incidental capture of bull trout in commercial and Tribal fisheries, when these fisheries overlap in space and time with bull trout presence.

b) Conducting periodic creel surveys to monitor and evaluate bull trout capture in recreational fisheries, and modifying timing and locations of open fisheries as necessary to reduce impacts.

c) Increasing law enforcement presence in the Nooksack River watershed during open recreational fisheries.

d) Increasing angler education and outreach on the following subjects: 1) proper identification and handling of bull trout; 2) the listed status of bull trout and illegality of intentionally killing or injuring bull trout; 3) ecological importance of bull trout, particularly in helping to maintain abundance and vitality of naturally-reproducing salmonid populations, including steelhead trout.

In order for the USFWS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the USFWS requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the (request/reinitiation request). As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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APPENDIX A:
STATUS OF THE SPECIES (RANGEWIDE): BULL TROUT

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Appendix A
Bull Trout Range-wide Status of the Species

Listing Status

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (64 FR 58910). Bull trout generally occur in the following areas: 1) Klamath River Basin of south-central Oregon; 2) the Jarbidge River in Nevada; 3) the Willamette River Basin in Oregon; 4) Pacific Coast drainages of Washington, including Puget Sound; 5) major rivers in Idaho, Oregon, Washington, and Montana, within the Columbia River Basin; and, 6) the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Bond 1992, p. 2; Brewin and Brewin 1997, p. 215; Cavender 1978, pp. 165-166; Leary and Allendorf 1997, pp. 716-719).

Throughout its range, bull trout are threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, poor water quality, entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels, and introduced non-native species (64 FR 58910). Although all salmonids are likely to be affected by climate change, bull trout are especially vulnerable given that spawning and rearing are constrained by their location in upper watersheds and the requirement for cold water temperatures (Battin et al. 2007, pp. 6672-6673; Rieman et al. 2007, p. 1552). Poaching and incidental mortality of bull trout during other targeted fisheries are additional threats.

The bull trout was initially listed as three separate Distinct Population Segments (DPSs) (63 FR 31647; 64 FR 17110). The preamble to the final listing rule for the United States coterminous population of the bull trout discusses the consolidation of these DPSs with the Columbia and Klamath population segments into one listed taxon and the application of the jeopardy standard under section 7 of the Endangered Species Act (Act) relative to this species (64 FR 58910):

> Although this rule consolidates the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under section 7 of the Act, we intend to retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process.

Recovery Planning

Between 2002 and 2004, three separate draft bull trout recovery plans were completed. In 2002, a draft recovery plan that addressed bull trout populations within the Columbia, Saint Mary-Belly, and Klamath River basins (USFWS 2002) was completed and included individual chapters for 24 separate recovery units. In 2004, draft recovery plans were developed for the

Coastal-Puget Sound drainages in western Washington, including two recovery unit chapters (USFWS 2004), and for the Jarbidge River in Nevada (USFWS 2004). None of these draft recovery plans were finalized, but they have served to identify recovery actions across the range of the species and to provide a framework for implementing numerous recovery actions by our partner agencies, local working groups, and others with an interest in bull trout conservation.

The U.S. Fish and Wildlife Service (Service) released a final bull trout recovery plan in September 2015 (USFWS 2015). The recovery plan: 1) incorporates and builds upon new information found in numerous reports and studies regarding bull trout life history, ecology, etc., including a variety of implemented conservation actions, since the draft 2002 and 2004 recovery planning period; and, 2) revises recovery criteria proposed in the 2002 and 2004 draft recovery plans to focus on effective management of threats to bull trout at the core area level, and de-emphasize achieving targeted point estimates of abundance of adult bull trout (demographics) in each core area.

The 2002 and 2004 draft recovery plans provide the general life history information, habitat characteristics, diet, reasons for decline, and distribution and abundance of the different core areas. The 2015 final recovery plan integrates new information collected since the 1999 listing regarding bull trout life history, distribution, demographics, conservation successes, etc., and updates previous bull trout recovery planning efforts across the range of the single DPS currently listed under the Act. The 2015 final recovery plan supersedes and replaces the previous draft recovery plans; however, the 2002 and 2004 draft recovery plans still provide important information on bull trout status and life history.

The 2015 recovery plan establishes four categories of recovery actions for bull trout:

1) Protect, restore, and maintain suitable habitat conditions for bull trout.

2) Minimize demographic threats to bull trout by restoring connectivity or populations where appropriate to promote diverse life history strategies and conserve genetic diversity.

3) Prevent and reduce negative effects of non-native fishes and other non-native taxa on bull trout.

4) Work with partners to conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks, and considering the effects of climate change.

Current Status and Conservation Needs

Bull trout recovery is based on a geographical hierarchical approach. Bull trout are listed as a single DPS within the five-state area of the coterminous United States. The single DPS is subdivided into six biologically-based recovery units (RUs): 1) Coastal Recovery Unit; 2) Klamath Recovery Unit; 3) Mid-Columbia Recovery Unit; 4) Upper Snake Recovery Unit; 5) Columbia Headwaters Recovery Unit; and, 6) Saint Mary Recovery Unit (USFWS 2015, p. 36). These are viable recovery units that meet the three primary principles of biodiversity: representation (conserving the breadth of the genetic makeup of the species to conserve its adaptive capabilities); resilience (ensuring that each population is sufficiently large to withstand stochastic events); and redundancy (ensuring a sufficient number of populations to provide a margin of safety for the species to withstand catastrophic events) (USFWS 2015, p. 33).

Each of the six RUs contain multiple bull trout core areas, 116 total, which are non-overlapping watershed-based polygons, and each core area includes one or more local populations. Currently there are 109 occupied core areas, which comprise 600 or more local populations. There are also six core areas where bull trout historically occurred but are now extirpated, and one research needs area where bull trout were known to occur historically, but their current presence and use of the area are uncertain.

Core areas can be further described as complex or simple. Complex core areas contain multiple bull trout local populations, are found in large watersheds, have multiple life history forms, and have migratory connectivity between spawning and rearing habitat and foraging, migration, and overwintering habitats (FMO). Simple core areas are those that contain one bull trout local population. Simple core areas are small in scope, isolated from other core areas by natural barriers, and may contain unique genetic or life history adaptations.

A local population is a group of bull trout that spawn within a particular stream or portion of a stream system. A local population is the smallest group of fish known to represent an interacting reproductive unit. For most waters where specific information is lacking, a local population may be represented by a single headwater tributary or complex of headwater tributaries. Gene flow may occur between local populations (*e.g.*, those within a core population), but is assumed to be infrequent compared with that among individuals within a local population.

The habitat requirements of bull trout are often generally expressed as the four “Cs”: cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout throughout all hierarchical levels.

Recovery Units

The following is a summary of the description and current status of bull trout within the six RUs. More comprehensive discussions can be found in the 2015 final bull trout recovery plan (USFWS 2015) and the individual RU implementation plans.

<u>Coastal Recovery Unit</u>

The Coastal RU is located within western Oregon and Washington. The Coastal RU is divided into three regions: Puget Sound, Olympic Peninsula, and the Lower Columbia River Regions. This RU contains 21 occupied core areas and 85 local populations, including the Clackamas River core area where bull trout had been extirpated and were reintroduced in 2011. This RU also contains four historically occupied core areas that could be re-established with bull trout. Core areas within Puget Sound and the Olympic Peninsula currently support the only anadromous local populations of bull trout. This RU also contains ten shared FMO habitats that are outside core areas but that allow for the continued natural population dynamics in which the core areas have evolved. There are four core areas within the Coastal RU that have been identified as current population strongholds: Lower Skagit, Upper Skagit, Quinault River, and Lower Deschutes River. These are the most stable and abundant bull trout populations in the RU. The current condition of bull trout in this RU is attributed to: the adverse effects of climate change; loss of functioning estuarine and nearshore marine habitats; residential, commercial, and industrial development and urbanization and related impacts (e.g., flood control, floodplain disconnection, bank armoring, channel straightening; loss of instream habitat complexity); agriculture (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation, livestock grazing); connectivity impairment and fish passage obstructions (e.g., dams, culverts, instream flows); forest management practices (e.g., timber harvest and associated road building activities); mining; and the introduction of non-native species. Conservation measures or recovery actions implemented include relicensing of major hydropower facilities that have improved upstream and downstream fish passage or complete removal of dams, land acquisition to conserve bull trout habitat, floodplain restoration, culvert removal, riparian revegetation, levee setbacks, road removal, and projects to protect and restore important nearshore marine habitats.

Klamath Recovery Unit

The Klamath RU is located in southern Oregon and northwestern California. The Klamath RU is the most significantly imperiled recovery unit, having experienced considerable extirpation and geographic contraction of local populations and declining demographic condition, and natural re-colonization is constrained by dispersal barriers and presence of nonnative brook trout. This RU currently contains three occupied core areas and eight local populations. Nine historic local populations of bull trout have been extirpated, and restoring additional local populations will be necessary to achieve recovery. All three core areas have been isolated from other bull trout populations for the past 10,000 years. The current condition of bull trout in this RU is attributed to the adverse effects of climate change, habitat degradation and fragmentation, past and present land use practices, agricultural water diversions, nonnative species, and past fisheries management practices. Conservation measures or recovery actions implemented include removal of nonnative fish (e.g., brook trout, brown trout, and hybrids), acquiring water rights for instream flows, replacing diversion structures, installing fish screens, constructing bypass channels, installing riparian fencing, culver replacement, and habitat restoration.

Mid-Columbia Recovery Unit

The Mid-Columbia RU is located within eastern Washington, eastern Oregon, and portions of central Idaho. The Mid-Columbia RU is divided into four geographic regions: Lower Mid-Columbia, Upper Mid-Columbia, Lower Snake, and Mid-Snake Geographic Regions. This IRU contains 25 occupied core areas, two historically occupied core areas, one research needs area, and seven FMO habitats. The current condition of the bull trout in this RU is attributed to the adverse effects of climate change, agricultural practices (e.g. irrigation, water withdrawals, livestock grazing), fish passage barriers (e.g. dams, culverts), nonnative species, forest management practices, and mining. Conservation measures or recovery actions implemented include road removal, channel restoration, mine reclamation, improved grazing management, removal of fish barriers, and instream flow requirements.

Upper Snake Recovery Unit

The Upper Snake RU is located in central Idaho, northern Nevada, and eastern Oregon. The Upper Snake RU is divided inoto seven geographic regions: Salmon River, Boise River, Payette River, Little Lost River, Malheur River, Jarbidge River, and Weiser River. This RU contains 22 occupied core areas and 206 local populations, with almost 60 percent being present in the Salmon River Region. The current condition of the bull trout in this RU is attributed to the adverse effects of climate change, dams, mining, forest management practices, nonnative species, and agriculture (e.g., water diversions, grazing). Conservation measures or recovery actions implemented include instream habitat restoration, instream flow requirements, screening of irrigation diversions, and riparian restoration.

Columbia Headwaters Recovery Unit

The Columbia Headwaters RU is located in western Montana, northern Idaho, and the northeastern corner of Washington. The Columbia Headwaters RU is divided into five geographic regions: Upper Clark Fork, Lower Clark Fork, Flathead, Kootenai, and Coeur d'Alene Geographic Regions. This RU contains 35 occupied core areas: 15 complex core areas represented by larger interconnected habitats, and 20 simple core areas comprising isolated headwater lakes with single local populations. The 20 simple core areas are each represented by a single local population, many of which may have persisted for thousands of years despite small populations and isolated existence. Fish passage improvements within the RU have reconnected previously fragmented habitats. The current condition of bull trout in this RU is attributed to the adverse effects of climate change, mining and contamination by heavy metals, nonnative species, modified instream flows, migratory barriers (e.g., dams), habitat fragmentation, forest practices (e,g., logging, roads), agriculture practices (e.g. irrigation, livestock grazing), and residential development. Conservation measures or recovery actions implemented include habitat improvement, fish passage, and removal of nonnative species. Unlike the other RUs, the Columbia Headwaters RU does not have any anadromous fish overlap. Therefore, bull trout within the Columbia Headwaters RU do not benefit from the recovery actions for salmon.

Saint Mary Recovery Unit

The Saint Mary RU is located in Montana but is heavily linked to downstream resources in southern Alberta, Canada. Most of the watershed in this RU is located in Canada. The United States portion includes headwater spawning and rearing habitat and the upper reaches of FMO habitat. This RU contains four occupied core areas, and eight local populations. The current condition of bull trout in this RU is attributed to the adverse effects of climate change, the Saint Mary Diversion operated by the Bureau of Reclamation (e.g., entrainment, fish passage, instream flows), and nonnative species. The primary issue precluding bull trout recovery in this RU relates to impacts of water diversions, specifically at the Bureau of Reclamations Milk River Project.

Life History

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993, pp. 1-18). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Fraley and Shepard 1989, p. 1; Goetz 1989, pp. 15-16). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989, pp. 135-137; Goetz 1989, pp. 22-25), or saltwater (anadromous form) to rear as subadults and to live as adults (Cavender 1978, pp. 139, 165-68; McPhail and Baxter 1996, p. 14; WDFW et al. 1997, pp. 17-18, 22-26). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime). Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Fraley and Shepard 1989, pp. 135-137; Leathe and Graham 1982, p. 95; Pratt 1992, p. 6; Rieman and McIntyre 1996, p. 133).

The iteroparous reproductive strategy of bull trout has important repercussions for the management of this species. Bull trout require adult and subadult passage both upstream and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and require only one-way adult passage upstream). Therefore, dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a downstream passage route for adults and subadults. Additionally, in some core areas, bull trout that migrate to marine waters must pass both upstream and downstream through areas with net fisheries at river mouths. This can increase the likelihood of mortality to bull trout during these spawning and foraging migrations.

Growth varies depending upon life-history strategy. Resident adults range from 6 to 12 inches total length, and migratory adults commonly reach 24 inches or more (Goetz 1989, pp. 29-32; Pratt 1984, p. 13). The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993, p. 7). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989, pp. 137, 141; Goetz 1989, pp. 19-26; Bond in Hoelscher and Bjornn 1989, p. 57; Howell and Buchanan 1992, p. 1; Pratt 1992, p. 6; Rich 1996, pp. 35-38; Rieman and McIntyre 1993, pp. 4-7; Rieman and McIntyre 1995, pp. 293-294; Sedell and Everest 1991, p. 1; Watson and Hillman 1997, pp. 246-250). Watson and Hillman (1997, pp. 247-249) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993, p. 7), bull trout should not be expected to simultaneously occupy all available habitats (Rieman et al. 1997, p. 1560).

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Gilpin, in litt. 1997, pp. 4-5; Rieman and McIntyre 1993, p. 7; Rieman et al. 1997, p. 1114). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a long time (Rieman and McIntyre 1993, p. 7; Spruell et al. 1999, pp. 118-120). Migration also allows bull trout to access more abundant or larger prey, which facilitates growth and reproduction. Additional benefits of migration and its relationship to foraging are discussed below under “Diet.”

Cold water temperatures play an important role in determining bull trout habitat quality, as these fish are primarily found in colder streams (below 15 °C or 59 °F), and spawning habitats are generally characterized by temperatures that drop below 9 °C (48 °F) in the fall (Fraley and Shepard 1989, p. 133; Pratt 1992, p. 6; Rieman and McIntyre 1993, p. 7).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Baxter et al. 1997, pp. 426-427; Pratt 1992, p. 6; Rieman and McIntyre 1993, p. 7; Rieman et al. 1997, p. 1117). Optimum incubation temperatures for bull trout eggs range from 2 °C to 6 °C (35 °F to 39 °F) whereas optimum water temperatures for rearing range from about 6 °C to 10 °C (46 °F to 50 °F) (Buchanan and Gregory 1997, pp. 121-122; Goetz 1989, pp. 22-24; McPhail and Murray 1979, pp. 41, 50, 53, 55). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8 °C to 9 °C (46 °F to 48 °F), within a temperature gradient of 8 °C to 15 °C (4 °F to 60 °F). In a landscape study relating bull trout distribution to maximum water temperatures, Dunham et al. (2003) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 11 °C to 12 °C (52 °F to 54 °F).

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Buchanan and Gregory 1997, pp. 121-122; Fraley and Shepard 1989, pp. 135-137; Rieman and McIntyre 1993, p. 2; Rieman and McIntyre 1995, p. 288; Rieman et al. 1997, p. 1114). Availability and proximity of cold water patches and food productivity can influence bull trout ability to survive in warmer rivers (Myrick et al. 2002). For example, in a study in the Little Lost River of Idaho where bull trout were found at temperatures ranging from 8 °C to 20 °C (46 °F to 68 °F), most sites that had high densities of bull trout were in areas where primary productivity in streams had increased following a fire (Gamett, pers. comm. 2002).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989, pp. 135-137; Goetz 1989, pp. 22-25; Hoelscher and Bjornn 1989, p. 54; Pratt 1992, p. 6; Rich 1996, pp. 35-38; Sedell and Everest 1991, p. 1; Sexauer and James 1997, pp. 367-369; Thomas 1992, pp. 4-5; Watson and Hillman 1997, pp. 247-249). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993, p. 7). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997, pp. 367-369). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989, pp. 135-137; Pratt 1992, p. 6; Pratt and Huston 1993, pp. 70-72). Pratt (1992, p. 6) indicated that increases in fine sediment reduce egg survival and emergence.

Bull trout typically spawn from August through November during periods of increasing flows and decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989, p. 135). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, p. 15; Pratt 1992, p. 8; Rieman and McIntyre 1996, p. 133). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992, p. 8). After hatching, fry remain in the substrate, and time from egg deposition to emergence may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Ratliff and Howell 1992 in Howell and Buchanan 1992, pp. 10, 15; Pratt 1992, pp. 5-6).

Early life stages of fish, specifically the developing embryo, require the highest inter-gravel dissolved oxygen (IGDO) levels, and are the most sensitive life stage to reduced oxygen levels. The oxygen demand of embryos depends on temperature and on stage of development, with the greatest IGDO required just prior to hatching.

A literature review conducted by the Washington Department of Ecology (WDOE 2002) indicates that adverse effects of lower oxygen concentrations on embryo survival are magnified as temperatures increase above optimal (for incubation). In a laboratory study conducted in Canada, researchers found that low oxygen levels retarded embryonic development in bull trout (Giles and Van der Zweep 1996, pp. 54-55). Normal oxygen levels seen in rivers used by bull trout during spawning ranged from 8 to 12 mg/L (in the gravel), with corresponding instream levels of 10 to 11.5 mg/L (Stewart et al. 2007). In addition, IGDO concentrations, water velocities in the water column, and especially the intergravel flow rate, are interrelated variables that affect the survival of incubating embryos (ODEQ 1995). Due to a long incubation period of 220+ days, bull trout are particularly sensitive to adequate IGDO levels. An IGDO level below 8 mg/L is likely to result in mortality of eggs, embryos, and fry.

Migratory forms of bull trout may develop when habitat conditions allow movement between spawning and rearing streams and larger rivers, lakes, or nearshore marine habitat where foraging opportunities may be enhanced (Brenkman and Corbett 2005, pp. 1073, 1079-1080; Frissell 1993, p. 350; Goetz et al. 2004, pp. 45, 55, 60, 68, 77, 113-114, 123, 125-126). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams, lakes, and marine waters; greater fecundity resulting in increased reproductive potential; and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1999, pp. 15-16; Rieman and McIntyre 1993, pp. 18-19; MBTSG 1998, pp. iv, 48-50; USFWS 2004a, Vol. 2, p. 63). In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbances make local habitats temporarily unsuitable. Therefore, the range of the species is diminished, and the potential for a greater reproductive contribution from larger fish with higher fecundity is lost (Rieman and McIntyre 1993, pp. 1-18).

Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. A single optimal foraging strategy is not necessarily a consistent feature in the life of a fish, because this strategy can change as the fish progresses from one life stage to another (i.e., juvenile to subadult). Fish growth depends on the quantity and quality of food that is eaten (Gerking 1994), and as fish grow, their foraging strategy changes as their food changes, in quantity, size, or other characteristics. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987, p. 58; Donald and Alger 1993, pp. 239-243; Goetz 1989, pp. 33-34). Subadult and adult migratory bull trout feed on various fish species (Brown 1994, p. 21; Donald and Alger 1993, p. 242; Fraley and Shepard 1989, p. 135; Leathe and Graham 1982, p. 95). Bull trout of all sizes other than fry have been found to eat fish up to half their length (Beauchamp and VanTassell 2001). Bull trout may feed heavily on fish eggs in watersheds shared with anadromous salmon (Lowery and Beauchamp 2015). In nearshore marine areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) (Goetz et al. 2004, p. 114; WDFW et al. 1997, p. 23).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. Optimal foraging theory can be used to describe strategies fish use to choose between alternative sources of food by weighing the benefits and costs of capturing one source of food over another. For example, prey often occur in concentrated patches of abundance ("patch model") (Gerking 1994). As the predator feeds in one patch, the prey population is reduced, and it becomes more profitable for the predator to seek a new patch rather than continue feeding on the original one. This can be explained in terms of balancing energy acquired versus energy expended. For example, in the Skagit River system, anadromous bull trout make migrations as long as 121 miles between marine foraging areas in Puget Sound and headwater spawning grounds, foraging on salmon eggs and juvenile salmon along their migration route (WDFW et al. 1997). Anadromous bull trout also use marine waters as migration corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman and Corbett 2005, p. 1079; Goetz et al. 2004, pp. 36, 60).

Effects of Climate Change on Bull Trout

The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19).

Climate change is likely to play an increasingly important role in determining the abundance of ESA-listed species and the conservation value of designated critical habitats in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. Areas with elevations high enough to maintain temperatures well below freezing for most of the winter and early spring will be less affected. Low-elevation areas are likely to be more affected. During the last century, average regional air temperatures increased by 1.5 °F, with increases as much as 4 °F in isolated areas (USGCRP 2009). Average regional temperatures are likely to increase an additional 3 °F to 10 °F over the next century (USGCRP 2009). Overall, about one-third of the current cold-water fish habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (USGCRP 2009).

Precipitation trends during the next century are less certain than for temperature, but more precipitation is likely to occur during October through March, less may occur during summer months, and more winter precipitation is likely to fall as rain rather than snow (ISAB 2007; USGCRP 2009). Significant reductions in both total snow pack and low-elevation snow pack in the Pacific Northwest is predicted over the next 50 years (Mote and Salathé 2010) – changes that will shrink the extent of the snowmelt-dominated habitat available to salmonids. Where snow occurs, a warmer climate will cause earlier runoff, which will increase flows in early spring but will likely reduce flows and increase water temperature in late spring, summer, and fall (ISAB 2007; USGCRP 2009).

As the snow pack diminishes and seasonal hydrology shifts to more frequent and severe early large storms, stream flow timing and increased peak river flows may limit salmonid survival (Mantua et al. 2010). Lower stream flows and warmer water temperatures during summer will degrade summer rearing conditions, in part by increasing the prevalence and virulence of fish diseases and parasites (USGCRP 2009). To avoid waters above summer maximum temperatures, juvenile rearing may be increasingly found only in the confluence of colder tributaries or other areas of cold water refugia (Mantua et al. 2010). Other adverse effects are likely to include altered migration patterns, accelerated embryo development, premature emergence of fry, variation in quality and quantity of tributary rearing habitat, and increased competition and predation risk from warm-water, non-native species (ISAB 2007).

The earth's oceans are also warming, with considerable interannual and inter-decadal variability superimposed on the longer-term trend (Bindoff et al. 2007). Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmonids, while cooler ocean periods have coincided with relatively high abundances (Scheuerell and Williams 2005; Zabel et al. 2006; USGCRP 2009). Ocean conditions adverse to salmonids may be more likely under a warming climate (Zabel et al. 2006).

Ocean acidification resulting from the uptake of carbon dioxide by ocean waters threatens corals, shellfish, and other living things that form their shells and skeletons from calcium carbonate (Orr et al. 2005; Feely et al. 2012). Such ocean acidification is essentially irreversible over a time scale of centuries (Royal Society 2005). Increasing carbon dioxide concentrations are reducing ocean pH and dissolved carbonate ion concentrations, and thus levels of calcium carbonate saturation. Over the past several centuries, ocean pH has decreased by about 0.1 (an approximately 30 percent increase in acidity) and is projected to decline by another 0.3 to 0.4 pH units (approximately 100 to 150 percent increase in acidity) by the end of this century (Orr et al. 2005; Feely et al. 2012). As aqueous carbon dioxide concentrations increase, carbonate ion concentrations decrease, making it more difficult for marine calcifying organisms to form biogenic calcium carbonate needed for shell and skeleton formation. The reduction in pH also affects photosynthesis, growth, and reproduction of marine organisms. The upwelling of deeper ocean water deficient in carbonate, and thus potentially detrimental to the food chains supporting juvenile salmonids, has recently been observed along the U.S. west coast (Feely et al. 2008).

Climate change is expected to make recovery targets for ESA-listed species more difficult to achieve. Actions improving freshwater and estuarine habitats can offset some of the adverse impacts of climate change. Examples include restoring connections to historical floodplains and estuarine habitats, protecting and restoring riparian vegetation, purchasing or applying easements to lands that provide important cold water or refuge habitat, and leasing or buying water rights to improve summer flows (Battin et al. 2007; ISAB 2007).

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APPENDIX B
STATUS OF THE DESIGNATED CRITICAL HABITAT: BULL TROUT

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Appendix B
STATUS OF BULL TROUT CRITICAL HABITAT (Rangewide)

Legal Status

Current Designation

The U.S. Fish and Wildlife Service (Service) published a final critical habitat designation for the coterminous United States population of the bull trout on October 18, 2010 (70 FR 63898); the rule became effective on November 17, 2010. A justification document was also developed to support the rule and is available on our website (http://www.fws.gov/pacific/bulltrout). The scope of the designation involved the species' coterminous range, including six draft recovery units [Mid-Columbia, Saint Mary, Columbia Headwaters, Coastal, Klamath, and Upper Snake (75 FR 63927)]. The Service's 1999 coterminous listing rule identified five interim recovery units (50 CFR Part 17, pg. 58910), which includes the Jarbidge River, Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments (also considered as interim recovery units). Our five year review recommended re-evaluation of these units based on new information (USFWS 2008, p. 9). However, until the bull trout draft recovery plan is finalized, the current five interim recovery units will be used for purposes of section 7 jeopardy analyses and recovery planning. The adverse modification analysis in this biological opinion does not rely on recovery units, relying instead on the listed critical habitat units and subunits.

Rangewide, the Service designated reservoirs/lakes and stream/shoreline miles as bull trout critical habitat (Table 1). Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing, and 2) foraging, migration, and overwintering (FMO).

Table 1. Stream/shoreline distance and reservoir/lake area designated as bull trout critical habitat by state.

State	Stream/Shoreline Miles	Stream/Shoreline Kilometers	Reservoir /Lake Acres	Reservoir /Lake Hectares
Idaho	8,771.6	14,116.5	170,217.5	68,884.9
Montana	3,056.5	4,918.9	221,470.7	89,626.4
Nevada	71.8	115.6	-	-
Oregon	2,835.9	4,563.9	30,255.5	12,244.0
Oregon/Idaho	107.7	173.3	-	-
Washington	3,793.3	6,104.8	66,308.1	26,834.0
Washington (marine)	753.8	1,213.2	-	-
Washington/Idaho	37.2	59.9	-	-
Washington/Oregon	301.3	484.8	-	-
Total	19,729.0	31,750.8	488,251.7	197,589.2

The 2010 revision increases the amount of designated bull trout critical habitat by approximately 76 percent for miles of stream/shoreline and by approximately 71 percent for acres of lakes and reservoirs compared to the 2005 designation.

This rule also identifies and designates as critical habitat approximately 1,323.7 km (822.5 miles) of streams/shorelines and 6,758.8 ha (16,701.3 acres) of lakes/reservoirs of unoccupied habitat to address bull trout conservation needs in specific geographic areas in several areas not occupied at the time of listing. No unoccupied habitat was included in the 2005 designation. These unoccupied areas were determined by the Service to be essential for restoring functioning migratory bull trout populations based on currently available scientific information. These unoccupied areas often include lower main stem river environments that can provide seasonally important migration habitat for bull trout. This type of habitat is essential in areas where bull trout habitat and population loss over time necessitates reestablishing bull trout in currently unoccupied habitat areas to achieve recovery.

The final rule continues to exclude some critical habitat segments based on a careful balancing of the benefits of inclusion versus the benefits of exclusion. Critical habitat does not include: 1) waters adjacent to non-Federal lands covered by legally operative incidental take permits for habitat conservation plans (HCPs) issued under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (Act), in which bull trout is a covered species on or before the publication of this final rule; 2) waters within or adjacent to Tribal lands subject to certain commitments to conserve bull trout or a conservation program that provides aquatic resource protection and restoration through collaborative efforts, and where the Tribes indicated that inclusion would impair their relationship with the Service; or 3) waters where impacts to national security have been identified (75 FR 63898). Excluded areas are approximately 10 percent of the stream/shoreline miles and 4 percent of the lakes and reservoir acreage of designated critical habitat. Each excluded area is identified in the relevant Critical Habitat Unit (CHU) text, as identified in paragraphs (e)(8) through (e)(41) of the final rule. See Tables 2 and 3 for the list of excluded areas. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation. Because exclusions reflect the often complex pattern of land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments.

Table 2. Stream/shoreline distance excluded from bull trout critical habitat based on Tribal ownership or other plan.

Ownership and/or Plan	Kilometers	Miles
Lewis River Hydro Conservation Easements	7.0	4.3
DOD – Dabob Bay Naval	23.9	14.8
HCP – Cedar River (City of Seattle)	25.8	16.0
HCP – Washington Forest Practices Lands	1,608.30	999.4
HCP – Green Diamond (Simpson)	104.2	64.7
HCP – Plum Creek Central Cascades (WA)	15.8	9.8
HCP – Plum Creek Native Fish (MT)	181.6	112.8
HCP–Stimson	7.7	4.8
HCP – WDNR Lands	230.9	149.5
Tribal – Blackfeet	82.1	51.0
Tribal – Hoh	4.0	2.5
Tribal – Jamestown S'Klallam	2.0	1.2
Tribal – Lower Elwha	4.6	2.8

Ownership and/or Plan	Kilometers	Miles
Tribal – Lummi	56.7	35.3
Tribal – Muckleshoot	9.3	5.8
Tribal – Nooksack	8.3	5.1
Tribal – Puyallup	33.0	20.5
Tribal – Quileute	4.0	2.5
Tribal – Quinault	153.7	95.5
Tribal – Skokomish	26.2	16.3
Tribal – Stillaguamish	1.8	1.1
Tribal – Swinomish	45.2	28.1
Tribal – Tulalip	27.8	17.3
Tribal – Umatilla	62.6	38.9
Tribal – Warm Springs	260.5	161.9
Tribal – Yakama	107.9	67.1
Total	3,094.9	1,923.1

Table 3. Lake/Reservoir area excluded from bull trout critical habitat based on Tribal ownership or other plan.

Ownership and/or Plan	Hectares	Acres
HCP – Cedar River (City of Seattle)	796.5	1,968.2
HCP – Washington Forest Practices Lands	5,689.1	14,058.1
HCP – Plum Creek Native Fish	32.2	79.7
Tribal – Blackfeet	886.1	2,189.5
Tribal – Warm Springs	445.3	1,100.4
Total	7,849.3	19,395.8

Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (75 FR 63898:63943 [October 18, 2010]). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. CHUs generally encompass one or more core areas and may include FMO areas, outside of core areas, that are important to the survival and recovery of bull trout.

Thirty-two CHUs within the geographical area occupied by the species at the time of listing are designated under the final rule. Twenty-nine of the CHUs contain all of the physical or biological features identified in this final rule and support multiple life-history requirements. Three of the mainstem river units in the Columbia and Snake River basins contain most of the physical or biological features necessary to support the bull trout's particular use of that habitat, other than those physical biological features associated with Primary Constituent Elements (PCEs) 5 and 6, which relate to breeding habitat.

The primary function of individual CHUs is to maintain and support core areas, which 1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993, p. 19); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (Rieman and McIntyre 1993, pp. 22-23; MBTSG 1998, pp. 48-49); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Hard 1995, pp. 314-315; Healey and Prince 1995, p. 182; Rieman and McIntyre 1993, pp. 22-23; MBTSG 1998, pp. 48-49); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Hard 1995, pp. 321-322; Rieman and McIntyre 1993, p. 23; Rieman and Allendorf 2001, p. 763; MBTSG 1998, pp. 13-16).

The Olympic Peninsula and Puget Sound CHUs are essential to the conservation of anadromous[1] bull trout, which are unique to the Coastal-Puget Sound population segment. These CHUs contain marine nearshore and freshwater habitats, outside of core areas, that are used by bull trout from one or more core areas. These habitats, outside of core areas, contain PCEs that are critical to adult and subadult foraging, overwintering, and migration.

Primary Constituent Elements for Bull Trout

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Based on our current knowledge of the life history, biology, and ecology of this species and the characteristics of the habitat necessary to sustain its essential life-history functions, we have determined that the following PCEs are essential for the conservation of bull trout.

1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

[1] Bull trout migrate from saltwater to freshwater to reproduce are commonly referred to as anadromous. However, bull trout and some other species that enter the marine environment are more properly termed amphidromous. Unlike strictly anadromous species, such as Pacific salmon, amphidromous species often return seasonally to fresh water as subadults, sometimes for several years, before returning to spawn (Brenkman and Corbett 2005, p. 1075; Wilson 1997, p. 5). Due to its more common usage, we will refer to bull trout has exhibiting anadromous rather than amphidromous life history patterns in this document.

4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

5. Water temperatures ranging from 2 °C to 15 °C (36 °F to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

6. In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

9. Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The revised PCE's are similar to those previously in effect under the 2005 designation. The most significant modification is the addition of a ninth PCE to address the presence of nonnative predatory or competitive fish species. Although this PCE applies to both the freshwater and marine environments, currently no non-native fish species are of concern in the marine environment, though this could change in the future.

Note that only PCEs 2, 3, 4, 5, and 8 apply to marine nearshore waters identified as critical habitat. Also, lakes and reservoirs within the CHUs also contain most of the physical or biological features necessary to support bull trout, with the exception of those associated with PCEs 1 and 6. Additionally, all except PCE 6 apply to FMO habitat designated as critical habitat.

Critical habitat includes the stream channels within the designated stream reaches and has a lateral extent as defined by the bankfull elevation on one bank to the bankfull elevation on the opposite bank. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of

1 to 2 years on the annual flood series. If bankfull elevation is not evident on either bank, the ordinary high-water line must be used to determine the lateral extent of critical habitat. The lateral extent of designated lakes is defined by the perimeter of the waterbody as mapped on standard 1:24,000 scale topographic maps. The Service assumes in many cases this is the full-pool level of the waterbody. In areas where only one side of the waterbody is designated (where only one side is excluded), the mid-line of the waterbody represents the lateral extent of critical habitat.

In marine nearshore areas, the inshore extent of critical habitat is the mean higher high-water (MHHW) line, including the uppermost reach of the saltwater wedge within tidally influenced freshwater heads of estuaries. The MHHW line refers to the average of all the higher high-water heights of the two daily tidal levels. Marine critical habitat extends offshore to the depth of 10 meters (m) (33 ft) relative to the mean lower low-water (MLLW) line (zero tidal level or average of all the lower low-water heights of the two daily tidal levels). This area between the MHHW line and minus 10 m MLLW line (the average extent of the photic zone) is considered the habitat most consistently used by bull trout in marine waters based on known use, forage fish availability, and ongoing migration studies and captures geological and ecological processes important to maintaining these habitats. This area contains essential foraging habitat and migration corridors such as estuaries, bays, inlets, shallow subtidal areas, and intertidal flats.

Adjacent shoreline riparian areas, bluffs, and uplands are not designated as critical habitat. However, it should be recognized that the quality of marine and freshwater habitat along streams, lakes, and shorelines is intrinsically related to the character of these adjacent features, and that human activities that occur outside of the designated critical habitat can have major effects on physical and biological features of the aquatic environment.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to "destroy or adversely modify" critical habitat by no longer serving the intended conservation role for the species or retaining those PCEs that relate to the ability of the area to at least periodically support the species. Activities that may destroy or adversely modify critical habitat are those that alter the PCEs to such an extent that the conservation value of critical habitat is appreciably reduced (75 FR 63898:63943; USFWS 2004, Vol. 1. pp. 140-193, Vol. 2, pp. 69-114). The Service's evaluation must be conducted at the scale of the entire critical habitat area designated, unless otherwise stated in the final critical habitat rule (USFWS and NMFS 1998, pp. 4-39). Thus, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Jarbidge River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments. However, we consider all 32 CHUs to contain features or areas essential to the conservation of the bull trout (75 FR 63898:63901, 63944). Therefore, if a proposed action would alter the physical or biological features of critical habitat to an extent that appreciably reduces the conservation function of one or more critical habitat units for bull trout, a finding of adverse modification of the entire designated critical habitat area may be warranted (75 FR 63898:63943).

Current Critical Habitat Condition Rangewide

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). This condition reflects the condition of bull trout habitat. The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of nonnative species (63 FR 31647, June 10 1998; 64 FR 17112, April 8, 1999).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PCEs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows: 1) fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Dunham and Rieman 1999, p. 652; Rieman and McIntyre 1993, p. 7); 2) degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989, p. 141; MBTSG 1998, pp. ii - v, 20-45); 3) the introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993, p. 857; Rieman et al. 2006, pp. 73-76); 4) in the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development; and 5) degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

Effects of Climate Change on Bull Trout Critical Habitat

One objective of the final rule was to identify and protect those habitats that provide resiliency for bull trout use in the face of climate change. Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features described in PCEs 1, 2, 3, 5, 7, 8, and 9. Protecting bull trout strongholds and cold water refugia from disturbance and ensuring connectivity among populations were important considerations in addressing this potential impact. Additionally, climate change may exacerbate habitat degradation impacts both physically (e.g., decreased base flows, increased water temperatures) and biologically (e.g., increased competition with non-native fishes).

Consulted on Effects for Critical Habitat

The Service has formally consulted on the effects to bull trout critical habitat throughout its range. Section 7 consultations include actions that continue to degrade the environmental baseline in many cases. However, long-term restoration efforts have also been implemented that provide some improvement in the existing functions within some of the critical habitat units.

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