United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington Fish and Wildlife Office
Central Washington Field Office
215 Melody Lane, Suite 119
Wenatchee, WA 98801

REPLY TO:
2011-F-0090, 2006-P-0009, HUC 17-02-00-18-07
CONS-120

March 16, 2012

Honorable Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

Dear Ms. Bose:

This correspondence conveys the U. S. Fish and Wildlife Service's (Service) biological opinion for the relicensing of the Wells Hydroelectric Project (Project) (FERC No. 2149), located on the Columbia River in Douglas County, Washington. The Project is owned and operated by Public Utility District No. 1 of Douglas County (Douglas PUD). This consultation was based primarily on our review of the May 28, 2010, Wells Final License Application and the August 29, 2011 Supplemental Draft Biological Assessment for relicensing of the Project. The attached biological opinion and documentation of informal consultation describes the effects of the Project on the bull trout *(Salvelinus confluentius)* and other listed species in accordance with Section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq*.).

The biological opinion assessed whether the Project is likely to jeopardize the continued existence of bull trout or result in the destruction or adverse modification of designated critical habitat and includes a detailed discussion of the effects of the action on bull trout and its designated critical habitat. The accompanying Incidental Take Statement provides exemption from Section 9 of the Act for the following activities as described in the BO: operation of the turbine(s), juvenile fish bypass, spillway, and adult fishways; reservoir operations; the predator control program; and implementation of the hatchery management plans and aquatic resource management plans. No analysis was completed and no incidental take was issued in this biological opinion for the *Historic Properties Management Plan*, *Recreation Management Plan*, the *Land Use Policy* (shoreline management), since sufficient information regarding these actions was not available at this time., Any construction of any new structures or facilities not mentioned in this biological opinion will need to be consulted on in the future..

On April 12, 2011, the Commission sent its letter to the Service regarding a request for concurrence on the "no effect" determination for Ute ladies'-tresses (*Spiranthes diluvialis*), marbled murrelet (*Brachyrampus marmoratus*), gray wolf (*Canis lupus*), Canada lynx (*Lynx canadensis*), northern spotted owl (*Strix occidentalis caurina*), grizzly bear (*Ursus arctos horribilis*), pygmy rabbit (*Brachylagus idahoensis*), Wenatchee Mountains checker mallow (*Sidalcea oregano*), and showy stickseed (*Hackelia venusta*). The Commission made a determination of "may affect, not likely to adversely affect" for the Columbia River bull trout and its designated critical habitat.

On May 5, 2011, the Service did not concur with the Commission's "may affect, not likely to adversely affect" determination for the bull trout, since there may be adverse effects to this species over the term of a new 30-50 year license for the Project and the Project contains critical habitat for this species. Although the Commission requested concurrence with its "no effect" determination for Ute ladies'-tresses, marbled murrelet, gray wolf, Canada lynx, northern spotted owl, grizzly bear, pygmy rabbit, Wenatchee Mountains checker mallow, and the showy stickseed, the Service does not have the statutory authority to concur with "no effect" determinations but acknowledged the Commission's determinations.

On July 19, 2011, the Commission requested formal consultation for the effects of relicensing the Project on bull trout. Since that time, the Service has corresponded with Douglas PUD for the purpose of analyzing the Project's effects within the Service's biological opinion for the Project and to update the consultation schedule.

In the enclosed biological opinion, the Service has determined that the proposed Project is "likely to adversely affect" the bull trout; however, the level of anticipated take is not likely to jeopardize the continued existence of the species. Critical habitat for the bull trout does occur within the action area and we have determined that the Project will "likely adversely affect" bull trout critical habitat; however, it is not likely to result in "adverse modification" of critical habitat. The Project will not result in appreciably diminishing the value of critical habitat for both the survival and recovery of bull trout.

Because the proposed Project is "likely to adversely affect" bull trout, the biological opinion includes reasonable and prudent measures with mandatory terms and conditions that must be implemented to minimize incidental take that might otherwise result from the proposed action.

The Service acknowledges and appreciates the patience and participation of Commission and Douglas PUD personnel in completing this consultation. Thank you all for providing technical information and cooperation needed to complete this consultation. The Service especially thanks Douglas PUD for their excellent working relationship with the Service throughout the relicensing process and their assistance to the Service in efforts to recover listed species, Pacific lamprey and white sturgeon.

If you have questions concerning this biological opinion or your responsibilities under the Endangered Species Act, please contact Steve Lewis of the Central Washington Field Office in Wenatchee, Washington at (509) 665-3508 x 14 or via e-mail at Stephen_Lewis@fws.gov.

Sincerely,

Jessica L Gonzales for

Ken S. Berg, Manager
Washington Fish and Wildlife Office

Attachment

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BIOLOGICAL OPINION

for the

Proposed Relicensing of Wells Hydroelectric Project

Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

U.S. Fish and Wildlife Service Reference Numbers:
13410-2011-F-0090
13260-2006-P-0009
Hydrologic Unit Code: 17-02-00-18-07

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Jessica L. Gonzales for
Ken S. Berg, Manager
Washington Fish and Wildlife
Office

Mar 16, 2012
Date

LISTS OF FIGURES AND TABLES

LIST of ABBREVIATIONS

Act	Endangered Species Act
AFA	Anadromous Fish Agreement
ANS	Aquatic Nuisance Species
ANSMP	Aquatic Nuisance Species Management Plan
APP	Avian Protection Plan
ASA	Aquatic Settlement Agreement
ASWG	Aquatic Settlement Work Group
BA	Biological Assessment
BLM	Bureau of Land Management
BO	Biological Opinion
BOP	Bypass Operation Plan
BOR	Bureau of Reclamation
BT	Bull Trout
BTMP	Bull Trout Management Plan
BTMMP	Bull Trout Monitoring and Management Plan
Cfs	Cubic feet per second
CH	Critical Habitat
CHU	Critical Habitat Unit
COE	U.S. Army Corps of Engineers
COED	Consulted-On Effects Database
Commission	Federal Energy Regulatory Commission
CR	Congressional Record
CSR-SRI	Columbia-Snake River Spill Response Initiative
CRWG	Cultural Resource Work Group
CWFO	USFWS Central Washington Field Office, Wenatchee
CWU	Central Washington University
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
DPS	Distant Population Units
Douglas	Douglas County Public Utilities District
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FCRPS	Federal Columbia River Power System
FERC	Federal Energy Regulatory Commission
FMO	Foraging, Migration and Overwintering
~~FR~~	~~Federal Record~~
GAP	Gas Abatement Plan
GBD	Gas Bubble Disease

GBT	Gas Bubble Trauma
HCP	Habitat Conservation Plan
HCP CC	Habitat Conservation Plan Coordinating Committee
HGMP	Hatchery Genetics Management Plan
Hp	Horsepower
ITP	Incidental Take Permit
ITS	Incidental Take Statement
JBS	Juvenile Bypass System
Kcfs	Kilo Cubic Feet Per Second
Kv	Kilovolt
kW	Kilowatts
LEE	Lamprey Entrance Efficiency
MBTSG	Montana Bull Trout Study Group
MCRFRO	Mid-Columbia River Fishery Resource Office
MHHW	Mean Higher High-Water
MLS	Mean Sea Level
MLLW	Mean Low Low-Water
NHP	Natural Heritage Program
NHPA	National Historic Preservation Association
NMFS	National Marine Fisheries Service
NNI	No Net Impact
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OS	Operations Study
PCE	Primary Constituent Elements
PIT	Passive Integrated Transponder
PLMP	Pacific Lamprey Management Plan
PM&E	Protection Mitigation and Enhancement
PSA	Plan Species Account
RFMP	Resident Fish Management Plan
RM	River Mile
Rpm	Revolutions per minute
RPM	Reasonable and Prudent Measures
RRWG	Recreation Resources Work Group
RTE	Rare, threatened and endangered species
SPCC	Spill Prevention Control and Countermeasure
SR	Spawning and Rearing
SRFB	Salmon Recovery Funding Board
SWG	Sturgeon Working Group
TDG	Total Dissolved Gas
TAILS	Tracking and Integrated Logging System
TRWG	Terrestrial Resources Work Group
UCSRB	Upper Columbia Salmon Recovery Board
UCR	Upper Columbia River
USDA	U.S. Department of Agriculture

USDC	U.S. Department of Commerce
USDI	U.S. Department of interior
USFWS	U.S. Fish and Wildlife Service
WAC	Washington Administrative Code
WCC	World Climate Conference
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington Department of Ecology
Wells	Wells Hydroelectric Project
WSMP	White Sturgeon Management Plan
WQMP	Water Quality Management Plan
WQS	Water Quality Standards

EXECUTIVE SUMMARY

The purpose of relicensing the 774.3 megawatt Wells Hydroelectric Project (Project) is to continue its operation and maintenance for the next 30-50 years, as determined by the Federal Energy Regulatory Commission (Commission). Public Utility District No. 1 of Douglas County (Douglas PUD) is the owner and operator of the Project. Douglas PUD is the Commission's designated non-federal representative for the purposes of Endangered Species Act consultation. Douglas PUD's existing Commission license for the Wells Project expires on May 31, 2012. Relicensing of the Project will allow Douglas PUD to continue the generation of electricity to serve local customers as well as tribal and utility power purchasers throughout the Pacific Northwest.

From 1969 to date, Douglas PUD has cooperatively entered into 16 major agreements related to protection, mitigation and enhancement measures (PMEs) for aquatic and terrestrial resources in the vicinity of the Wells Project. These include Douglas PUD's Anadromous Fish Agreement and Habitat Conservation Plan (Wells AFA/HCP), initiated specifically for the relicensing of the Wells Project and the Bull Trout Monitoring and Management Plan (BTMMP), an effort designed to monitor incidental take associated with the Wells Project and guide the management and protection of bull trout and habitat within the Project area. Douglas PUD is not proposing any changes to Wells Project operations beyond the implementation of the existing and new resource management plans and settlement agreements.

New resource management plans and settlements proposed for inclusion in a new license are the measures contained in the Wells AFA/HCP, the Aquatic Settlement Agreement (White Sturgeon, Pacific Lamprey, Bull Trout, Resident Fish, Water Quality and Aquatic Nuisance Species management plans), the Wildlife and Botanical Management Plan, Avian Protection Plan, Historic Properties Management Plan, Recreation Management Plan, and Douglas PUD's Land Use Policy.

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation, and alteration. Five 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 interim recovery units. The Project is located in the Columbia River interim recovery unit which currently contains over 100 core areas and 500 local populations. The immense size and complexity of this interim recovery unit make it difficult to determine its current status. In a recent risk assessment for the bull trout five year status review, 76 percent of the core areas in the unit (including the Methow core area, located upstream of the Project and the Yakima core area, located below the Project) are in the two highest-risk categories. This risk profile suggests that unit-wide resilience to further habitat degradation may be limited. The high number of and variability in conditions among core areas, difficulty of assessing aggregate risk, lack of key biological information, and the lack of a completed Recovery Plan to inform 7(a)(2) analysis all contribute to uncertainty about the current status of the unit and the potential unit-wide consequences of localized project effects.

Bull trout are widely distributed in the action area (Methow, Entiat, Wenatchee, and Yakima core areas); however, most bull trout exposed to the Project originate from the Methow core area. Abundance in these core areas is generally low to moderate and production is highly variable. All core areas also show a reduced distribution of the migratory life-history form. Numerous historic and ongoing threats continue to limit the potential for population recovery at the core-area scale. For example, several spawning locations within the Methow core area have been directly and severely affected by wildfire in recent years. Population indicators in the core area discussed above are "functioning at unacceptable risk." This evaluation is based on redd surveys yielding low estimates of total population size, insufficient data to accurately estimate abundance trends, reduced connectivity among local populations in the core areas, and concern about introgressive hybridization with brook trout (*Salvelinus fontinalis*).

The baseline condition of most habitat pathways in these core areas ranges from "functioning at risk," to "functioning at unacceptable risk" with conditions in the lower watersheds generally being more degraded than in the upper watersheds. Elevated temperature and sedimentation, a deficiency of large woody debris, low base flows, and high road density are common factors contributing to reduced habitat suitability for bull trout, especially in the lower portions of these watersheds.

The Service's revised designation of critical habitat for bull trout includes streams in the action area. The nine primary constituent elements of critical habitat range from "functioning at risk" to "functioning at unacceptable risk" in the critical habitat units affected by this Project.

Overall, the Project will adversely affect bull trout and designated critical habitat. The Project is most likely to have adverse effects to primary constituent element 2 and 7 of critical habitat, which focus on migration habits and a natural hydrograph, respectively. Effects associated with the upstream and downstream passage of bull trout through the Wells Hydroelectric Project influence the migratory behavior of bull trout through the operation and maintenance of the fishways at the Project. Peak and base flows are also moderated at the Project. Conversion of the flows from a natural riverine environment to a reservoir utilized for the purpose of hydroelectric generation is a substantial departure from the historic hydrograph.

Incidental take of bull trout is likely to occur as a result of implementation of all Project elements. We anticipate that adult bull trout, sub-adult, and juvenile bull trout could experience adverse direct effects annually due to the implementation of the Project, including the Wells AFA/HCP and the aquatic management plans associated with the Wells Aquatic Settlement Agreement. We estimate annual lethal incidental take of up to 25 adult bull trout and 26 subadult bull trout due to project implementation during the 30-50 year license term of this Project. The Incidental Take Statement accompanying this biological opinion includes mandatory Reasonable and Prudent Measures and Terms and Conditions intended to minimize this incidental take. Non-mandatory conservation recommendations are also provided to minimize or avoid adverse effects of this proposed action on listed species and to develop information.

We expect the negative effects of the Project at the local scale to be moderate at the larger scales of the core areas, interim recovery unit, or coterminous range. The status of the bull trout in the

Methow, Entiat, Wenatchee, and Yakima core areas is likely to remain in its current state with the implementation of the Project, considering the effects of the proposed Project together with cumulative effects. Therefore, the proposed action is not likely to jeopardize the continued existence of the bull trout at the range-wide scale.

We believe these Project effects are also consistent with the conservation role of critical habitat range-wide to support viable core area populations of bull trout. On that basis, implementation of the proposed Project is not likely to destroy or adversely modify bull trout critical habitat at the range-wide scale.

INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the Federal Energy Regulatory Commission's (FERC or Commission) proposed relicensing of the Wells Hydroelectric Project (FERC No. 2149) (Project), owned and operated by Public Utility District No. 1 of Douglas County (Douglas PUD), located in Douglas and Chelan Counties, Washington. This biological opinion analyzes the effects of the Project on the threatened bull trout (*Salvelinus confluentus*) and its designated critical habitat, prepared in accordance with section 7 of the Endangered Species Act (Act or ESA) of 1973, as amended (16 U.S.C. 1531 et seq.).

This biological opinion analyzes the effects of implementing FERC's recommended alternative and measures associated with the relicensing of the Wells Project on federally listed bull trout and related critical habitat. Information in this biological opinion is primarily from the Douglas PUD's May 28, 2010 Final License Application and the Commission's April 1, 2011 Draft Environmental Impact Statement (FEIS), as well as references cited herein. A complete decision record of this consultation is on file at the Service's Central Washington Field Office in Wenatchee, Washington.

CONSULTATION HISTORY

The following chronology documents key points of the consultation process that culminated in the following biological opinion.

1. On December 1, 2006, Douglas PUD initiated the Integrated Licensing Process for the relicensing of the Project by filing a Notice of Intent to apply for a new license and Pre-Application Document.

2. On December 7, 2005, the Commission sent a letter to Douglas PUD designating Douglas PUD as the non-federal representative for the purpose of conducting ESA consultation with the Service.

3. In October 2008, Douglas PUD distributed for execution the Wells Aquatic Settlement Agreement which was signed by Douglas PUD, the Service, Department of Ecology (Ecology), Washington Department of Fish and Wildlife, Colville Tribe, Yakama Nation, and the Bureau of Land Management.

4. On May 28, 2010, Douglas PUD filed a Final License Application (FLA) for the continued operation and maintenance of the Project. The FLA includes Douglas PUD's Draft Biological Assessment for the Project.

5. On April 12, 2011, the Commission sent its letter to the Service regarding a request for concurrence on the "no effect" determination for Ute ladies'-tresses (*Spiranthes*

diluvialis), marbled murrelet (*Brachyrampus marmoratus*), gray wolf (*Canis lupus*), Canada lynx (*Lynx canadensis*), northern spotted owl (*Strix occidentalis caurina*), grizzly bear (*Ursus arctos horribilis*), pygmy rabbit (*Brachylagus idahoensis*), Wenatchee Mountains checker mallow (*Sidalcea oregano*), and the showy stickseed (*Hackelia venusta*). The Commission made a determination of "may affect, not likely to adversely affect" for the Columbia River bull trout and its designated critical habitat.

6. On May 5, 2011, the Service did not concur with the Commission's "may affect, not likely to adversely affect" determination for the bull trout, since there may be adverse effects to this species over the term of a new 30-50 year license for the Project and the Project contains critical habitat for this species. Although the Commission requested concurrence with its "no effect" determination for Ute ladies'-tresses, marbled murrelet, gray wolf, Canada lynx, northern spotted owl, grizzly bear, pygmy rabbit, Wenatchee Mountains checker mallow, and the showy stickseed, the Service does not have the statutory authority to concur with "no effect" determinations.

7. On June 29, 2011, the Service met with Douglas PUD to discuss the issuance of the Department of Ecology's 401 Water Quality Certification, the official start date for initiation of formal consultation and the need to have FERC acknowledge Douglas PUD's BA as their own for the purpose of ESA consultation.

8. July 19, 2011, the Commission requests formal consultation for the effects of relicensing the Project on bull trout.

9. On August 5, 2011, the Service did not concur with the Commission's conclusion that the Draft Biological Assessment is complete and advised FERC to conduct further analysis of bull trout critical habitat in the project area.

10. On August 25, 2011, the Service provided comments via teleconference call on Douglas PUD's Supplemental Biological Assessment regarding the analysis of bull trout critical habitat.

11. On August 29, 2011, Douglas PUD filed a Supplemental Draft Biological Assessment for the relicensing of the Project.

12. On September 8, 2011, the Service approved the Supplemental Draft Biological Assessment for the relicensing of the Project.

13. On September 14, 2011, the Commission requests formal consultation under the Endangered Species Act for the Project and they also request the Service to provide its biological opinion to the Commission by January 28, 2012.

14. On January 19, 2012, the Service met with Douglas PUD to review comments made by Douglas PUD on the Draft Biological Opinion.

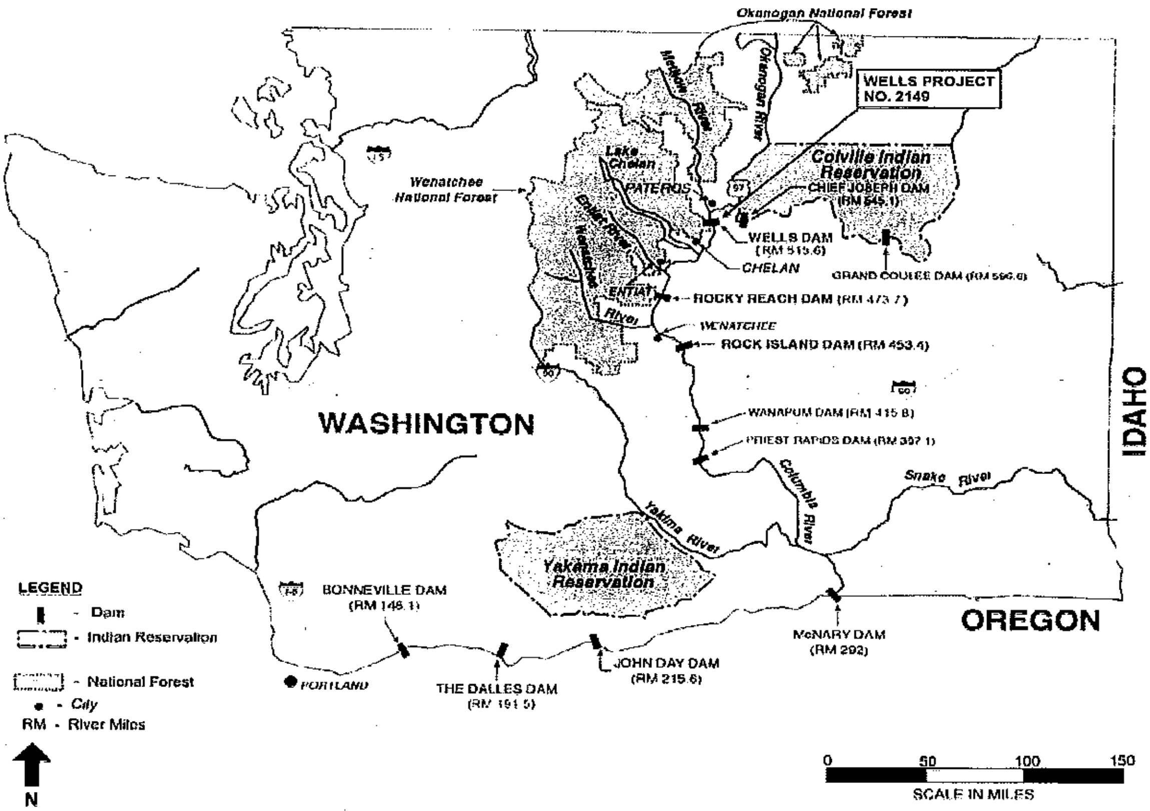
15. On Februrary 24, 2012, the Service informed the Commission via telephone correspondence that it would issue the Final Biological Opinion for the Project in March 2012.

BIOLOGICAL OPINION

1.0 DESCRIPTION OF THE PROPOSED ACTION

The proposed action is the relicensing of the Project, which consists of the Wells Dam and all facilities associated with Douglas PUD's mitigation obligations, located primarily in Chelan and Douglas Counties, Washington (FERC No. 2149). The Project is an integral part of the seven-dam Mid-Columbia River Hydroelectric System, which is the single largest coordinated hydroelectric system in the country (Figure 1). Three Public Utility Districts operate five of the facilities, while the furthest upstream facilities are federally owned and operated. The area referred to as the Mid-Columbia River extends from the federally owned and operated Grand Coulee Dam at the upstream end of the reach, to the Hanford Reach, nearly 210 miles downstream. The Project is operated in coordination with other Mid-Columbia River hydroelectric projects that use project storage to reshape the inflow hydrograph to help meet hourly changes in electricity demands. The current FERC license for the Project expired in June 2006.

Figure 1. Location of the Wells Hydroelectric Project in relation to other dams within the Columbia River Basin (source: FERC 2011).



The hydroelectric project is located on the Columbia River at river mile 515.6 in Douglas, Chelan, and Okanogan Counties, Washington, approximately 8 miles downstream from the city of Pateros, Washington (Figure 1). The project is situated approximately 30 river miles downstream from the Chief Joseph Dam, owned and operated by the United States Army Corps of Engineers, and 42 miles upstream from the Rocky Reach Dam (FERC No. 2145), owned and operated by Public Utility District Number 1 of Chelan County.

The Project operates under various river flow and settlement agreements established by the Mid-Columbia utilities, government agencies, and Tribes for the purpose of optimizing the use of the Columbia River resources and the protection of fish resources. Various regional agreements that may affect Project operations/flows include, but are not limited to, the Wells Anadromous Fish Agreement and Habitat Conservation Plan (Wells AFA/HCP), the Mid-Columbia Hourly Coordination Agreement, the Aquatic Settlement Agreement, and the Hanford Reach Fall Chinook Protection Program Agreement. These agreements are described in further detail in Douglas PUD's Final License Application (Douglas PUD 2010) and the Commission's Draft Environmental Impact Statement (FERC 2011).

The Wells Hydroelectric Project and associated facilities consist of the following structures and devices:

1. The Wells Reservoir with a surface area of 9,740 acres, a gross storage capacity of 331, 200 acre feet at an elevation of 781 feet mean sea level (msl), and a useable storage of 97, 985 acre-feet;
2. The hydrocombine is a 1,165-foot-long, 160-foot-high structure that includes 11 spillway bays, 10 generating units, upstream and downstream fish passage facilities, and a switchyard;
3. The dam includes the east abutment which is 1,030 feet long 160 feet high and consists of an impervious core to bedrock with a filter zone, gravel, and rockfill shell on each side. The west abutment is 2,300 feet long and 40 feet high and consists of an impervious core to the riverbed materials with a filter zone, gravel, and rockfill shell on each side;
4. The spillway bays are located on top of the generating units. Each spillway bay is 46 feet wide and spill is controlled by a 66-foot-high gate that is divided into a top and bottom section;
5. The switchyard, located on top of the hydrocombine section, consists of two single-circuit, 230-kilovolt (kV) transmission lines. These transmission lines extend about 41 miles to the Douglas switchyard operated by Douglas PUD, where it interconnects with the electric grid;
6. The project's fish passage facilities are all located within the hydrocombine and include two upstream fish ladders and a downstream juvenile bypass system. One fish ladder is located at each end of the hydrocombine, and each ladder includes a pump system for providing attraction flows to the ladder entrance, a counting station, a fish trap and sorting facility, and Passive Integrated Transponder (PIT) tag detection equipment;
7. The downstream juvenile bypass system consists of fabricated steel barriers that are seasonally inserted into spillway bay nos. 2, 4, 6, 8, and 10 to modify the intake velocities into the spillways. The steel barriers are 72 feet high and block all but a 72-foot-high by 16-foot-wide vertical slot through each of the five spillway entrances, thereby

consolidating spill flows and increasing water velocities through each of the five open spillways;
8. The Wells Fish Hatchery, located on the downstream side of the west abutment of Wells dam. The Wells Fish Hatchery consists of a 6,100-foot-long channel that is modified to hold adult and juvenile fish, numerous above-ground and in-ground raceways, four large earthen rearing ponds, a centralized incubation and early rearing area, a cold storage facility, an administration building, a vehicle storage building, a steelhead spawning building, and several residences for hatchery personnel;
9. Seventeen formal recreation facilities along Wells reservoir and tailrace in Pateros, Brewster, and Bridgeport, Washington, and along the lower reaches of the Methow and Okanogan Rivers, tributaries located upstream or downstream to the Columbia River; and
10. Mitigation facilities developed to fulfill conditions in the existing license are located partly or entirely outside of the current project boundary. Facilities located entirely outside of the project boundary include: the Methow Fish Hatchery and associated facilities (Twisp acclimation pond, Chewuch acclimation pond, and the Twisp adult collection weir).

1.1 Summary of the Project Elements

The Service is one of the numerous parties to an Anadromous Fish Agreement and Habitat Conservation Plan (AFA/HCP) (NMFS 2002) filed with the Commission regarding mitigation activities and actions for salmon and steelhead at the Wells Hydroelectric Project. On May 11, 2004, the Service issued a biological opinion and incidental take statement for the implementation of the Wells AFA/HCP, and determined it was not likely to jeopardize the continued existence of the Columbia River distinct population segment of bull trout and, as part of a conference opinion, was not likely to destroy or adversely modify proposed critical habitat for bull trout (FWS Reference Number: 04-W0203). The *Wells Hydroelectric Project Bull Trout Monitoring and Management Plan, 2004-2008* (Douglas PUD 2004) was developed to address the requirements of the incidental take statement. Under the proposed action for that consultation, the Project would continue to operate in a manner consistent with the AFA/HCP and associated 2003 incidental take permit issued by the National Marine Fisheries Service (NMFS) on August 20, 2003. FERC amended the existing Project license on June 21, 2004, to incorporate the AFA/HCP and incidental take permit requirements. The AFA/HCP and incidental take permits are intended to achieve and maintain a "no net impact" (NNI) standard for spring and summer/fall Chinook salmon (*Onchorhynchus tshawytscha*), sockeye salmon (O. *nerka*), coho salmon (O. *kisutch*), and steelhead (O. *mykiss*) (collectively call the Plan Species). No net impact was to be achieved by attaining both adult and juvenile project survival standards through project passage improvements, and implementation of hatchery and tributary programs to mitigate for at-project mortality. The Wells HCP Coordinating Committee, comprised of Douglas PUD, fishery agencies, and tribal entities, oversees the implementation of activities associated with the AFA/HCP. FERC's FEIS recommended that the new license for the Project continue to incorporate the AFA/HCP and incidental take permit requirements, in addition to the Wells Aquatic Settlement Agreement *Bull Trout Monitoring and Management Plan* (FERC 2011).

In this consultation, the proposed action is composed of FERC's issuance of a new license for the existing 744.3 megawatt Project for a term of up to 50 years (proposed action). The proposed action includes license requirements consistent with the FERC staff's recommended alternative in its FEIS (FERC 2011) and in Douglas PUD's Supplemental Biological Assessment (Douglas PUD 2011). Measures are also identified within the Wells HCP and the Aquatic Settlement Agreement that are either complimentary or in addition to the FERC prescribed measures. These measures were developed in collaboration with Federal, State, local and tribal governments and are expected to be included within the final license order and are expected to be contained within the final 401 water quality certification for the Wells Project.

The Wells HCP Coordinating Committee and Wells Aquatic Settlement Working Group, which include Douglas PUD, government agencies, and tribal entities, will oversee activities related to aquatic and terrestrial resources.

A complete description of the proposed action subject to relicensing is presented in Douglas PUD's Final License Application and Supplemental Biological Assessment, the Commission's FEIS, which are herein incorporated by reference (Douglas PUD 2010, 2011; FERC 2011). For the purposes of this biological opinion, elements of the proposed action that may affect the bull trout and its critical habitat are categorized and presented in the manner outlined below.

The relicensing of the Project consists of the following components that could have an impact on bull trout or bull trout critical habitat. There are four major project component categories, which are: Project Operations, the Wells AFA/HCP, Aquatic Settlement Agreement (ASA), and Terrestrial Resource Management Plans.

Implementation of the Wells AFA/HCP contains the following component plans: (1) Passage Survival Plan; (2) Wells Dam Juvenile Dam Passage Plan; (3) Adult Passage Plan; (4) Tributary Conservation Plan; (5) Hatchery Management Plans; and (6) Predator Control Program.

Implementation of the ASA includes the following component plans: (1) Water Quality Management Plan; (2) Bull Trout Management Plan; (3) Pacific Lamprey Management Plan; (4) White Sturgeon Management Plan; (5) Resident Fish Management Plan; and (6) Aquatic Nuisance Management Plan.

Finally, the implementation of Terrestrial Management Plans include: (1) Wildlife and Botanical Management Plan; (2) Transmission Line Avian Protection Plan; (3) Recreation Management Plan; (4) Historic Properties Management Plan; and (5) Land Use Policy. Each of these components is further discussed below.

1.2 Proposed Project Operation and Environmental Measures

Douglas PUD is not proposing any changes to its operation of the Wells Project, other than the implementation of the proposed environmental measures described herein. A complete description of the existing and proposed project operations can be found in Exhibit B of the Final License Application, Section 2.2 of the FERC FEIS, and Section 2.0 of the FERC adopted Supplemental Biological Assessment. Implementation of the operations described in these documents is not anticipated to result in electric generation or reservoir operation changes.

Douglas PUD is, however, proposing the following environmental measures as described in its application for a new FERC license.

1.2.1 Project Operation

1.2.1.1 Turbine Operation

The Project was designed as a hydrocombine to reduce the area of concrete structures founded on bedrock. Unlike conventional dams where the turbine units and spillways are distributed side by side, a hydrocombine dam has the spillways located directly above the turbine intakes. The spill bay and turbine intake floors are 75 and 130 feet from the surface, respectively. Wells Dam has 10 generating units with an installed nameplate capacity of 774,300 kilowatts (kW) and a maximum generating capability of 840,000 kW. The turbine-generator units rotate at a synchronous speed of 85.7 revolutions per minute (rpm). Each generating unit is housed in a concrete structure 95 feet wide and 172 feet long. Each structure contains a vertical-shaft Kaplan turbine. The original turbine runners were supplied by Allis Chalmers. The original turbine runners were replaced with Fuji Electric runners during the period from 1988 to 1990. Each turbine is rated at 120,000 horsepower (hp) at 64 feet net head and a discharge of 22,000 cubic feet per second (cfs) (Billenness and Lemon 2007). Each turbine has three intakes (total 30) and, except for bays 1 and 11, each spill bay has three intakes. Water enters the spill intakes above water entering the turbine intakes because of the hydrocombine design. The juvenile fish bypass is built in the spillway.

The main factor governing turbine operations at Wells Dam is local and regional power demand. Discharges are normally modulated to match the shape of the power demand, taking into account discharge and spill requirements for other purposes such as fish passage, flood control and recreation. At the Project, power demands can be more than twice as high during the day as they are at night. Consequently, there is a high likelihood that several of the 10 turbines will go through one or more on-off cycles during a typical 24-hour period. Evidence of these cycles can be noted in the minimum and maximum daily discharges at the Project. Generally, there is prioritization to the order in which turbines are turned on and off at the Project. However, attempts are made to distribute turbine usage so that all units received approximately the same wear.

The water surface at the forebay of the Project is designed for a normal operating range of 10.0 feet, between elevations 781.0 and 771.0. The typical elevation of the forebay water surface is assumed to be 780.5.

1.2.1.2 Spillway Operation

Wells Dam contains eleven 46-foot wide gated spillways capable of passing a total of 1,180 Kcfs. The forebay elevation is controlled by fixed wheel vertical lift gates located in the spillway bays. Each spillway gate is 65 feet in height and composed of two sections, an upper and a lower section. The upper section or leaf is approximately 35 feet in height. The lower leaf is approximately 30 feet in height. The upper leaf has a rubber seal on the bottom and the lower leaf has a rubber seal on its top. This sealing design minimizes leakage from the forebay when the gates are closed.

The lower leaf of each spillway gate can be raised to release water from the Wells Reservoir when needed. The lower leaf can be raised to any increment from zero up to a maximum of 34 feet-6 inches. The lower leaves of gates 3, 4, 5, 6, 7, 8 and 9 are attached by cable to stationary hoists. Raising the seven lower gate leaves to their fully opened position can accommodate passage of 340 kcfs. The hoists that raise these lower gate leaves can be operated by push button from a control cabinet located next to each gate on the hydrocombine deck or from Wells Dam's main control room. The lower leaves of gates 1, 2, 10 and 11 are not raised by stationary hoists but rather by gantry cranes located on the hydrocombine deck. Raising the four lower gate leaves to their fully opened position can accommodate passage of 194 kcfs. Dogging brackets along the sides of each gate provide support for the gates when raised. The upper gate leaves of spillways 2 and 10 are equipped with an automatic hoist for opening two sluiceways. These sluiceways are used to pass ice and debris.

Wells Dam has a total turbine discharge capacity of 220,000 cfs. On occasions when river flows at the Project exceed the turbine discharge capacity plus any additional non-power needs for discharge, it becomes necessary to provide forced spill. For the handling of larger flows, the upper leaves of the spillway gates can be removed using the gantry cranes. Raising the upper gate leaves requires the removal of the stationary hoists and steel railings above the spillway gates. The eleven lower gate leaves can accommodate all but the most extreme spill events. Forced spill events have decreased considerably since implementation of the Canadian storage facilities in the mid-1970's and since the development of the Wells juvenile bypass in 1989.

In the case of a power loss at the dam, spillway gates 3 through 9 can be operated through a backup power supply system. This system consists of a 300 kW diesel generator which is located atop the hydrocombine deck at elevation 795. The generator is connected to an emergency transfer switch and a standby generator power panel equipped with spillway power supply breakers. This arrangement will provide power to the stationary hoists for spillway gates 3 through 9.

1.2.1.3 Reservoir Operation

The Project is part of a seven-dam hydroelectric complex on the Mid-Columbia River that includes Priest Rapids, Wanapum, Rock Island, Wells, Chief Joseph, and Grand Coulee dams (Figure 1.0-1). This complex is operated under a power-peaking or load-following mode to meet demand for electricity in the Pacific Northwest. Hydropower generation through these projects largely governs stream flow in the Mid-Columbia River. As part of the larger Columbia River hydropower system, the Mid-Columbia projects are operated under numerous treaties and agreements that affect river flows and fish resources.

The Project generally operates as "run-of-river", meaning that daily inflow is approximately equal to daily outflow. By the terms of the current FERC license, the Project is constrained to operate within a relatively narrow operational range from elevation 781 feet to elevation 771 feet. At 781 feet elevation, total storage capacity is approximately 331,200 acre-feet, of which approximately 30% (97,985 acre-feet) can be used.

Although daily operations generally result in reservoir elevation fluctuations of one to two feet, infrequent reservoir operations also occur in unusual circumstances. For this description, "infrequent reservoir operations" are defined as changes in water elevation which exceed twice the normal daily operation fluctuations (i.e., a change of more than four feet in a 24-hour period).

The majority of these events are necessitated when intense precipitation or rapid snowmelt increases inflow from the Methow and Okanogan tributaries, subsequently requiring flood control operations of the Wells Reservoir. In addition, the Wells Project must accommodate inflow from upstream spill events at Chief Joseph Dam by drafting water. Past environmental management actions that required infrequent reservoir operation changes have included flushing flows to move sediment from the lower Methow River; increased discharge and resultant reservoir drafting to support downstream spawning, incubation and emergence for Hanford Reach fall Chinook; and lowered water level elevations to facilitate construction of islands for waterfowl habitat.

Review of hourly monitoring data has shown that the Wells Project operations remain well within the allowable limits established by its FERC license. During the past five years of operation, the daily fluctuation frequency of the reservoir was less than three feet 93.3% of the time and minimum elevations fell below 777 feet only 3.8% of the time. Infrequent reservoir operations resulting in fluctuations over four feet in a 24 hour period have occurred only 1.1% of the time. In the last 15 years (1990-2005), the forebay maintained a minimum water surface elevation of at least 777 feet 95.1% of the time and infrequent reservoir operations occurred only 0.8% of the time.

The effects of infrequent reservoir operations are limited by the operational requirements of the Project because forebay elevation cannot fall below 771 feet and the maximum possible fluctuation is ten feet (i.e., between 781 and 771 ft). However, in the past, infrequent reservoir operations generally result in fluctuations of less than five feet. This is because the Project is required to maintain sufficient storage to provide minimum flows if called upon by downstream projects. As a result, over a 15-year period (1990-2005), infrequent reservoir operations have resulted in fluctuations beyond six feet only 0.1% of the time and never resulted in fluctuations past seven feet.

Infrequent reservoir operations are generally brief in duration (i.e., 1 to 5 hours); and, reservoir stage may rise and fall several times in the course of an event. Infrequent reservoir operations took place a total of 21 times between 2000 and 2005, ranging in frequency from one in 2003 to seven in 2005. In order to characterize the features of individual occurrences of infrequent reservoir operations, eleven randomly selected events that occurred between 2000 and 2005 were examined by Douglas PUD. The periods immediately preceding and following each of the eleven occurrences were also examined to accurately portray the drafting and recharging of the reservoir. The mean duration for these occurrences was 7.1 hours, and the median value was 3.0 hours. Six of the eleven occurrences of infrequent reservoir operations were less than five hours duration, and only two of the eleven exceeded ten hours. During these occurrences, successive changes in water elevation sometimes dewatered and immersed a zone of two to three vertical feet numerous times.

Infrequent reservoir operations have occurred in each month except in February, August, September, and December, over the last five years and have occurred most frequently in July (5 events) and April (4 events). However, the pattern of occurrence was highly variable; and, infrequent reservoir operations rarely occurred in the same month in successive years.

1.2.2 Wells AFA/HCP

The Wells AFA/HCP (Douglas PUD 2002) commits Douglas PUD to a 50-year program to ensure that the Wells Project has No Net Impact (NNI) on salmon and steelhead runs. The Wells AFA/HCP requires that this be accomplished through a combination of juvenile and adult fish passage measures at the dam, off-site hatchery programs and evaluations, and habitat restoration work conducted in tributary streams upstream of Wells Dam. The Wells AFA/HCP outlines a schedule for meeting and maintaining NNI throughout the 50-year term of the agreement. NNI consists of two components: (1) a 91 percent combined adult and juvenile Wells Project survival standard achieved by Wells Project improvement measures implemented within the geographic area of the Wells Project and (2) up to 9 percent compensation for unavoidable Wells Project related mortalities. Compensation to meet NNI is provided through hatchery and tributary programs under which 7 percent compensation is provided through hatchery production and 2 percent compensation is provided through the funding of enhancements to tributary habitats that support Plan Species.

The Wells AFA/HCP was designed to address Douglas PUD's obligations for relicensing and as such included all of the parties terms, conditions and recommended measures related to regulatory requirements to conserve, protect and mitigate plan species pursuant to ESA, the Federal Power Act (FPA), the Fish and Wildlife Coordination Act, the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act, the Pacific Northwest Electric Power Planning and Conservation Act and Title 77 RCW of the State of Washington. The HCP also obligates the parties to work together to address water quality issues.

The Wells AFA/HCP was signed in 2002 by NMFS, USFWS, Colville Tribe, WDFW, Douglas PUD and the Wells Project power purchasers (PSE, PGE, PacifiCorp and Avista Corporation). In 2005, the Wells AFA/HCP was signed by Yakama. In late 2003, NMFS issued Douglas PUD a new ESA section 10 incidental take permit (ITP) (permit No. 1391) for the taking of UCR summer-run steelhead (steelhead), UCR spring-run Chinook salmon (spring Chinook), UCR summer/fall Chinook salmon and Okanogan River sockeye salmon in association with the operation and maintenance of the Wells Project. The Wells AFA/HCP was approved by the FERC on June 21, 2004, and made part of the Wells Project license. Following the FERC's approval of the Wells AFA/HCP, Douglas PUD implemented the Wells HCP as part of the package of measures developed for the relicensing of the Wells Project.

Concurrent with the issuance of permit No. 1391, NMFS also issued Douglas PUD three separate ESA section 10 ITPs (permit Nos. 1395, 1347 and 1196) for the taking of salmon and steelhead associated with the operation of Douglas PUD's hatchery programs. These hatchery programs are central to Douglas PUD's fulfillment of the hatchery mitigation requirements of the HCP and Wells Project license. Permit No. 1196 and 1365 are for the taking of ESA-listed salmon and steelhead in association with the operation of Douglas PUD's spring Chinook and steelhead hatchery programs, respectively. Permit No. 1347 is for the taking of ESA-listed salmon and steelhead in association with the operation of Douglas PUD's hatchery programs for non-ESA-listed salmon.

The Wells HCP also required the formation of four committees, namely the Policy, Coordinating, Hatchery, and Tributary committees, that provide a forum to implement, monitor and administer the agreement. The Wells HCP contains several plans and programs for implementing the components of the agreement.

1.2.2.1 Passage Survival Plan

The Passage Survival Plan contained within Section 4 of the Wells AFA/HCP provides specific detail regarding the implementation and measurement of unavoidable juvenile and adult losses for each of the Plan Species passing through Wells Dam. Due to an agreed upon inability of the parties to differentiate between sources of adult mortality, initial compliance with the combined adult and juvenile survival standard is based upon measurement of juvenile survival (93 percent juvenile Project survival and 95 percent juvenile dam passage survival). The plan lays out the methodologies for measuring survival rates and the decision process that will be followed depending on whether the applicable survival standards are achieved or not. This section of the plan also details the specific survival standards that must be achieved within defined time frames in order for the licensee to be considered in compliance with the terms of the Wells HCP (Douglas PUD 2002).

1.2.2.2 Wells Dam Juvenile Dam Passage Plan

In addition to the specific details describing how survival studies will be implemented and evaluated relative to achievement of NNI, the Wells AFA/HCP also contains specific criteria for the operation of the Wells juvenile fish bypass system. This section of the Wells AFA/HCP outlines specific bypass operational criteria, operational timing and evaluation protocols to ensure that at least 95 percent of the juvenile Plan Species passing through Wells Dam are provided a safe, non-turbine passage route around the dam. The operational dates for the bypass are set annually by unanimous agreement of the parties to the Wells AFA/HCP.

While existing documentation within the Wells AFA/HCP details the specific operating criteria for the Project, additional Project operational information is presented for reference during the effect assessments.

Fish Bypass

The Wells Project's juvenile bypass system (JBS) was completed in 1989. The bypass system was developed to guide downstream migrating juvenile steelhead and salmon away from the turbines and into the spillways. The JBS serves as Douglas PUD's method of bypassing fish away from turbines and safely over the dam. This configuration has demonstrated exceptionally high levels of juvenile fish protection while utilizing only 6-8 percent of the Columbia River flow. The efficiency and effectiveness of the JBS are important factors in limiting the amount of spill, and therefore total dissolved gas (TDG), while maximizing fish passage and survival. The bypass has an efficiency rate of 92.0% for spring migrants and 96.2% for summer migrants (Skalski *et al.* 1996) and is the most efficient bypass system on the mainstem Columbia River.

The system was developed by modifying the upper portions of spillways 2, 4, 6, 8, and 10. Each spillway has three sections. The bypass system modifies the two outside spill sections with solid steel barriers and the middle section with a slotted steel barrier. The slotted barrier has an opening that is 16 feet wide and 72 feet deep. During bypass operations, the gates on spillways 2, 4, 6, 8, and 10 are opened approximately one foot when an adjacent generating unit is operating. Spillways 2 and 10 are also configured to allow passage through either the ice trash sluiceways or through the bottom spill gates. Since most juvenile salmon and steelhead migrate near the water's surface, with the help of the bypass system they successfully pass Wells Dam and avoid the turbine intakes located below the bypass entrance. The bypass system is in operation annually from mid-April until late August. Because all 11 spillways may be needed during emergency operations, the bypass barriers are designed to collapse when the spillway gates are opened more than six feet.

Douglas PUD, the Licensee, proposes to operate the Project's downstream fish passage facilities in accordance with the terms of the Wells AFA/HCP. Under those terms, the Licensee prepares an annual Bypass Operation Plan (BOP) in consultation with the Wells HCP Coordinating Committee (HCP CC). The HCP CC approves measurement and evaluation programs to determine when the Licensee has met the Wells HCP of No Net Impact and the 91% combined adult and juvenile project survival objectives for Plan Species. The BOP provides the details of operations and procedures necessary to safely pass juvenile fish through the Project to meet the standards agreed upon in the Wells AFA/HCP. Douglas PUD will continue to implement a bypass program of controlled spill using five bypass baffles at the Wells Project to meet the criteria set out below:

1. No turbine will be operated during the juvenile migration period unless the adjacent bypass system is operating according to the following criteria.

2. The five (5) bypass system bays will be Nos. 2, 4, 6, 8, and 10. Operation of the turbines will be in pairs with the associated bypass system bays as follows:

Turbines Operating	Bypass Bays Operating
1 and/or 2	2
3 and/or 4	4
5 and/or 6	6
7 and/or 8	8
9 and/or 10	10

(For example, if turbines 1, 5, and 6 are operating, bypass systems 2 and 6 will be operating.)

3. At least one bypass will be operating continuously throughout the juvenile migration period, even if no turbines are operating.

4. The bypass systems and spillgates will be operated in configuration K of the 1987 bypass system report (bottom spill, 1 foot spill gate opening, 2,200 cfs, and a vertical baffle opening) for all bypass system bays.

5. Top spill has been shown to be as effective as bottom spill in bypass bays 2 and 10, therefore, top spill will be allowed in these bays.

6. If the Chief Joseph Dam Uncoordinated Discharge Estimate is 140,000 cubic feet per second (140 Kcfs) or greater for the following day, all five bypass systems will be operated continuously for 24 hours regardless of turbine unit operation.

7. If the Chief Joseph Dam Uncoordinated Discharge Estimate is less than 140 Kcfs, bypass system operation will be as follows:

Number of Turbines Operating	Minimum Number of Bypass Systems Operating
9 or 10	5
7 or 8	4
5 or 6	3
3 or 4	2
0, 1 or 2	1

The Wells HCP states that Douglas PUD shall operate the bypass system continuously between April 10 and August 15. Initiation of the bypass system may occur between April 1 and April 10, when it can be demonstrated that greater than 5% of the spring migration takes place prior to April 10. The basis for making this determination shall be the historical hydro-acoustic index, verified by historical species composition information. Termination of the bypass system between August 15 and August 31 will occur when it can be demonstrated that 95% of the summer migration has passed the project. The basis for making this determination shall be the historic hydro-acoustic index, verified by the historical species composition information. The bypass will not operate past August 31 unless a party to the Wells AFA/HCP provides credible scientific evidence to the Wells HCP CC that the run timing is such that a significant component of a Plan Species migrates through the forebay, dam and tailrace outside the usual migration period (April 1 through August 31).

Run timing information will be gathered through the 2002 migration. The historic hydroacoustic and fyke netting information (1982 – 2002) will be used to verify that 95% of the spring and 95% of the summer migrations are being protected by operating the bypass system from April 10 through August 15.

After the 2002 migration, changes to the April 10 through August 15 operation may be agreed to by the Wells HCP CC based upon historical hydroacoustic and species composition information that would provide bypass operations for 95% of the spring and 95% of the summer migration of juvenile Plan Species.

Additional hydroacoustic and species composition monitoring shall be conducted once every 10 years in order to verify that a significant component (greater than 5%) of the juvenile migration is not present outside the normal bypass operating period (April 10 through August 15) and to verify that the operations established by the Wells HCP CC are adequately protecting 95% of the spring and summer migrations of juvenile Plan Species.

For the past 10 years the Wells bypass system has been operated based upon a historical analysis of 25 years of run timing and species composition data collected at Wells Dam. Based upon this analysis, the bypass system started operation on April 12 and ended on August 26. Based upon a recent analysis of passage data at Wells and Rocky Reach Dams by the HCP CC, the dates for bypass operations were revised to better cover the spring and summer migrations. Starting in 2012, the bypass operating dates will be April 9 to August 19. These operating dates better reflect the contemporary migrational characteristic of anadromous salmonids at the Wells Project. The HCP CC is expected to reevaluate, and if necessary, modified these dates annually to ensure at least 95% of the juvenile salmon and steelhead migrating through Wells Dam are provided an opportunity to pass over the dam via a non-turbine passage route.

1.2.2.3 Adult Passage Plan

The Adult Passage Plan, as contained within Section 4.4 and Appendix A of the Wells HCP, is intended to ensure safe and rapid passage for adult Plan Species as they pass through the fish ladders at Wells Dam. The plan contains specific operating and maintenance criteria for the two adult fish ladders and the two adult fish ladder traps, and provides details regarding the implementation of passage studies on adult Plan Species, including studies related to passage success, timing and rates of fallback.

Adult Fishways

Douglas PUD proposes to operate the Project's upstream fish passage facilities in accordance with the terms of the Wells AFA/HCP. Douglas PUD's Adult Fish Passage Plan found in Section 15 of the Wells AFA/HCP contains all pertinent operation, maintenance, inspection and reporting procedures for the upstream fish passage facilities (Douglas PUD 2010).

The continued use of the Project's existing upstream fish passage facilities constitutes the Douglas PUD's proposal for moving bull trout and Plan Species upstream. Wells Dam has two adult fish ladders, one on each side of the dam immediately adjacent to the right and left banks of the Columbia River. The ladders were built during the original construction of the dam. Each ladder contains 73 fishway weirs. They descend one foot per pool and discharge a constant 48 cubic feet per second of river flow through the ladder. This discharge flows from one pool to another over the walls and through submerged orifices. Depending on the tailwater elevation, fish can swim over many of the lower weir walls without the need to pass through the orifices. The upper 17 pools hold more water, have larger orifices and are used to control the amount of water flowing through the lower sections of the ladder.

Each of the two fish ladders has a single entrance for fish, which is located at the downstream end of each ladder's collection gallery. Each entrance opens into a collection gallery that is flooded with water in excess of that flowing in the fish ladders. This excess "attraction water" is designed to attract migrating fish into the collection gallery and ultimately into the fish ladder. The current collection gallery to tailwater differential criteria is 1.5 feet. As fish move up the ladders, infrastructure for sorting and trapping fish are located adjacent to Pool 40. This area is equipped with a holding box and adult Passive Integrated Transponder (PIT) tag detectors. In addition, the traps are also equipped with slide gates to either retain fish or return them to the ladder. This area is used for brood stock collection, for fish tagging and for other research opportunities. Pool 64 contains facilities for fish counting, including a viewing window, video cameras and a light panel. Pools 67 and 68 are equipped with PIT tag detection devices that interrogate each fish with a PIT tag and, once detected, will record the presence of each tag, as the fish ascend the ladders.

1.2.2.4 Tributary Conservation Plan and Committee

Douglas PUD's *Tributary Conservation Plan* is detailed in Section 7 of the AFA/HCP. To implement the *Tributary Conservation Plan*, Douglas PUD agreed to provide a "Plan Species Account" to fund projects for the protection and restoration of spring, summer, and fall Chinook salmon, sockeye salmon, coho salmon, and steelhead (the Plan Species) habitat within the Columbia River watershed as well as the Methow, and Okanogan River watersheds. The Plan compensates for up to 2% "unavoidable project mortality" (part of the assumed 9% Plan Species mortality caused by the Project that is compensated through the tributary and hatchery programs).

At this time, the *Tributary Conservation Plan* does not specifically consider conservation actions specifically targeted towards bull trout and its accompanying critical habitat. However, actions under the Plan are anticipated to have a positive effect on the following bull trout habitat characteristics: (1) water temperatures; (2) complex stream channels features such as large woody debris, side channels, and undercut banks; (3) substrate of sufficient amount, size, and composition; (4) natural hydrograph; (5) migratory corridors; and (6) abundant food base.

The Tributary Committee, comprised of Douglas PUD, fishery agencies, and tribal entities, is charged with the task of selecting projects and approving project budgets from each Plan Species Account, for purposes of implementing applicable elements of the *Tributary Conservation Plan*. Whenever feasible, projects selected by the Tributary Committee take into consideration and are coordinated with other conservation plans or programs. Whenever feasible, the Tributary Committee cost-shares with other programs, seek matching funds, and coordinates projects with other habitat protection and restoration efforts. Habitat protection and restoration projects may include, but are not limited to, the following:

1. Opening fish passage in blocked stream sections or oxbows;

2. Changing the points of origin for problematic irrigation withdrawals to less sensitive site(s);

3. Purchasing, from a willing seller, water shares for the Trust Water Rights Program;

4. Providing alternative sources of irrigation and domestic water to mitigate impacts of problematic surface water diversions;

5. Removing dams or other passage barriers on the tributaries;

6. Using mechanical means to encourage natural development of riparian areas; and

7. Using engineering techniques which increase the complexity of permanently altered habitats.

The overarching goal of the Tributary Enhancement Fund, which houses the Plan Species Account, is the long-term protection or enhancement of Plan Species' habitats in the tributaries, which in turn, should improve the productivity of Plan Species populations in those basins. It is anticipated that some activities will require additional permitting and ESA consultation at a later time. Through these means and by active participation on the Tributary Committee, the parties to the Wells AFA/HCP would ensure that any negative impacts to Plan Species due to in-water or riparian tributary protection and enhancement activities would be minimized to the extent practicable through choice of methodology, seasonal timing of work, and mitigation measures for short-term impacts.

The Wells Plan Species Account is a component of the Wells AFA/HCP and was established by Douglas PUD in September 2004 with an initial contribution of $2,272,740, with subsequent contributions in the form of annual payments commencing on January 31, 2010. Annual payments on January 31 will continue for the duration of the agreement in the amount of $176,178 in 1998 dollars. The 2010 payment was $237,455; and, the 2011 payment was $238,153. To date, contributions by Douglas PUD to the Wells Plan Species Account total $2,748,348, and interest earnings to date total $328,820.

The Wells Plan Species Account was intended by the signatories of the Wells AFA/HCP to fund projects for the protection and restoration of Plan Species habitat at or upstream of the Project (in the mainstem of the Columbia and tributaries) and downstream of Chief Joseph Dam. To date, the Wells Plan Species Account has funded 15 habitat projects at a total cost of $2,052,809. Funding of three additional projects has been approved by the Wells Tributary Committee (disbursement pending) with a budget of $201,169, bringing the total spent on or budgeted for habitat projects to $2,253,978. Administrative costs since September of 2004 have totaled $45,874, or approximately 2 percent of total expenditures, and approximately 98 percent of expenditures have been for habitat projects.

The Wells AFA/HCP Tributary Committee solicits project proposals from regional project sponsors through either the "Small Projects" program or the "General Salmon Habitat" program. The Small Projects program provides quick funding decisions for projects of not more than $50,000, with the HCP Tributary Committee accepting Small Projects applications any time.

The General Salmon Habitat program funds projects with total costs exceeding $50,000, though the funding request to the HCP Tributary Committee may be for a fraction of that cost. Applications for the General Salmon Habitat program are solicited annually in coordination with the annual funding cycle of the Salmon Recovery Funding Board (SRFB). The Upper Columbia Salmon Recovery Board (UCSRB) orchestrates the coordination between the Tributary Committee and SRFB, combining annual project tours and sponsor presentations for Tributary Committee members; SRFB local Lead Entities, Technical Review Panel members, and Citizens

Committees members; and UCSRB Regional Technical Team members. The Bonneville Power Administration and Priest Rapids Coordinating Committee-Habitat Subcommittee also coordinate to some extent with the annual funding cycle of the HCP Tributary Committee and SRFB. Thus, with all the coordination between the various funding sources, regional project proponents are blessed with numerous options for project funding. With the many sources available, the Wells Plan Species Account is often called on to provide a cost share with another funding source for the funding of a specific project. Despite the adherence to date to the coordinated approach to annual funding rounds, the HCP Tributary Committee reserves the right to identify and select projects for funding at any time.

As of June 2011, projects funded to date include seven protection projects, seven restoration projects, and one restoration-design project. Protection projects funded include three property acquisitions and four conservation easements, all in the Methow Basin. Restoration projects include two livestock exclusion projects (fencing and water sources to exclude livestock from streams and riparian areas); one riparian enhancement project (caging of trees planted in riparian areas to prevent deer grazing) on several properties in the Methow Basin; two projects to remove passage barriers (culvert replacement/removal) in the Methow Basin; one conversion of an irrigation withdrawal from the Methow River to a well; and one floodplain access/side-channel reconnection project on the Canadian Okanagan River near Oliver. Finally, the restoration-design project provided the hydraulic analysis of restoration alternatives and final engineering and construction-ready designs for the floodplain access/side-channel reconnection project on the Okanagan River described above.

The strategy of the Wells HCP Tributary Committee has been to judiciously use the Plan Species Account to maintain a balance sufficient to respond to future funding opportunities that may arise. Unlike the SRFB funds, the Tributary Committee is under no obligation to spend money annually. Thus, while some projects are likely to receive funding via the Wells Plan Species Account in any given year, such funding is not required nor guaranteed.

Future funding patterns are impossible to predict, yet, it is likely that habitat protection will remain a preferred use of the Wells Plan Species Account because such use is prioritized in the Wells HCP. However, concerns over the exorbitant prices for conservation easements in the Methow Basin have caused the Tributary Committee to reject several funding proposals and to consider alternative protection strategies. Additional funding for restoration projects in the Canadian Okanagan Basin is probable, as many opportunities exist there for increasing spawning and rearing habitat. Excellent working relationships have developed between proponents of Canadian projects and the Tributary Committee, and the Canadians have demonstrated their ability to efficiently deliver cost-effective and biologically beneficial projects. Beyond the continued emphasis on habitat protection and working to improve habitat in the Canadian Okanagan, neither Douglas PUD nor other members of the Wells HCP Tributary Committee have promoted any specific funding strategy for the future of the Wells Plan Species Account.

1.2.2.5 Hatchery Management Plans

The Hatchery Compensation Plan, together with NMFS's authorized Incidental Take permits and HCP Hatchery Committee approved Hatchery Genetic Management Plans (HGMPs), form the basis for the NNI hatchery programs'management. In 2010, new HGMPs were developed and approved by the HCP Hatchery Committee for UCR spring Chinook salmon and UCR steelhead. Once approved by NMFS and the FERC, these new HGMPs will require substantial modification to the facilities and operations previously authorized at the Methow and Wells fish hatcheries.

Hatchery and genetic management plans are used to address the take of ESA-listed species that may occur as a result of artificial propagation activities. The primary goal of a HGMP is to devise biologically-based artificial propagation management strategies that ensure the conservation and recovery of listed fish with evolutionarily significant units (ESUs). Information from HGMPs is used to evaluate impacts on anadromous salmon and steelhead listed under the ESA, and to inform issuance of ESA Section 10 incidental take permits for artificial propagation activities.

While existing documentation within the HCP details the specific operating criteria for the Hatchery, additional Project operational information is presented below to inform the effect analysis.

Hatchery Management

Wells Hatchery is situated adjacent to the Wells Dam west ladder. The hatchery, funded by Douglas PUD and operated by WDFW, produces summer Chinook, summer steelhead, kokanee, lahontan cutthroat trout and rainbow trout. The hatchery has also been contracted by the Yakama Nation in the past to acclimate coho juveniles. It was originally developed to compensate for the loss of fish production resulting from the inundation of the Columbia River above the dam. The Wells Hatchery consists of a 6,100 foot long spawning channel with portions of the channel modified to hold adults and juveniles, numerous above ground and in ground raceways, four large earthen rearing ponds, a centralized incubator, early rearing, cold storage and administration building, vehicle storage building, steelhead spawning building, and a separate set of residences for hatchery personnel.

The Wells Hatchery's four earthen rearing ponds vary in size and purpose. Pond 1 is used for rearing yearling summer Chinook and is connected to the main hatchery outfall channel via a gate and outlet structure. When acclimated and ready for release, the juvenile summer Chinook are allowed access to the main hatchery outfall channel and are volitionally released into the Columbia River below Wells Dam. Pond 2 is the largest pond and has historically been used to raise yearling summer steelhead. Ponds 3 and 4 are used each year for the rearing of yearling summer steelhead. All of the earthen steelhead rearing ponds have volitional collection and transportation facilities located downstream of their outlet structures. All of the summer steelhead raised at the Wells Hatchery are truck planted or acclimated in the Methow and Okanogan rivers. No juvenile steelhead are currently released through the hatchery outfall channel. The implementation of the Wells Steelhead HGMP is expected to result in an increase in steelhead smolts released directly from the Wells Hatchery via the outfall.

Brood stock for the Wells Hatchery summer Chinook program is collected primarily in the hatchery outfall channel. Summer Chinook brood stock can also be collected from the west ladder trap when conditions require that additional wild summer Chinook adult be included into the hatchery population. In a normal year, less than 5% of the broodstock for the Wells summer

Chinook program are collected from the west ladder trap. Broodstock collection for summer Chinook typically occurs from August through September.

Historically summer steelhead brood stock has been exclusively collected from the east and west ladder traps at Wells Dam. However, implementation of the new steelhead HGMP is expected to eliminate the reliance upon these traps for steelhead brood stock. Once fully implemented, the HGMP will require Douglas PUD to collect steelhead brood stock for the three Douglas PUD steelhead programs, via the Wells Hatchery outfall channel, Twisp Weir and Methow Hatchery outfall trap. The ladder traps at Wells Dam will primarily support the management of adult escapement in years when hatchery steelhead runs exceed the escapement goals established by the fishery co-managers.

The Methow Hatchery produces yearling spring Chinook and is dedicated to enhancing spring Chinook salmon in the Methow, Twisp, and Chewuch river basins. The Methow Hatchery consists of 12 covered production raceways, three covered adult raceways, a centralized incubator, early rearing, administrative and hatchery maintenance building, one on-site acclimation pond, two satellite acclimation ponds, and a separate set of residences for hatchery personnel.

All twelve of the production raceways and the on-site Methow acclimation pond are equipped with an outlet channel to the Methow River for releasing juvenile spring Chinook. Two additional satellite acclimation ponds are located at river mile 11 on the Twisp River, and the third is located at river mile 7 on the Chewuch River. The Methow Hatchery program currently raises up to 550,000 yearling spring Chinook each year with equal numbers of fish released at each of the acclimation ponds. The ladder traps at Wells Dam and a fish trap located within the site's outfall channel are used for the purpose of collecting broodstock for the Methow and Chewuch spring Chinook supplementation programs. The ladder traps at Wells Dam and the Twisp Weir are used to collect brood stock for the Twisp River spring Chinook supplementation program. The Yakama Nation also utilizes the Methow Hatchery for their coho broodstock fish trapping operations. Recently, the Yakama Nation documented the incidental capture of an individual bull trout at this facility in the fish trap. This is the first verified capture of a bull trout at the Methow Hatchery in the past 10 years.

Twisp Weir

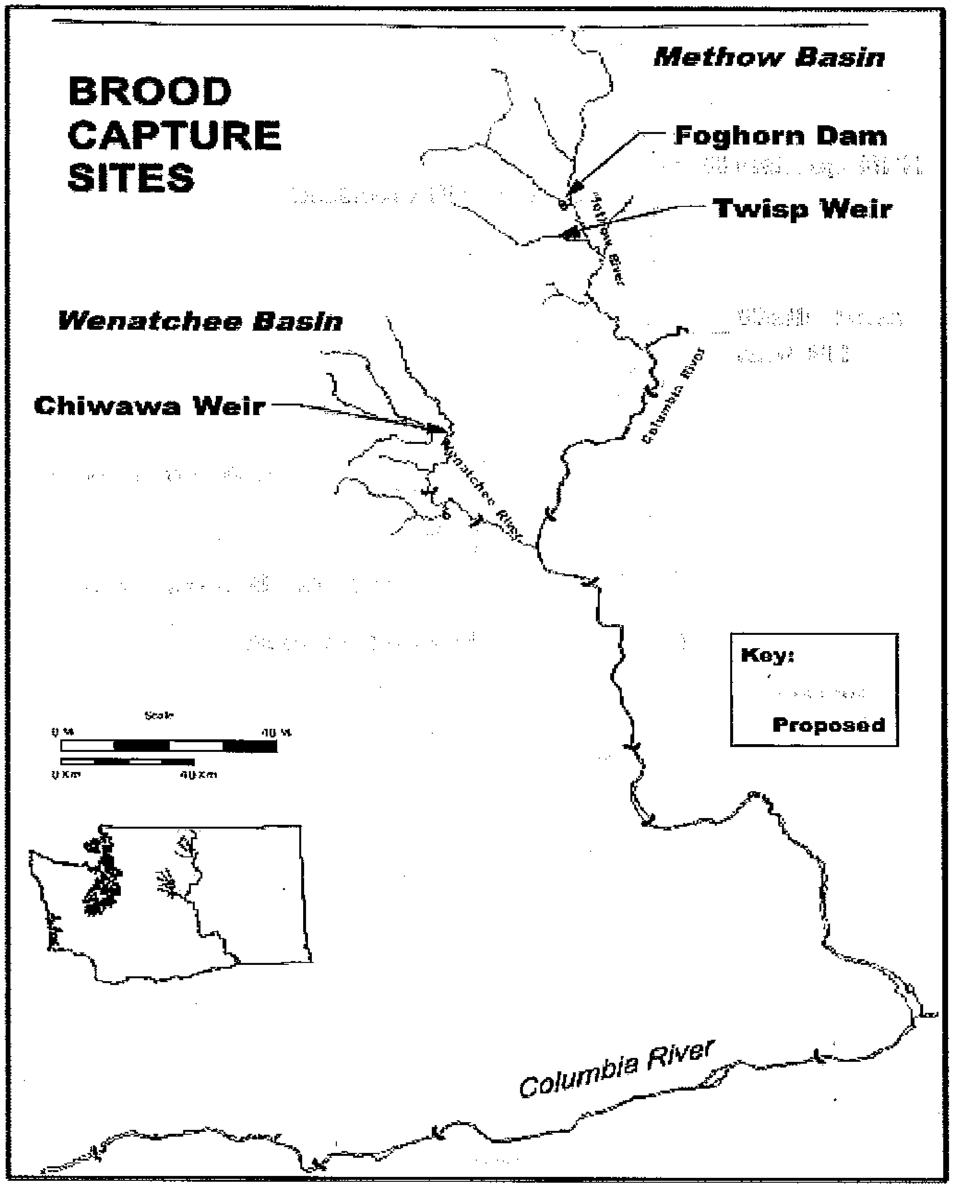
This adult fish broodstock weir is located at river mile 3.7 on the Twisp River (Figure 1.2-1). The weir system is comprised of a series of hydraulically-controlled panels and two fish trap boxes. The panels of the weir are permanently installed and kept in the full lowered position throughout the fall and winter. In the spring the trap boxes are installed, at which point the pickets are raised enough to allow upstream migrating fish to swim under them and along the sill, until they find the openings to the trap boxes, while preventing them from passing over the pickets themselves.

Douglas PUD typically installs the trap boxes no later than March 15th, although installation occurred on March 17th in 2011. During the spring (March 15th to mid-June) the trap is operated by WDFW Science Division staff as part of Douglas PUD's contract with them for steelhead broodstock collection activities and for the management of hatchery-origin spawners, as part of a steelhead relative reproductive success study. From mid-June to the end of August weir operations are supervised by WDFW Methow Hatchery staff to collect spring Chinook salmon broodstock. The trap boxes are usually removed in early to mid-September and the slide gates (trap exit doors) on the traps are removed during the interim between the end of the Chinook trapping season and the removal of the traps. In 2011 the trap exit doors were removed on August 30th and the trap boxes were removed on September 19th.

Facility staff relies on PIT tag antenna arrays in the lower Twisp and mainstem Methow River, along with visual counts of fish passing upstream of the weir, to assess upstream use of the facility. During operation/trapping fish are sampled at least once each day and more frequently when more than two adult fish are trapped. The weir, however, is monitored throughout the day and adjusted, as needed, to maintain a barrier to upstream migration during changing flow levels, and to allow debris passage, as needed. During trapping, the panels are raised only enough to discourage fish from swimming over the weir and thereby avoiding the trap boxes. Depending on water levels, this usually means the panels are off the river bottom but still at a negative angle in relation to river bed. This negative angle allows fish and debris moving downstream to pass safely over the weir. The weir is monitored throughout the day and raised and lowered for short periods of time to pass debris at the operator's discretion (debris loads can change quickly during spring freshets). The upstream exits of the trap boxes are protected by a temporary debris boom. The debris boom is installed and removed whenever the trap boxes are installed and removed. The weir is considered to be operating whenever the trap boxes are in and the trap box exits are closed. No trapping or fish sampling is conducted during high flow events because conditions are not safe for personnel to enter the traps to remove captured fish. Improvements to the weir were made in 2007 to improve efficiency during high flow conditions. The weir is operated under guidelines specified in the annual HCP Brood Stock Collection Plan and the annual Monitoring and Evaluation Work Plan developed and approved by the Wells HCP Hatchery Committee (USFWS, NMFS, WDFW, Colville Tribes, Yakama Nation and Douglas County PUD). Additional operating requirements are found within the various ESA permits issued by NMFS and the Service.

Effects related to the operation of this weir on bull trout spawning migration have not been evaluated; however, it has been proposed in Douglas PUD's BTMP and is part of the Project proposal. Bi-weekly quotas for broodstock collection are typically developed in annual broodstock protocol documents, written by June 30 each year, in cooperation with Douglas PUD and the members of the Wells HCP Hatchery Committee. Shortfalls at this and other tributary trap locations would require increased collections at Wells Dam and/or the Methow Fish Hatchery. The Twisp River Weir is funded by Douglas PUD and operated by WDFW

Figure 2. The location of Douglas PUD's Twisp Weir.



Hatchery Genetics Management Plan

In 2010, new Hatchery Genetics Management plans (HGMP) were developed by the Wells HCP Hatchery Committee for UCR spring Chinook salmon and UCR steelhead. Once approved by NMFS and the FERC, these new HGMPs will require substantial modification to the hatchery programs previously authorized at the Methow and Wells fish hatcheries.

Specifically, these HGMPs contemplate changes in the numbers of spring Chinook juveniles and steelhead juveniles released in the Methow River Basin and below Wells Dam. The release locations for these fish will also be changed in the future. For example, currently up to 250,000 juvenile steelhead from the Wells Hatchery are planted directly into the Methow River Basin at various locations. The implementation of the HGMPs is expected to modify the total number of steelhead released above Wells Dam and is expected to require the development and release of three separate populations of steelhead with up to 200,000 fish to be released below Wells Dam in order to recruit adult fish back to the Wells Hatchery, a separate stock of up to 100,000 steelhead would be released from the Methow Hatchery and a third stock of up to 50,000 steelhead would be released into the Twisp River.

Juvenile Salmonid Release

While related to the HGMP, the release of juvenile hatchery fish is its own identified activity. In accordance with section 8 of the AFA/HCP, Douglas PUD's *Hatchery Compensation Plan* entails numerous programs for the release of juvenile salmon and steelhead into the mainstem Columbia River and its associated tributaries. Species specific hatchery program objectives developed by the fishery agencies may include contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest. These management changes are intended to increase the number of salmonids released within the Project and elevate the number of returning adults.

1.2.2.6 Predator Control Program

Section 4.3.3 of the Wells HCP requires Douglas PUD to implement a northern pikeminnow, piscivorous bird and piscivorous mammal harassment and control program to reduce the level of predation upon anadromous salmonids being reared in Douglas PUD hatchery facilities and migrating through Wells Dam. The northern pikeminnow removal program includes activities such as a northern pikeminnow bounty program, fishing derbies and tournaments, and the use of longline fishing and trapping.

The other component of the predator control program is the implementation of control measures for piscivorous birds and mammals. The focus of these programs is not removal but hazing and access deterrents. Hazing includes propane cannons, pyrotechnics and the physical presence of hazing staff. Access deterrents include steel wires across the hatchery ponds and tailrace, fencing and covers for hatchery ponds, and electric fencing.

1.2.3 Aquatic Settlement Agreement

Douglas PUD has entered into an Aquatic Settlement Agreement (ASA) with the Washington State Department of Ecology (Ecology), USFWS, BLM, the Colville Tribe, the Yakama Nation, and WDFW. The purpose of the ASA is to resolve all remaining aquatic resource issues related to compliance with all federal and state law applicable to the issuance of a new license for the Wells Project. The ASA was developed to clearly define Douglas PUD's obligations for the protection of aquatic resources during the term of a new FERC license. The ASA established an Aquatic Settlement Work Group (Aquatic SWG), which serves as the primary forum for coordination between the Parties and making recommendations, and operates under the ASA protocols, objectives, and management plans.

The ASA includes six aquatic resource management plans. Collectively, these six aquatic resource management plans are critical to guide implementation of Protection, Mitigation, and

Enhancements (PMEs) during the term of a new license and for protection of bull trout and its critical habitat. Together with the Wells AFA/HCP, these measures are intended to function with the Water Quality Attainment Plan (WQAP) in support of the Section 401 Water Quality Certification of the Clean Water Act for the Wells Project. NMFS was invited to participate in the development of aquatic resource management plans, but declined because its interests are satisfied by the measures identified within the Wells AFA/HCP. Implementation of the six ASA management plans, described individually in greater detail below, is not expected to result in any changes in future Project operations.

1.2.3.1 Water Quality Management Plan

The goal of the Water Quality Management Plan (WQMP) is to protect the quality of the surface waters affected by the Wells Project. Studies conducted during the relicensing process have found water quality within the Wells Project to be within compliance. Reasonable and feasible measures will be implemented in order to maintain compliance with the numeric criteria of the Washington State Water Quality Standards (WQS), Chapter 173-201A WAC. In further support of the aquatic life designated uses in the Wells Project, five other aquatic resource management plans within the ASA and the measures in the Wells HCP are currently active or proposed for implementation through the new license term.

The measures presented within the WQMP are designed to meet the following five objectives:

Objective 1: Maintain compliance with state WQS for TDG.

Project TDG Monitoring

Douglas PUD shall continue to maintain fixed monitoring stations in the forebay and tailrace area of Wells Dam to monitor TDG and barometric pressure. TDG will be monitored hourly during the fish spill season each year. Data from the Wells forebay and tailrace stations will be transmitted on a daily basis to the applicable web-accessible database used by Ecology and regional fish management agencies. Douglas PUD shall maintain this monitoring program consistent with activities described in the then-current Wells Gas Abatement Plan (GAP).

Douglas PUD shall provide an annual report of all spill (and predicted TDG levels in the tailrace) occurring outside the fish passage season (currently October 1 to March 15).

Project Spill Operations

Within one year of issuance of the new license, Douglas PUD shall coordinate the annual Wells HCP Project Fish Bypass/Spill Operations Plan with the Aquatic SWG and the GAP, using best available information to minimize the production of TDG during periods of spill. All operations identified within the plan shall require the approval of the Wells HCP Coordinating Committee and the Aquatic SWG in order to ensure that spill operations are aimed at protecting designated uses and complying with the WQS numeric criteria for TDG in the Columbia River at the Project. In consultation with the Wells

HCP Coordinating Committee and Aquatic SWG, the spill operations plan will be reviewed and updated, as necessary.

Project Gas Abatement Plan and TDG Exemption

Pending Ecology's approval of each subsequent Gas Abatement Plan (GAP) (which provides for the TDG exemption), Douglas PUD shall continue to implement the activities identified within the previously-approved plan. Douglas PUD shall submit the GAP to Ecology by February 28th of each year, or on a less frequent basis, as documented by Ecology in writing. Douglas PUD shall submit the GAPs through the term of the new license or until no longer required by Ecology.

The GAP will include a Spill Operations Plan and will be accompanied by a fisheries management plan and physical and biological monitoring plans. The GAP shall include information on any new or improved technologies to aid in the reduction in TDG.

It is anticipated that the TDG monitoring activities described in Section 4.1.1 will be adequate for the physical monitoring plan requirement and the Wells HCP and Aquatic Resource Management Plans in the ASA with respect to fish passage will be adequate for fish management plans, for the purposes of the GAP. Additional biological monitoring studies for purposes of Gas Bubble Trauma Monitoring may be required.
Douglas PUD shall provide an annual TDG report as required by the Ecology-approved GAP.

Objective 2: Maintain compliance with state WQS for water temperature.

Project Temperature Monitoring

Douglas PUD shall continue to monitor temperature at the Wells Dam forebay and tailrace in conjunction with its TDG monitoring program (currently April 1-September 15). Temperature data from the TDG monitoring program will be recorded hourly and reported daily to regional databases. Water temperatures shall also be monitored at all boundary conditions of the Project (Methow River RM 1.5, Okanogan River RM 10.5, and Columbia River RM 544.5) and in the Well Dam forebay and tailrace as required by the Aquatic SWG.

Douglas PUD shall continue to collect hourly fish ladder temperatures 24 hours a day during the fish passage season (May 1 to November 15) at Pool No. 39 on the east ladder. Water temperatures shall also be monitored hourly in the auxiliary water supply system and near the east shore of the Wells Dam forebay (bottom, middle, and surface depths) during this same time period.

Temperature TMDL Development and Implementation

Douglas PUD shall participate in EPA Region 10's water temperature TMDL development for the U.S. portion of the Columbia River, in coordination with the Aquatic SWG. Temperature data from the monitoring program at Wells Dam and software and results of the CE-QUAL-W2 model will be made available to EPA and other entities to assist in the development of the Columbia River temperature TMDL.

Where the measures identified in the TMDL are more protective than other measures in this plan, provisions of the temperature TMDL and implementation plans relevant to the Project and its operations, including specified time frames for implementing improvement measures, shall be implemented at the Project.

If a TMDL is not timely approved by EPA, Ecology may establish an allocation. In this case, Ecology will work with the Aquatic SWG and other interested parties to identify reasonable and feasible measures.

This plan does not exclude the option of the Aquatic SWG to consider modifying the water quality standard through a use attainability analysis or other process.

Objective 3: Maintain compliance with state WQS for other numeric criteria.

Douglas PUD shall report information indicative of non-compliance with other numeric criteria immediately to Ecology for regulatory discretion and to the Aquatic SWG for consideration. This includes existing or developed criteria for toxic substances in water or sediments within Project Boundaries. The Aquatic SWG shall evaluate the information, and, if needed, require Douglas PUD to develop a plan to identify and address Project-related impacts, if any.

After the evaluation, if no reasonable and feasible improvements have been identified, Douglas PUD may propose an alternative to achieve compliance with the standards, such as site-specific criteria, a use attainability analysis, or a water quality offset.

Objective 4: Operate the Project in a manner that will avoid, or where not feasible to avoid, minimize, spill of hazardous materials and implement effective countermeasures in the event of a hazardous materials spill.

Spill Prevention and Control Requirements

Douglas PUD shall operate the Project in a manner that will minimize spill of hazardous materials and implement effective countermeasures in the event of a hazardous materials spill. The Project Spill Prevention Control and Countermeasures Plan (SPCC) will be updated pursuant to the FERC's requirements and recommendations as provided by Ecology. Douglas PUD shall comply with the updated version(s) of the SPCC.

Participation in the Columbia and Snake River Spill Response Initiative

Douglas PUD shall continue participation in the Columbia and Snake River Spill Response Initiative (CSR-SRI). The CSR-SRI is a collaborative effort made up of local, state, and federal oil spill response entities as well as members of industry and was developed to address the immediate need for oil spill preparedness and response in the area along the Columbia and Snake rivers. In addition to participation in the CSR-SRI, Douglas PUD shall continue to operate the Project in accordance with its SPCC (Jacobs 2007).

Inspections

For the term or the new license, Douglas PUD shall, upon reasonable notice, allow Ecology staff or representatives access to inspect the Project, including inside the dam, for the purpose of assessing Spill Prevention and Control measures and compliance with Section 4.4.1. Following inspection, Douglas PUD shall address oil and hazardous material prevention and control issues identified by Ecology.

Objective 5: Participate in regional forums tasked with improving water quality conditions and protecting designated uses in the Columbia River basin.

Participation in Regional Water Quality Forums

Douglas PUD shall continue its participation in both the Water Quality Team and Adaptive Management Team meetings to address regional water quality issues, including sharing the results from monitoring, measuring, and evaluating water quality in the Wells Project. However, Douglas PUD will not advocate for any water quality measures in regional forums without consulting with the Aquatic SWG.

Project Operations

Douglas PUD may, following notice and opportunity for hearing, coordinate the operation of the project, electrically and hydraulically, with other Mid-Columbia hydroelectric operations to the extent practicable. Coordinated operations are intended to reduce spill, increase generating efficiencies and thereby reduce the potential for exceedances of the TDG numeric criteria. These coordinated operations should be beneficial to TDG compliance and Aquatic Resources.

FERC Compliance Additions

In addition to the measures addressed above, FERC has also included the following additional measures and compliance tasks: (1) filing of annual TDG and spill (outside the fish passage season) reports with the Commission for approval, prior to implementation; (2) filing the GAP and Quality Assurance Protection Plans (QAPPs) (and any subsequent changes to the plans) with the Commission for approval, prior to implementation; (3) notifying the Commission within 48 hours of any temporary modifications to approved operations or facilities that are implemented to protect water quality and aquatic resources in emergency situations; and (4) obtaining prior Commission approval through the filing of an application to amend the license if any long-term (non-emergency) measures are proposed to address non-compliance with water quality criteria other than TDG (which would be addressed in the GAP).

1.2.3.2 Bull Trout Management Plan

The goal of the Bull Trout Management Plan (BTMP) is to identify, monitor, and address impacts to bull trout, if any, resulting from the Wells Project, in a manner that is consistent with the USFWS Bull Trout Recovery Plan and the terms of the Section 7 Incidental Take Statement (ITS). The BTMP requires implementation of management activities to protect bull trout during the new license term in a manner consistent with the original BTMMP (Douglas PUD 2004). Douglas PUD, in consultation with the Aquatic SWG, will implement the following PMEs in order to meet the goals and six objectives of the BTMP:

Objective 1: Operate the upstream fishways and downstream bypass systems in a manner consistent with the HCP.

Provide Upstream and Downstream Passage for Adult and Sub-Adult Bull Trout

Douglas PUD will continue to provide upstream passage for adult bull trout through the existing upstream fishways and downstream passage of adult and sub-adult bull trout through the existing downstream bypass system. Both upstream fishway facilities (located on the west and east shores) are operational year around with maintenance occurring on each fishway at different times during the winter to ensure that one upstream fishway is always operational. Maintenance activities on Wells fishways occur during the winter when, based on past data from year-round monitoring efforts, bull trout have not been observed passing Wells Dam. Operation of the downstream passage facilities for bull trout will be consistent with bypass operations for Plan Species identified in the HCP. Currently the bypass system is operated from April 12 through August 26 of each year. This operating period is consistent with the period of high bull trout and anadromous fish presence at the Project.

Upstream Fishway Counts

Douglas PUD shall continue to conduct video monitoring in the Wells Dam fishways from May 1st through November 15th to count and provide information on the population size of upstream moving bull trout.

Upstream Fishway Operations Criteria

Douglas PUD shall continue to operate the upstream fishway at Wells Dam in accordance with criteria outlined in the Wells HCP.

Bypass Operations Criteria

Douglas PUD operates a JBS annually to provide a non-turbine passage route through the dam for 95 percent of the spring and summer-run juvenile plan species outmigration. The bypass is in operation annually from mid-April until late August, which is consistent with the period of high bull trout and anadromous fish presence at the Wells Project.

The procedures set forth in the Wells HCP guide the operating criteria for the JBS. This plan also includes specific operating criteria for the turbines and spillways sufficient to maximize fish use and survival through the JBS (USFWS 2004c). A more detailed description of JBS, spillway and turbine operations can be found in Section 4.3 and Appendix A of the Wells HCP." Douglas PUD shall continue to operate the bypass system at Wells Dam in accordance with criteria outlined in the Wells HCP.

Objective 2: Identify any adverse Project-related impacts on adult and sub-adult bull trout passage.

Adult Bull Trout Upstream and Downstream Passage Evaluation

Douglas PUD shall continue to monitor upstream and downstream passage and incidental take of adult bull trout through Wells Dam and in the Wells Reservoir through the implementation of a radio-telemetry study. Specifically, in years 5 and 10 of the new license, and continuing every ten years thereafter during the new license term, Douglas PUD will conduct a one-year monitoring program to determine whether Douglas PUD remains in compliance with the ITS. This program was recommended and approved by the FERC and USFWS. The same study protocols used during past radio-telemetry assessments at Wells Dam (LGL and Douglas PUD 2007) will be employed for these monitoring studies.

If the adult bull trout counts at Wells Dam increase more than two times the existing 5-year average or if there is a significant change in the operation of the fish ladders or hydrocombine, then the Aquatic SWG will determine whether additional years of take monitoring are needed beyond those identified in this section of the BTMP. If the authorized incidental take level is exceeded during any one-year period, Douglas PUD will conduct another monitoring study in the succeeding year. If the authorized incidental take level is exceeded in this second year, Douglas PUD will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to exceedance of the allowable level of incidental take.

Douglas PUD does not develop take estimates based upon observed mortality rates for bull trout. In the eight years of monitoring, Douglas PUD has never observed any bull trout mortality. Therefore, to develop take estimates based upon observed bull trout mortality at the Wells Project, other than zero mortality, is not possible. Douglas PUD's bull trout program seeks to reduce any potential incident of harassment or delay as a result of Project activity (i.e., sub-lethal take).

Adult Bull Trout Passage Evaluation at Off-Project Collection Facilities

Douglas PUD shall assess upstream and downstream passage and incidental take of adult, migratory bull trout at off-Project (outside of the Project Boundary) adult salmon and steelhead brood stock collection facilities associated with the hatchery compensation component of the Wells HCP. Specifically, beginning in year one of a new license, Douglas PUD will conduct a one-year radio-telemetry study to assess passage and incidental take at off-Project adult collection facilities (i.e., Twisp weir). Douglas PUD will capture and tag up to 10 adult, migratory bull trout (>400mm) at adult collection facilities and use fixed receiver stations upstream and downstream of collection facilities to examine upstream and downstream passage characteristics and incidental take. Study protocols that have been used during past radio-telemetry assessments at Wells Dam will be employed for this assessment (LGL and Douglas 2008).

If negative impacts to passage associated with Off-Project collection facilities are observed or the authorized incidental take level is exceeded during any one-year period, Douglas PUD will conduct another monitoring study in the succeeding year. If negative impacts to passage continue to be observed or the authorized incidental take level is exceeded in this second year, Douglas PUD will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to passage impacts or the exceedance of the allowable level of incidental take.

After year one of a new license, the implementation of this sub-objective will be integrated into the one-year telemetry monitoring program that is to be conducted every ten years (beginning in year 10 of the new license) at Wells Dam. In year 10 of the new license and every 10 years thereafter, bull trout will be captured and tagged only at Wells Dam since data show that bull trout passing Wells Dam are migrating back into the Methow River watershed (LGL and Douglas 2008). Through the continued deployment of fixed station monitoring at off-Project adult salmon and steelhead brood stock collection facilities, these tagged bull trout will continue to provide passage and take information in support of this sub-objective throughout the term of a new license.

Sub-Adult Bull Trout Monitoring

While an objective of the BTMP is to identify potential Project impacts on upstream and downstream passage of sub-adult bull trout, Aquatic SWG members (including the USFWS) agree that it is not feasible to assess sub-adult passage because sub-adult bull trout have not been observed at Wells Dam. Even though sub-adult bull trout were not documented passing Wells Dam during the previous six years of bull trout data collection at Wells Dam (BioAnalyst Inc. 2004; LGL and Douglas 2008), we conclude that sub-adult bull trout have passed upstream and downstream through the Project based upon the activity of other PIT-tagged sub-adult bull trout in the Columbia River Basin. However, it is expected that through the increased monitoring associated with the implementation of the BTMP there may be encounters with sub-adult bull trout.

If at any time during the new license term, sub-adult bull trout are observed passing Wells Dam in significant numbers (>10 per calendar year), the Aquatic SWG will recommend reasonable and appropriate methods for monitoring sub-adult bull trout. Specifically, Douglas PUD may modify counting activities, continue to provide PIT tags and equipment, and facilitate training to enable fish sampling entities to PIT tag sub-adult bull trout when these fish are collected incidentally during certain fish sampling operations. This activity will occur the year following the first observation of >10 sub-adult bull trout (in a single calendar year), and subsequently as recommended by the Aquatic SWG.

Objective 3: Implement reasonable and appropriate options to modify upstream fishway, downstream bypass, or operations if adverse impacts on bull trout are identified and evaluate effectiveness of these measures.

Douglas PUD shall continue to operate the upstream fishway and downstream bypass at Wells Dam in accordance with the Wells HCP. However, if upstream or downstream passage problems for bull trout are identified (as agreed to by the USFWS and Douglas PUD), Douglas PUD will identify and implement, in consultation with the Aquatic SWG and HCP Coordinating Committee, reasonable and appropriate options to modify the upstream fishway, downstream bypass, or operations to reduce the identified impacts to bull trout passage.

Objective 4: Periodically monitor for bull trout entrapment or stranding during low Wells Reservoir elevations (similar to what is called for in the BTMMP).

During the implementation of the BTMMP from 2004-2008, Douglas PUD, through the use of high resolution bathymetric information, hydraulic and elevation data, and backwater curves, identified potential bull trout entrapment and stranding areas in the Wells Reservoir. Although no stranded bull trout were observed in these areas during the implementation of the BTMMP, Douglas PUD will continue to investigate potential entrapment or stranding areas for bull trout through periodic monitoring when periods of low reservoir elevation expose identified sites. During the first five years of the new license, Douglas PUD will implement up to five bull trout entrapment/stranding assessments during periods of low reservoir elevation (below 773' MSL). If no incidences of bull trout stranding are observed during the first five years of study, additional assessment will take place every fifth year during the remainder of the license term, unless waived by the Aquatic SWG. If bull trout entrapment and stranding result in take in exceedance of the authorized incidental take level, then reasonable and appropriate measures will be implemented by Douglas PUD, in consultation with the Aquatic SWG, to address the impact.

Objective 5: Participate in the development and implementation of the USFWS Bull Trout Recovery Plan, including information exchange and genetic analysis. Should bull trout be delisted, the Aquatic SWG will re-evaluate the needs and objectives of the BTMP.

Monitoring Other Aquatic Resource Management Plan Activities and Predator Control Program for Incidental Capture and Take of Bull Trout

Douglas PUD will monitor activities associated with the implementation of other Aquatic Resource Management Plans (white sturgeon, Pacific lamprey, resident fish, aquatic nuisance species, and water quality) and Predator Control Program that may result in the incidental capture and take of bull trout. If the incidental take of bull trout is exceeded due to the implementation of other Aquatic Resource Management Plan activities, then Douglas PUD will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to the exceedance of the allowable level of incidental take. If the incidental take of bull trout is exceeded due to the implementation of the Predator Control Program, then Douglas PUD will develop a plan, in consultation with the HCP Coordinating Committee and the Aquatic SWG, to address the identified factors contributing to the exceedance of the allowable level of incidental take.

Funding Collection of Tissue Samples and Genetic Analysis

Beginning in year 10 of the new license, and continuing every 10 years thereafter for the term of the new license, Douglas PUD will, if recommended by the Aquatic SWG, collect up to 10 adult bull trout tissue samples in the Wells Dam fishway facilities over a period of one year and fund their genetic analysis. Genetic tissue collection will take place concurrent with the implementation of the bull trout radio-telemetry monitoring study. Samples will be submitted to the USFWS Central Washington Field Office in Wenatchee, Washington. Any sub-adult bull trout collected during these activities will also be incorporated into the larger bull trout genetic analysis for the Columbia Basin.

Beginning in year one of the new license, Douglas PUD will collect up to 10 adult bull trout tissue samples from the Twisp River brood stock collection facility over a period of one year and will fund their genetic analysis. Genetic tissue collection will take place concurrent with the implementation of the Off-Project bull trout radio-telemetry monitoring study.

Information Exchange and Regional Monitoring Efforts

Douglas PUD will continue to participate in information exchanges with other entities conducting bull trout research and regional efforts to explore availability of new monitoring methods and coordination of radio-tag frequencies for bull trout monitoring studies in the Project.

Douglas PUD will make available an informational and educational display at the Wells Dam Visitor Center to promote the environmental education about the conservation and recovery of bull trout in the Upper Columbia River and associated tributary streams.

Objective 6: Identify any adverse impacts of Project-related hatchery operations on adult and sub-adult bull trout.

Bull Trout Monitoring During Hatchery Activities

During the term of the new license, Douglas PUD shall monitor hatchery actions (e.g., salmon trapping, sturgeon brood stocking and capture activities) that may encounter adult and sub-adult bull trout for incidental capture and take. Actions to be monitored shall be associated with the Wells Hatchery, the Methow Hatchery, and any future facilities directly funded by Douglas PUD.

If the incidental take of bull trout is exceeded due to Douglas PUD's hatchery actions then Douglas PUD will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to the exceedance of the allowable level of incidental take.

FERC Compliance Additions

In addition to the measures addressed above, FERC has also included the following additional measures and compliance tasks: (1) providing information about the project and project-specific measures for promoting the conservation and recovery of bull trout in project waters in the informational and educational display at the Wells Dam Visitor Center; and (2) developing a detailed study plan to evaluate bull trout stranding and incidental take of bull trout during implementation of other aquatic resources measures and operation of the Wells Hatchery.

1.2.3.3 Pacific Lamprey Management Plan

The goal of the Pacific Lamprey Management Plan (PLMP) is to implement measures to monitor and address impacts, if any, on Pacific lamprey (*Lampetra tridentata* or *Entosphenus tridentata*) resulting from the Wells Project during the term of the new license. The PLMP is intended to be compatible with other Pacific lamprey management plans in the Columbia River. Furthermore, the PLMP is intended to be supportive of the Wells HCP (see below for description); the critical research needs identified by the Columbia River Basin Technical Working Group, the Resident Fish Management Plan, Bull Trout Management Plan, and White Sturgeon Management Plan.

Douglas PUD, in collaboration with the Aquatic SWG, will implement PMEs for Pacific lamprey in the Wells Project consistent with the goals and objectives identified in the PLMP. The PMEs are designed to meet the following three objectives:

Objective 1: Identify and address any adverse Project-related impacts on passage of adult Pacific lamprey.

Upstream Fishway Operations Criteria

Douglas PUD is required to operate the upstream fishways at Wells Dam in accordance with criteria outlined in the Wells HCP. Based upon information collected from activities conducted during the implementation of the PLMP, Douglas PUD, in consultation with the Aquatic SWG and the HCP Coordinating Committee, may evaluate various operational and structural modifications to the upstream fishways (e.g., reduction in fishway flows at night) for the benefit of Pacific lamprey passing upstream through Wells Dam during the new license term. If requested, the Aquatic SWG shall develop an Operations Study Plan (OS Plan) that specifically identifies all operational modifications to be evaluated, the proposed monitoring strategy, implementation timeline and criteria for success. The plan shall include a component to evaluate the effects of lamprey modifications on salmon. Upon completion of the evaluation, the Aquatic SWG, in consultation with the HCP Coordinating Committee, will determine whether the proposed modifications should be made permanent, removed, or modified.

Salvage Activities During Ladder Maintenance Dewatering

Douglas PUD shall continue to implement the Adult Fish Passage Plan and associated Adult Ladder Dewatering Plan as required by the Wells HCP. These plans include practices and procedures utilized during fishway dewatering operations to minimize fish presence in the fish ladders and then once dewatered directs Douglas PUD staff to remove stranded fish and safely place them back into the Columbia River. All fish species, including Pacific lamprey that are encountered during dewatering operations are salvaged consistent with the protocol identified in the Wells HCP. Any adult lamprey that are captured during salvage activities will be released upstream of Wells Dam, unless otherwise determined by the Aquatic SWG. Douglas PUD will provide a summary of salvage activities in the annual PLMP report.

Upstream Fishway Counts and Alternative Passage Routes

Douglas PUD shall continue to conduct annual adult fish passage monitoring in the Wells Dam fishways using the most current technology available, to count and provide information on upstream migrating adult Pacific lamprey 24-hours per day during the adult fishway monitoring season (May 1- November 15). Based upon information collected from passage evaluation activities conducted as part of the PLMP, Douglas PUD, in consultation with the Aquatic SWG, may choose to address the use of alternative upstream passage routes around Wells Dam fishway counting stations by adult Pacific lamprey. Potential measures to improve counting accuracy, following consultation and approval of the Aquatic SWG, may include, but may not be limited to, the development of a correction factor based upon data collected during passage evaluations or utilization of an alternative passage route as a counting facility for adult Pacific lamprey.

Upstream Passage Improvement Literature Review

If additional passage improvement measures are deemed necessary by the Aquatic SWG, then within six months after this determination, Douglas PUD, in consultation with the Aquatic SWG, shall complete a literature review on the effectiveness of upstream passage measures (i.e., lamprey passage systems, plating over diffuser grating, modifications to orifices, rounding sharp edges, fishway operational changes, etc.) implemented at other Columbia and Snake river hydroelectric facilities. The literature review will be conducted in support of fishway modification activities identified in the PLMP to help in the selection of reasonable measures that may be implemented to improve adult lamprey passage at Wells Dam.

Fishway Modifications to Improve Upstream Passage

If additional passage improvement measures are deemed necessary by the Aquatic SWG, based upon the results of studies conducted at Wells Dam, then within one year or as soon as practicable following consultation with the Aquatic SWG, Douglas PUD shall identify, design and implement any reasonable upstream passage modifications (structural and/or operational). Passage measures will be designed to improve passage performance by providing safe, effective, and volitional passage for Pacific lamprey through the Wells Dam fishways without negatively impacting the passage performance of adult anadromous salmonids. The following components shall be included in these passage measures:

- <u>Fishway Inspection</u>: Within one year of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas PUD shall conduct a fishway inspection with the Aquatic SWG and regional lamprey passage experts to identify and prioritize measures to improve adult lamprey passage and enumeration at Wells Dam. Additional ladder inspections will be conducted at the request of the Aquatic SWG, consistent with winter ladder dewatering operations.

- Entrance Efficiency: Within one year of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas PUD shall develop a Lamprey Entrance Efficiency Plan (LEE Plan) for evaluating operational and physical ladder entrance modifications intended to create an environment at the fishway entrances that are conducive to adult lamprey passage without significantly impacting the passage of adult salmonids. These improvements shall be evaluated until compliance, as described below, is attained.
- Diffuser Gratings: Within five years of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas PUD shall identify and address, if needed, diffuser gratings within fishways at Wells Dam that adversely affect passage of adult Pacific lamprey.
- Transition Zones: Within five years of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas PUD shall identify and address, if needed, transition zones within fishways at Wells Dam that adversely affect passage of adult Pacific lamprey.
- Ladder Traps and Exit Pools: Within five years of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas PUD shall identify and address, if needed, lamprey ladder traps and exit pools within fishways at Wells Dam that adversely affect passage of adult Pacific lamprey.

Douglas PUD shall exhibit steady progress, as agreed to by the Aquatic SWG, towards improving adult lamprey passage until performance at Wells Dam is determined to be similar to other Mid-Columbia River hydroelectric dams, or until scientifically rigorous standards and evaluation techniques are established by the Lamprey Technical Work Group, or its successor, and adopted regionally. The Aquatic SWG will then evaluate, and if applicable and appropriate, adopt these standards for use at Wells Dam. If compliance is achieved, Douglas PUD shall only be required to implement activities pursuant to Section 4.1.7 of the PLMP (Periodic Monitoring) for adult Pacific lamprey passage.

Adult Pacific Lamprey Upstream Passage Evaluation

Should upstream passage measures be implemented, then within one year following the implementation of such measures, Douglas PUD, in consultation with the Aquatic SWG, shall conduct a one-year study to monitor the effectiveness of such measures on upstream passage performance of adult Pacific lamprey through Wells Dam. If monitoring results indicate that passage rates at Wells Dam are not similar to passage rates at other Mid-Columbia River dams or within standards as described above, Douglas PUD, in consultation with the Aquatic SWG, shall develop and implement additional measures to improve upstream Pacific lamprey passage. Fishway modification and passage evaluation measures (pursuant to Sections 4.1.5 and 4.1.6 of the PLMP) may be repeated, as necessary, until adult passage through Wells Dam is similar to passage rates at other Mid-Columbia River hydroelectric dams or within standards as described above.

Periodic Monitoring

Once adult Pacific lamprey upstream passage rates at Wells Dam are similar to rates at other Mid-Columbia River dams, Douglas PUD, in consultation with the Aquatic SWG, shall periodically monitor adult Pacific lamprey passage performance through Wells Dam fishways to verify the effectiveness of passage improvement measures. Specifically, every ten years after compliance has been achieved, or as determined by the Aquatic SWG, Douglas PUD shall implement a one-year study to verify the effectiveness of the adult fish ladders with respect to adult lamprey passage. If results of the monitoring program confirm the effectiveness of adult lamprey passage measures and the results indicate that passage rates are still in compliance, then no additional measures are needed. If the results indicate that adult upstream passage rates are out of compliance, then the upstream passage study will be replicated to confirm the results. If the results after two years of study both indicate that passage rates have not been maintained, Douglas PUD, in consultation with the Aquatic SWG, shall develop and implement measures to improve upstream Pacific lamprey passage, if any.

Objective 2: Identify and address any Project-related impacts on downstream passage and survival and rearing of juvenile Pacific lamprey.

Downstream Bypass Operations Criteria

Douglas PUD is required to operate the downstream bypass system at Wells Dam in accordance with criteria outlined in the Wells HCP.

Salvage Activities During Ladder Maintenance Dewatering

Douglas PUD shall continue to conduct salvage activities as required by the Wells HCP's Adult Fish Passage Plan during fishway dewatering operations. All fish species, including Pacific lamprey that are encountered during dewatering operations shall be salvaged consistent with the protocol identified in the Wells HCP. Any juvenile Pacific lamprey that are captured during salvage activities will be released downstream of Wells Dam. Douglas PUD will coordinate salvage activities with the Aquatic SWG and allow for member participation. Douglas PUD will provide a summary of salvage activities in the annual report.

Juvenile Pacific Lamprey Passage and Survival Literature Review

Beginning in year five and every five years thereafter during the new license, Douglas PUD, in consultation with the Aquatic SWG, shall conduct a literature review to summarize available technical information related to juvenile lamprey passage and survival through Columbia and Snake River hydroelectric facilities. This information will be used to assess the feasibility of conducting activities identified in Section 4.2.4 of the PLMP.

Juvenile Pacific Lamprey Downstream Passage and Survival Evaluation

Based upon the current state of the science regarding tag technology and methodologies for Pacific lamprey macrophthalmia, coupled with the challenges of obtaining macrophthalmia in sufficient numbers within the Project to meet sample size requirements for a statistically rigorous study, a juvenile downstream passage and survival evaluation is not feasible at this time.

During the term of a new license, if tag technology and methodologies are developed and field tested and a sufficient source of macrophthalmia in or upstream of the Project are identified to ensure that a field study will yield statistically rigorous and unbiased results, Douglas PUD, in consultation with the Aquatic SWG, shall implement a one-year juvenile Pacific lamprey downstream passage and survival study.

If statistically valid study results indicate that Project operations have a significant negative impact on the Pacific lamprey population above the Wells Dam, Douglas PUD, in consultation with the Aquatic SWG, shall identify and implement scientifically rigorous and regionally accepted measures (e.g., translocation, artificial production or habitat enhancement), if any, or additional studies to address such impacts. If operational changes are needed to improve passage of juvenile lamprey migrants, Douglas PUD, in consultation with the Aquatic SWG, will coordinate with the HCP Coordinating Committee to implement such measures.

Juvenile Pacific Lamprey Habitat Evaluation

Within three years of the effective date of a new license, Douglas PUD shall implement a one-year study to examine presence and relative abundance of juvenile Pacific lamprey in habitat areas within the Project that may be affected by Project operations. As part of this measure, Douglas PUD shall identify areas of potential juvenile Pacific lamprey habitat for future evaluation. Sampling of these areas will assess presence/absence and relative abundance. Any sampling methodologies used in support of this activity will require coordination with the HCP Coordinating Committee and regulatory approval of the federal and state agencies.

Objective 3: Participate in the development of regional Pacific lamprey conservation activities.

Regional Lamprey Working Groups

Douglas PUD shall participate in Pacific lamprey work groups in order to support regional conservation efforts (e.g., the Pacific Lamprey Technical Work Group and the USFWS Lamprey Conservation Initiative). Activities may include but are not limited to information exchanges with other entities, meeting attendance, and coordination of Douglas PUD's Pacific lamprey activities with other entities conducting lamprey research in the Mid-Columbia River. Activities may also include conducting PLMP research within the Project, and sharing that information with other entities.

FERC Compliance Additions

In addition to the measures addressed above, FERC is requiring Douglas PUD to prepare plans and implementation schedules for any of the four specific fishway improvement measures, if chosen for implementation, and file them with the Commission for approval prior to implementation.

1.2.3.4 White Sturgeon Management Plan

The goal of the White Sturgeon Management Plan (WSMP) is to increase the white sturgeon (*Acipenser transmontanus*) population in Wells Reservoir to a level that can be supported by the available habitat and characterized by a diverse age structure consisting of multiple cohorts (juveniles and adults). In addition, the WSMP is intended to support spawning, rearing and migration as identified by the aquatic life designated use under Washington Administrative Code (WAC) 173-201A in the Washington State Water Quality Standards (WQS). Based upon the information available as of December 2006, the Aquatic SWG determined that an assessment of Wells Project effects on white sturgeon was not practical given sturgeon life history characteristics and the limited number of fish estimated to exist in the Wells Project. The Aquatic SWG concluded that resource measures related to white sturgeon should focus on population protection and enhancement by means of supplementation as an initial step to increase the number of fish within Wells Reservoir. In addition to the initial supplementation activities, the Aquatic SWG proposed implementation of a monitoring and evaluation program to assess natural recruitment, juvenile habitat use, carrying capacity, and the potential for natural reproduction in order to inform the scope of a future, long-term supplementation strategy.

To fulfill the goals and objectives of the WSMP, Douglas PUD, in consultation with the Aquatic SWG, developed a white sturgeon management program that will be implemented in two phases. Phase I will be implemented during the first ten years of a new license and includes juvenile stocking, and monitoring and evaluation activities. Phase II will include long-term juvenile stocking, adult passage evaluation and monitoring for the remainder of the new license. The scope of the Phase II activities will be determined in part by the results of the Phase I measures. Douglas PUD will provide an annual report that documents all white sturgeon activities conducted within the Wells Project and include any decisions, statements of agreement, evaluations, or changes made pursuant to the WSMP. The PMEs presented within the WSMP were designed to meet the following six objectives and will be implemented during a 50-year license term:

Objective 1: Supplement the white sturgeon population in order to address Project effects, including impediments to migration and associated bottlenecks in spawning and recruitment.

Due to the low numbers of sturgeon indicated by the 2001-2003 white sturgeon study (Jerald 2007) and the need to increase genetic variation, there is a low probability that brood stock from only the Wells Reservoir can be utilized as the basis for supplementation activities. Consequently, other sources of fish must be considered in addition to capturing fish from Wells Reservoir to increase the white sturgeon population. Within one year of issuance of a new license, Douglas PUD shall prepare and implement a Brood Stock Collection and Breeding Plan, in consultation with the Aquatic SWG, which considers such factors as genetics and questions of imprinting, and are consistent with the goal and objectives of the WSMP and includes the level of detail provided in other existing white sturgeon breeding plans.

Following is a prioritized list of juvenile fish source options that shall be incorporated into a Brood Stock Collection and Breeding Plan:

- Brood stock collected from the Wells Reservoir;
- Brood stock collected from nearby reservoirs (Priest Rapids, Wanapum, Rocky Reach, Rock Island);
- Brood stock collected from McNary Reservoir;
- Juvenile production from the Lake Roosevelt white sturgeon recovery effort;
- Brood stock collected from below Bonneville Dam in the lower Columbia River;
- Juveniles purchased from a commercial facility.

A white sturgeon supplementation program may include the following implementation options (Not listed in a priority order).

- Build new or retrofit existing Douglas PUD funded hatchery facilities to accommodate white sturgeon brood stock, egg incubation, and juvenile rearing;
- Development of a Mid-Columbia hatchery facility funded by the Mid-Columbia PUDs (Douglas, Chelan, and Grant) to accommodate various phases of white sturgeon supplementation: brood stock, egg incubation, and juvenile rearing;
- Direct release into the Wells Reservoir of juveniles produced via appropriate Breeding Plan criteria and reared at a commercial facility;
- Direct release into the Wells Reservoir of juveniles or adults trapped and hauled from the lower Columbia River.

The initial source of brood stock shall be determined within the first year of issuance of a new license. Collection of brood stock shall occur consistent with the brood stock collection plan in years 1-4 of the new license. Any additional years during the Phase I program (first ten years of the new license) in which brood stock collection shall occur in order to facilitate additional juvenile stocking into the Wells Reservoir will be determined by the Aquatic SWG. The intent of brood stock collection is to use their progeny, if feasible, for future white sturgeon stocking activities in the Wells Reservoir. The brood stock collection plan shall be updated annually, or as otherwise recommended by Douglas PUD in consultation with the Aquatic SWG, to incorporate new and appropriate information.

Juvenile White Sturgeon Stocking

Within two years following issuance of a new license, Douglas PUD shall release up to 5,000 yearling white sturgeon into the Wells Reservoir annually for four consecutive years (20,000 fish total). Additional years and numbers of juvenile sturgeon to be stocked during Phase I will be determined by the Aquatic SWG and will not exceed 15,000 juvenile sturgeon (total of 35,000 juvenile sturgeon during Phase I). Douglas

PUD shall ensure that all hatchery-reared juvenile white sturgeon released into the Wells Reservoir are marked with Passive Integrated Transponder (PIT) tags and year-specific scute marks for monitoring purposes. In order to allow for tracking of juvenile white sturgeon emigration (Objective 2), Douglas PUD shall ensure that up to one percent (or a maximum of 50) of the juvenile white sturgeon released into the Wells Reservoir are large enough to allow implantation of an active tag prior to release. In addition, following the third year of supplementation (unless the Aquatic SWG determines more analysis is required), the Aquatic SWG may elect to release juveniles at an earlier or later life stage for the fourth year in order to compare success of fish released at varying life stages.

Objective 2: Determine the effectiveness of the supplementation activities through a monitoring and evaluation program.

Douglas PUD shall conduct a monitoring and evaluation program within the Wells Reservoir for the purpose of assessing the effectiveness of the supplementation activities described in the WSMP. Monitoring shall include both an Index Monitoring Program and a Marked Fish Tracking Program. Both programs will be used to collect life history and population dynamics information including rates of fish movements into and out of the Wells Reservoir and habitat use. Douglas PUD shall also obtain updated information, when available, on other white sturgeon recovery programs (e.g., Upper Columbia River, Kootenai River, Mid-Columbia PUDs), in order to improve the monitoring and evaluation program and refine its implementation. The results of this information will also inform supplementation, monitoring and evaluation activities during implementation of Phase II of the WSMP.

Index Monitoring Program

Within three years following issuance of a new license, Douglas PUD shall initiate an index monitoring program (Years 3-5) for juvenile and adult sturgeon in the Wells Reservoir to determine age-class structure, survival rates, abundance, density, condition factor, growth rates, and to identify distribution and habitat selection of juvenile sturgeon. The indexing methods shall include using gillnets, set lines or other appropriate recapture methods for juveniles and adults.

As a component of the indexing monitoring program, Douglas PUD shall capture and implant active tags in a portion of the juvenile and sexually mature adult sturgeon population found in the Wells Reservoir. This tagging effort shall be used to augment broodstock collection, population level information and juvenile habitat use and natural reproduction potential.

The information collected during the index monitoring program will be used to assess age-class structure, survival rates, abundance, condition factor, and growth rates; identify distribution and habitat selection of juvenile sturgeon; and to inform the supplementation program strategy.

Marked Fish Tracking Program

Beginning in year three of the new license and continuing for three years (Years 3-5), Douglas PUD shall conduct tracking surveys of the juvenile white sturgeon that were released with active tags as part of supplementation activities. This will require one percent of each of the annual classes of juvenile sturgeon (up to a maximum of 50 fish each year) released in years 2, 3, 4, and 5 to be reared large enough to implant an active tag for tracking purposes. The purpose of tracking active-tagged fish is to determine juvenile white sturgeon emigration rates out of the Wells Reservoir and habitat use within the Wells Reservoir.

Douglas PUD shall repeat the tracking survey for two additional years during Phase I. The additional two years of surveys shall track active tags implanted in a percentage of juvenile fish from previous years of supplementation activities (dependent upon tag life) and any juvenile and adult fish implanted with active tags during the last indexing period preceding the survey. Subsequent Phase I surveys are likely to coincide with the additional Phase I index monitoring and juvenile stocking activities.

Objective 3: Determine the potential for natural reproduction in the Wells Reservoir in order to appropriately inform the scope of future supplementation activities.

Objective 4: Adaptively manage the supplementation program as warranted by the monitoring results.

For both Objectives 3 and 4, in years where environmental conditions are appropriate, Douglas PUD shall track sexually mature adult sturgeon that were captured and implanted with active tags for the purpose of identifying potential spawning locations and determining natural reproduction potential. Appropriate environmental conditions may be determined by examining the following factors: water quality and quantity (i.e., flow, temperature, and turbidity), the presence of reproductively viable adults during index monitoring activities, and the status of maturity for supplemented fish. In years in which sexually mature adult sturgeon are tagged under, Douglas PUD may also utilize egg collection mats in combination with tracking in areas of the Wells Reservoir for the purpose of identifying potential spawning locations and activity. Five surveys of natural reproduction using adult tracking and/or egg mat placement shall occur over the term of a new license. Several of these surveys are intended to be implemented during the latter part of the license in order to examine the natural reproductive potential of supplemented fish recruiting to sexual maturity.

Objective 5: Evaluate whether there is biological merit to providing safe and efficient adult upstream passage.

In year eleven of the new license and every 10 years thereafter for the duration of the new license unless otherwise determined by the Aquatic SWG, the Aquatic SWG shall evaluate the biological merit of providing upstream passage for adult white sturgeon. The assessment of biological merit shall be determined by: (1) evaluating information gathered from monitoring and evaluation activities and determining whether there is significant biological benefit and need for upstream passage; (2) the availability of reasonable and appropriate means to provide upstream passage; and (3) consensus from all other operators of the Mid-Columbia projects to implement adult upstream passage measures. If all three criteria above are met, Douglas PUD, in consultation with the Aquatic SWG shall develop adult passage measures that are consistent with measures being implemented by other Mid-Columbia project operators.

Objective 6: Identify white sturgeon educational opportunities that coincide with WSMP activities.

Douglas PUD, in consultation with the Aquatic SWG, shall identify appropriate WSMP activities as opportunities for education to local public entities such as schools, cities, fishing and recreation groups, and other interested local groups. WSMP activities that may be appropriate for public participation are hatchery tours, release of hatchery juveniles, and tagging of juveniles prior to release.

Supplementation Program Review

During the implementation of WSMP, Douglas PUD shall compile information on other white sturgeon supplementation programs in the Columbia River Basin as needed in order to assess whether the white sturgeon supplementation program being implemented at the Wells Project is: (i) consistent and comparable with the technology and methods being implemented by other supplementation programs in the region; (ii) reasonable in cost and effective to implement at the Project; and (iii) consistent with the supplementation program goals and objectives. The supplementation program review will be conducted annually in coordination with the development of the annual report.

FERC Compliance Additions

In addition to the measures addressed above, FERC is requiring Douglas PUD to file a white sturgeon collection and breeding plan with the Commission for approval, prior to implementation.

1.2.3.5 Resident Fish Management Plan

The goal of the Resident Fish Management Plan (RFMP) is to protect and enhance native resident fish populations and habitat in the Wells Project during the term of a new license. The RFMP is intended to be compatible with other resident fish management plans in the Columbia River mainstem. Furthermore, the RFMP is intended to be supportive of the Wells HCP (see below), BTMP, PLMP and WSMP by continuing to monitor changes, if necessary, in the resident fish assemblage within the Wells Project. Douglas PUD, in collaboration with the Aquatic SWG, has agreed to implement several resident fish PMEs in support of the goals and objectives of the RFMP. The four objectives and PMEs are as follows:

Objective 1: Implementation of Programs that Benefit Resident Fish.

HCP Predator Control Programs

Douglas PUD shall continue to conduct annual predator control activities for northern pikeminnow and avian predators as outlined in the Wells HCP (Douglas PUD 2002). Although implementation of this program is targeted at reducing predation on anadromous species covered by the Wells HCP, it is also anticipated to have direct benefits for resident fish species.

Land Use Policy

Douglas PUD's Land Use Policy requires approval of all land use activities that take place within the Project Boundary. All permit activities such as construction of boat docks, piers, and landscaping within Project Boundary will be subject to review and approval by Douglas PUD only after the applicant has received all other required regulatory permits, in addition to consideration by the Wells HCP signatory parties and permit review by state and federal action agencies. The purpose of the Douglas PUD review and approval process captured in the Land Use Policy is to protect habitats and species that may be affected by proposed land use activities within the Project.

The Land Use Policy is Douglas PUD's mechanism to ensure land use activities are consistent with all of Douglas PUD's license obligations and other binding agreements. The Wells AFA/HCP's Reservoir Habitat criterion requires habitat protection to be used towards meeting NNI standards for anadromous salmonids. For example, Douglas PUD's Land Use Policy prohibits construction of additional docks outside the city limits of Pateros, Bridgeport and Brewster. In addition, Douglas PUD conducts regular reservoir shoreline monitoring patrols for unpermitted uses; damage caused by adjacent property owners' unauthorized use of Project lands is required to be repaired, and other unauthorized damage to habitat is repaired by Douglas PUD.

Objective 2: Resident Fish Assemblage Monitoring.

Douglas PUD shall conduct a resident fish study to determine the relative abundance of the various resident fish species found within the Wells Reservoir. This assessment shall occur in year 2 and every 10 years thereafter during the term of the new license. The study objectives will focus on (1) identifying whether there have been major shifts in the resident fish populations resulting from the implementation of the White Sturgeon, Bull Trout, Pacific Lamprey, and Aquatic Nuisance Species (ANS) Management Plans, and (2) collecting information on resident predator fish populations found within the Wells Reservoir.

In order to maintain comparative assemblage information over time to inform Project resident fish status and trends, methodology for monitoring activities shall remain consistent with the methods described in Beak (1999). Information collected from these monitoring activities may be used to inform the implementation activities of the other Wells aquatic resource management plans and the Wells HCP predator control activities.

Objective 3: Actions to Address Major Shifts in Native Resident Fish Assemblage.

Based upon information collected during the resident fish status and trends monitoring, if any statistically significant negative changes to native resident fish populations of social, economic, and cultural importance are identified, and are not caused by and cannot be addressed through the implementation of other aquatic resource management plans or activities (white sturgeon, Pacific lamprey, bull trout, ANS, HCP, predator control), reasonable and appropriate implementation measures to address negative changes, if any, will be undertaken by Douglas PUD.

Objective 4: Monitoring in Response to Proposed Changes in Project Operations.

If at any time during the new license term, future changes in Wells Dam operations are proposed that require the FERC's approval and the Aquatic SWG concludes that either reservoir or tailrace habitat within Project Boundary may be affected by the proposed change with regards to spawning, rearing, and migration (aquatic life designated uses) of native resident fish, an assessment will be implemented to identify potential effects, if any, in order to make informed license decisions. If the results of the assessment identify adverse effects to native resident fish species of social, economic and cultural importance, attributable to such changes in Project operations, then Douglas PUD will consult with the Aquatic SWG to select and implement reasonable and appropriate measures to address such effects.

In addition to these activities, Douglas PUD will provide an annual report to the Aquatic SWG summarizing the previous year's activities undertaken in accordance with the RFMP. The report will document all native resident fish activities conducted within the Wells Project. Furthermore, any decisions, statements of agreement, evaluations, or changes made pursuant to this RFMP will be included in the annual report. If no significant activity was conducted in a given year, Douglas PUD will prepare a memorandum providing an explanation of the circumstances in lieu of the annual report.

1.2.3.6 Aquatic Nuisance Species Management Plan

The goal of the Aquatic Nuisance Species Management Plan (ANSMP) is to prevent the introduction and/or spread of ANS in Wells Project waters. The ANSMP is intended to be compatible with other aquatic nuisance species management plans in the Columbia River mainstem. Furthermore, the management plan is intended to be supportive of the Wells HCP, BTMP, PLMP, RFMP, WSMP, and WQMP by continuing to prevent the introduction and/or spread of aquatic nuisance species in Wells Project waters. The PMEs presented within the ANSMP are designed to meet the following three objectives:

Objective 1: Implement best management practices to prevent Eurasian Watermilfoil (*Myriophyllum spicatum*) proliferation during in-water (i.e., construction, maintenance, and recreation improvements) improvement activities in the Project.

If at any time during the new license term, Douglas PUD is required to construct, improve or maintain recreation access at boat launches and swim areas and the removal or disturbance of aquatic macrophtye beds that contain Eurasian Watermilfoil may potentially occur, Douglas PUD will implement containment efforts utilizing best management practices (BMPs), agreed to by the Aquatic SWG, during such activities.

Objective 2: Continue participation in regional and state ANS efforts.

Coordination with Regional and State Entities

Douglas PUD shall continue to coordinate with regional and state entities to implement activities in Project waters to monitor for the presence of ANS, specifically zebra and quagga mussels. Activities covered by this objective will consist of continued monitoring for the presence of zebra and quagga mussels. If ANS are detected during monitoring activities, Douglas PUD will immediately notify the appropriate regional and state agencies and assist in the implementation of reasonable and appropriate measures to address the ANS presence as is consistent with ANS Management protocols.

Douglas PUD shall participate in information exchanges and regional efforts to coordinate ANS monitoring activities.

Monitor Bycatch from other Project Aquatic Resource Management Activities

Douglas PUD shall monitor bycatch data collected from ongoing Project aquatic resource management activities for aquatic nuisance species presence to support regional and state efforts and the ANSMP. Such ongoing activities may consist of broodstock collection activities at Wells Dam and in associated Project tributaries, the northern pikeminnow removal program, water quality monitoring and any other aquatic resource activities related to implementation of Aquatic Resource Management Plans for bull trout, Pacific lamprey, white sturgeon, and resident fish.

ANS Information and Education

Douglas PUD shall develop and make available to the public, information regarding the effects of ANS introductions and the importance of prevention. Such outreach activities may consist of posting signage at Project recreation areas and boat launches.

Douglas PUD shall also provide literature produced by appropriate state entities (Ecology and WDFW) for distribution at the visitor centers of local communities of the Project (Pateros, Brewster, Bridgeport) including Wells Dam.

Objective 3: Monitoring in Response to Proposed Changes in Project Operations.

If at any time during the new license term, future changes in Project operations requiring the FERC's approval are proposed and the Aquatic SWG concludes that such proposed operations may encourage the introduction or proliferation of aquatic nuisance species within the Project, the Aquatic SWG will assess the potential effects, if any, in order to make informed management decisions.

If the assessment identifies adverse effects to aquatic resources due to ANS, which are attributable to changes in Project operations, Douglas PUD shall consult with the Aquatic SWG to select and implement reasonable and appropriate PMEs to address the identified adverse effect(s).

FERC Compliance Additions

In addition to the measures addressed above, FERC has also included the following additional measures and compliance tasks: (1) the specific BMPs that would be implemented to contain aquatic nuisance species during the implementation of recreation enhancement measures, and (2) the specific measures that would be implemented if additional aquatic nuisance species are detected in the project area.

1.2.4 Terrestrial Management Plans

Douglas PUD is also proposing to implement additional management plans and environmental measures for various terrestrial resources as part of the relicensing of the Wells Project. These plans and measures include the Wildlife and Botanical Management Plan (Douglas PUD 2009e), Wells 230 kV Transmission Line Corridor Avian Protection Plan (Douglas PUD 2009d), Recreation Management Plan (Douglas PUD 2009b), Historic Properties Management Plan (Douglas PUD 2009a), and Douglas PUD's Land Use Policy (Douglas PUD 2009c).

1.2.4.1 Wildlife and Botanical Management Plan

The goal of the Wildlife and Botanical Management Plan (WBMP) is to protect, maintain and enhance wildlife populations and habitat on Wells Project lands. The plan is also intended to guide wildlife management activities and to protect rare, threatened and endangered (RTE) wildlife species on Wells Project lands during the term of a new license for the Wells Project. Members of the Terrestrial Resource Work Group (TRWG) include USFWS, WDFW, BLM, Colville Tribes, and Douglas PUD.

Douglas PUD, in collaboration with the TRWG, has agreed to implement several measures in support of the goals and objectives of the WBMP. The seven objectives and measures are as follows:

Objective 1: Protect and Enhance RTE Terrestrial Species Habitat on Project Lands.

The only State-listed terrestrial wildlife species known to use the Wells Project is the American white pelican (Douglas PUD 2006b, 2009f). Sharp-tailed grouse were found in the Bridgeport Bar unit of the Wells Wildlife Area, but have not been observed for over 20 years (M. Hallet, WDFW, email to B. Patterson, Douglas PUD, December 31, 2007). Currently no federal ESA listed, proposed or candidate terrestrial species utilize the Project.

Following receipt of a new license, Douglas PUD will do the following: (1) starting in year 2 of the new license Douglas PUD will provide educational material (signs) at

Douglas PUD boat launches and local visitor centers advising boaters to avoid pelicans while boating, fishing and hunting, and as an enhancement and Douglas PUD will (2) continue to water irrigation dependent riparian trees, shrubs and associated vegetation located below Wells Project Boundary within the confines of the Bridgeport Bar Unit of the Wells Wildlife Area (WWA). Continued watering of this habitat will benefit a wide range of wildlife species, including migratory waterfowl, and in harsh winters could benefit future wintering sharp-tailed grouse, if WDFW efforts to restore populations in the Dyer Hill area of Douglas County are successful.

Objective 2: Protect RTE Botanical Species from Land Disturbing Activities and Herbicide Sprays.

Based on botanical surveys that targeted RTE plants, the only federal or state listed plant species known to occur in the Wells Project are little bluestem and Thompson's clover (Douglas PUD 2006a, 2009f). Thompson's clover and little bluestem are State-listed threatened plant species. In year five of the new license and every 10 years thereafter, Douglas PUD proposes to survey and revise site boundaries for populations of little bluestem and Thompson's clover found within the Project.

For lands owned by Douglas PUD within the Wells Project Boundary, no new ground disturbing activities will be allowed within a 500 ft buffer zone surrounding identified RTE plant locations and no new land use permits will be issued for these buffer areas. For private lands, located within the Wells transmission line corridor, Douglas PUD will control weeds within a 500 ft buffer around Thompson's clover occurrences within the transmission line right of way.

Any weed control activities within the 500 ft buffer zones will utilize the following methods in descending order of preference: biological control, hand pulling and hand wiping of individual weeds with herbicide.

Objective 3: Conserve Habitat for Species on Project Lands Protected by the Federal Endangered Species Act, Bald and Golden Eagle Protection Act, and Migratory Bird Treaty Act.

Following receipt of a new license, Douglas PUD is proposing to (1) inspect raptor perch poles annually and repair or replace perch poles as warranted and remove avian (cormorant) perch poles near Starr Boat Launch, (2) conduct monthly boat surveys during the months of November through March to inventory wintering bald eagle numbers and to identify perch trees that may need protection from beavers, (3) protect from beaver damage large living trees, regularly used by bald eagles as perches, and (4) plant at least 50 acres of annual grain crops along Wells Reservoir to provide food for wintering Canada geese and dabbling ducks. Douglas PUD will implement the WBMP in a manner consistent with the *National Bald Eagle Management Guidelines* (USFWS 2007).

Objective 4: Protect Wildlife Habitat on Wells Project Lands.

Following receipt of a new license, Douglas PUD is proposing to monitor Wells Project lands by boat twice a month for unauthorized encroachment and damage caused by recreational activities and adjacent land owners. Wildlife habitat damage by unauthorized encroachments or recreational activities will be repaired or replaced with in-kind habitat within 12 months of identifying unauthorized activity.

Objective 5: Maintain Productive Wildlife Habitat on the Cassimer Bar Wildlife Management Area.

Following receipt of a new license, Douglas PUD is proposing to manage the Cassimer Bar Wildlife Area for the benefit of wildlife including implementation of the following specific measures: (1) implement weed management annually to control new occurrences of noxious weeds and reduce existing weed occurrences, (2) manage access and replace damaged habitat to reduce adverse effects of recreation on wildlife habitat, (3) maintain perimeter fencing to protect habitat from livestock, and (4) contingent upon receiving the necessary permits, repair the dikes on Cassimer Bar to enhance habitat for waterfowl and other aquatic species. In year four and every year thereafter, the dikes will be inspected and repaired as soon as the design work and permitting allow.

Objective 6: Control Noxious Weeds on Project Lands.

Douglas PUD annually checks the state and county weed lists for changes, and complies with legal requirements for noxious weed control. Douglas PUD annually controls Class A (if any detected) and B designate weed occurrences on Wells Project lands and, starting in year five of the new license, proposes to survey Wells Project lands for new terrestrial weed infestations every five years. Douglas PUD implements appropriate weed control actions based on effectiveness of controlling weed growth with least impact to surrounding vegetation.

Douglas PUD does not conduct any broadcast herbicide spray treatment of Project lands. Where herbicide is used, application is with a backpack sprayer and application is to individual weed plants. Calculating acreage treated is therefore difficult. The majority of weed control spray efforts is in uplands along the transmission line ROW, far removed from water. Douglas PUD almost never uses glyphosate, of any formulation, in native habitats due to its nonselective nature and broad spectrum botanical lethality.

Douglas has used an IPM approach to noxious weed control since at least 2000, when Rodeo™ Herbicide spraying of purple loosestrife around the reservoir was discontinued in favor of biological control agents (beetles). Douglas PUD collects beetles annually on public lands in the Columbia Basin, and releases those in loosestrife areas around the reservoir. Biological agents are also collected and dispersed annually by Douglas PUD to control Dalmatian toadflax in the Wells Project.

Douglas PUD will, as required for consistency with the terms of the new operating license, include BMPs for the use of herbicides associated with recreation facilities operation and maintenance contracts.

Objective 7: Consultation

As part of implementing the WBMP, Douglas PUD will meet with resource agencies at least once per year to discuss management of wildlife and botanical species on Project lands. Changes to the WBMP must be made in writing and following consultation with the terrestrial agencies and tribes. Any agreed-upon changes to the WBMP will be submitted to the FERC for review and approval.

FERC Compliance Additions

In addition to the measures addressed above, the FERC has also included the following measures and compliance task: (1) filing progress reports, developed in consultation with the Terrestrial Resources Work Group (TRWG), that describe measures implemented in the past year and activities planned for the coming year; (2) reviewing changes to the Washington Natural Heritage Program (Washington NHP) rare plant list; and (3) updating the list of sensitive species.

1.2.4.2 Transmission Line Avian Protection Plan

The Wells 230 kV Transmission Line Corridor Avian Protection Plan (APP) was developed to reduce the potential for bird collisions with the Wells 230kV transmission lines and structures, and was prepared in consultation with the TRWG including detailed involvement from the WDFW and USFWS. The APP considers both avian migrants interacting with the transmission lines crossing the Columbia River and birds nesting on the transmission line structures.

As part of the APP, Douglas PUD is proposing to implement the following practices during the term of a new license:

1. Reporting Protocol: All avian mortalities found in the transmission line corridor will be reported to the appropriate parties.

2. Nest Management Protocol: Within two years of receiving a license, a nest management protocol will be developed in compliance with Federal and State bird protection laws.

3. Training Protocol: All appropriate utility personnel will be trained to evaluate avian issues when performing maintenance on the transmission lines and corridor.

Under the APP, Douglas PUD is proposing to annually train all appropriate utility personnel (Wildlife Biologist, Linemen and Right of Way workers) to evaluate avian issues when performing maintenance on the transmission lines and corridor. All nest management will be performed in compliance with applicable state and federal laws. All avian mortalities found in the transmission line corridor will be reported to Douglas PUD's Wildlife Biologist.

1.2.4.3 Recreation Resources Management Plan

The Recreation Management Plan (RMP) establishes a process for developing, planning, and implementing recreation enhancements during the term of the new license. Douglas PUD developed this plan in consultation with the members of the Recreation Resources Work Group (RRWG). Members of the RRWG include representatives from the cities of Pateros, Brewster and Bridgeport, Okanogan and Douglas counties, Washington State Parks and Recreation Commission (State Parks), Washington Recreation and Conservation Office, WDFW, the National Park Service, Colville Tribe, BLM and Douglas PUD. The RMP replaces the Recreation Action Planning Process used during the initial license period.

The goal of the RMP is to define Douglas PUD's role and responsibilities related to the management of the recreation resources of the Wells Project during the term of a new license. The RMP includes the following measures designed to achieve the RMP goals:

Wells Dam Overlook Interpretive Displays

The Wells Dam Visitor Center, previously located inside the Wells Dam, has been closed to the public since 2001 due to security concerns. Douglas PUD is proposing to construct a new Visitor Interpretation Facility to be located on lands owned by Douglas PUD at the access point to the Wells Dam in the vicinity of the current Wells Dam Overlook. Exhibits to be provided at the new facility may include, but are not limited to, power generation, the history of Wells Dam, benefits of hydropower, fish and wildlife, and recreation. A live video feed of the Wells Project fish ladder will also be provided at the facility.

Marina Park Expansion

Relicensing studies determined that Marina Park in Bridgeport is often filled to capacity during peak recreation season. To accommodate increasing use, Douglas PUD will expand Marina Park to include an additional 10 recreation vehicle (RV) spaces. The park will be expanded to the north along the river within Project Boundary. The expansion will include all facilities needed to accommodate recreation use associated with 10 additional RV spaces, including restroom facilities, lift stations, landscaping and access roads.

All necessary environmental permits would be acquired following license issuance, and prior to implementing this project.

Boat-in Tent Camping and Signage

Relicensing studies identified a need to improve access to the Wells Project for non-motorized boats. As such, Douglas PUD will implement several measures to improve access for non-motorized boaters, including installing Greater Columbia Water Trail Coalition signs and informational material at appropriate Wells Project recreational access facilities; providing information on portaging around Wells Dam; constructing a formal boat-in tent camping facility in the vicinity of the Okanogan River, including restroom and picnic shelter; and designating and providing basic improvements for an informal/rustic boat-in tent camping location on the west side of the river within several miles of Wells Dam.

All necessary environmental permits would be acquired following license issuance, and prior to implementing this project.

Extend Chicken Creek Boat Launch

The Chicken Creek Boat Launch is located on Washburn Pond within the Wells Project Boundary. Lower pond levels are often observed in the fall season, and public access can be restricted due to the short length of the launch. Douglas PUD is proposing to place additional concrete planks at the end of the launch in order to extend the launch for improved access during the fall season.

All necessary environmental permits would be acquired following license issuance, and prior to implementing this project.

Reservoir Navigation Maps

In order to facilitate effective navigation of the reservoir, Douglas PUD will install maps of the reservoir showing areas of the reservoir where shallow waters may be encountered. Maps will be installed at high-use boat launches in Pateros, Brewster, and Bridgeport.

The O&M Program also includes a provision for aquatic plant control at designated swimming areas in Bridgeport, Brewster, and Pateros. Douglas PUD proposes to identify and implement the most feasible measures to manage aquatic plant growth at these three locations. Measures may include but not be limited to harvesting, herbicide application, installation of plastic liners, etc. All necessary environmental permits would be acquired following license issuance, and prior to conducting these activities.

Wildlife Viewing Trail Development Feasibility Study

Douglas PUD's proposed RMP includes a wildlife viewing feasibility study and a trail development feasibility study. The conduct of these studies will not have an impact on ESA-listed species.

Promotion of Recreation Facilities

Douglas PUD is proposing to make available printed and web-based material showing day-use sites, boat launches, wildlife viewing areas, campsites, trails, etc. The promotion of recreation facilities will not impact ESA-listed species.

Recreation Facility Operation, Maintenance and Monitoring Program

Douglas PUD's proposed RMP includes a Recreation Facility Operation, Maintenance and Monitoring Program. Under this program Douglas PUD will be responsible for ensuring that operation and maintenance (O&M) standards are met at all Wells Project recreation facilities. Activities under the O&M Program include regular maintenance of buildings and restrooms, docks and boat launches, picnic facilities, trash receptacles, access roads and pavement, trails, landscaping and turf. Douglas PUD's recreation use monitoring program will inform future planning related to recreation management during the term of the new license and does not include actions that could affect ESA-listed species.

FERC Compliance Additions

- Because of a lack of specificity regarding the location and scope of proposed recreational improvements, FERC has added a general requirement to the recreation measures described above, that requires Douglas PUD to submit detailed construction plans and designs for recreational facilities to FERC for approval prior to implementation.

1.2.4.4 Historic Properties Management Plan

In November 2005, Douglas PUD formed a Cultural Resource Work Group (CRWG) to conduct consultation as required by Section 106 of the National Historic Preservation Act (NHPA), and to develop studies to identify Project effects. The CRWG was comprised of representatives from the Colville Tribes, the Washington Department of Archaeology and Historic Preservation (DAHP), the FERC, the BLM, the Bureau of Indian Affairs (BIA), and Douglas PUD. The CRWG developed a Historic Properties Management Plan (HPMP) to address potential Project-related effects to cultural resources within the area of potential effect (APE).

The purpose of the HPMP is to provide guidelines to Douglas PUD for managing historic properties affected by the operation and maintenance of the Wells Project and complying with the NHPA during the term of the new FERC license. The HPMP includes programs for achieving NHPA compliance through monitoring and protection of historic properties, and through consultation with the DAHP State Historic Preservation Officer (SHPO), CCT Tribal Historic Preservation Officer (THPO) and other interested parties. Table 1.2-1 summarizes implementation measures within the HPMP.

Table 1. Historic Properties Management Plan Implementation Measures

Implementation Measure	Description
Designate a HPMP Coordinator	Douglas PUD will appoint a staff HPMP Coordinator responsible for implementation of the HPMP.
Consultation	Douglas PUD will manage historic properties within the Wells Project APE in consultation with the SHPO, THPO, FERC and other agencies as applicable.
Education and Interpretation Program	Douglas PUD will develop an Employee Education Program to inform appropriate staff and contractors on the relevant HPMP programs. Douglas PUD will develop a Public Education and Interpretation Program designed to provide information about historical uses of the Wells Project area.
Management Standards for Historic Properties	For projects that cause ground disturbance or that have other potential effects to cultural resources, Douglas PUD will consult with the THPO, SHPO and other interested parties prior to beginning the project.
Curation and Document Management	Archaeological collections will be curated at the Colville curation facility in Nespelem, WA. Douglas PUD will inventory and index relevant documents, data, drawings, photographs, etc., that are considered historic or of value to historic properties management.
Historic Structures	Wells Dam and the associated facilities will be evaluated for historic

Implementation Measure	Description
Evaluation	architectural and engineering significance after the facility turns 50 years old (2017).
Inadvertent Discoveries and Emergencies	For inadvertent discoveries, all activities at the project site will cease and Douglas PUD will consult with the appropriate parties to identify the appropriate measures.
Site Specific Management Measures	Douglas PUD will implement the Archaeological Sites Monitoring Plan as described in Appendix G of the HPMP. This program is summarized below.
Traditional Cultural Properties	Douglas PUD will consult with the THPO and the SHPO for those activities that may have effects on TCPs, and will prepare Determinations of Eligibility for the National Register of Historic Places.

Monitoring and Treatment Program

The HPMP archaeological monitoring program includes five basic components: 1) an archaeological site monitoring program; 2) a site testing program; 3) a monitoring program for inundated sites; 4) an erosion monitoring program; and 5) a site protection program. Sites to be managed under each of these programs include 44 sites to be monitored annually, 211 sites to be monitored every 10 years, 65 inundated sites to be monitored during low reservoir events, 8 sites requiring additional information or site testing, and 6 sites requiring protection measures. Erosion monitoring will be conducted by a professional geomorphologist at a subset of archaeological sites which will be selected based on landform, river environment, and archaeological content.

Each of the sites identified for management were selected and prioritized by the CRWG based on study results and past research. Management measures will be modified as new information becomes available after each monitoring cycle. Each year the CRWG will meet to discuss study results and to modify the monitoring program as appropriate.

Consultation

Consultation with the THPO, SHPO, and other parties as applicable, is a key component of each program within the HPMP. For projects that cause ground disturbance or that have other potential effects to cultural resources, Douglas PUD will consult with the THPO, SHPO and other interested parties prior to beginning the project. Consultation is also required for inadvertent discoveries, traditional cultural properties, education and interpretation, emergency situations, annual monitoring program, and for periodic revisions to the HPMP. The CRWG will review the HPMP every five years to identify whether any potential changes are needed.

1.2.4.5 Land Use Policy

The waters and shoreline features of the Wells Project have been designated as critical habitat for several ESA listed species. As it applies to the Wells Project, the goal of the Douglas PUD Land Use Policy is to ensure that Project operations are in compliance with the FERC license and other federal and state regulations, including the HCP and the protection of fish and wildlife habitat, protection of critical habitat for ESA-listed species, protection of significant historical, cultural and natural features and compliance with existing settlement agreements including the Wells HCP. The Douglas PUD Land Use Policy is Douglas PUD's decision making process for issuing any land use permit for commercial and private use of Wells Project land and waters. The plan, together with the Wells HCP, ASA, other Terrestrial Resource Management Plans, and Off-License Settlement, form the core of the Douglas PUD resource measures.

The use of Wells Project lands will be governed by the Wells Project license and the Douglas PUD Land Use Policy, and must comply with applicable federal and state laws, the Wells AFA/HCP and various fish and wildlife settlement agreements. All required environmental permits must be obtained and the proposed use must comply with the FERC license and the Douglas PUD Land Use Policy before Douglas PUD will issue a land use permit. Permits from city, county, state and federal agencies may be required before a permit will be issued.

Terrestrial Resources

Within the Wells Project Boundary, no new ground disturbing activities will be allowed within buffer areas surrounding RTE plant locations, and no new land use permits will be issued for these buffer areas. Ground disturbing activities are not allowed on Douglas PUD owned or controlled lands, within 500 ft in any direction, of any know RTE plants locations mapped by EDAW, Inc. (Douglas PUD 2006a).

Douglas PUD will comply with the guidelines established in the WBMP for the protection of RTE terrestrial species. The guidelines include protection of bald eagle (*Haliaeetus leucocephalus*) perch trees on land owned by Douglas PUD.

Aquatic Resources

The Wells HCP provides for the protection of the reservoir habitat for the HCP Plan Species while making land use permit decisions. Douglas PUD is required to consider the cumulative impact effects of land use decisions, in order to meet the HCP objective of "no net impact". Douglas PUD is also required to notify and consider comments from the various agencies and tribes (Wells HCP signatory parties only) regarding land use permit applications.

Docks provide habitat for piscivorous fish to hide and wait to ambush prey moving past the dock. Docks disrupt the shoreline forcing small fish to leave the shoreline cover and either swims under the dock where the predators wait or out into deeper water and away from cover. Douglas PUD's Land Use Policy limits new boat docks to the city limits of Bridgeport, Brewster and Pateros to ensure high survival of juvenile HCP Plan Species. These restrictions are intended to protect juvenile salmon from predation and meet smolt survival standards required by the Wells HCP.

Large portions of the mainstem Columbia River and Methow River Basin are designated as critical habitat under the ESA for bull trout, spring Chinook or steelhead. Critical habitat designations further restrict Douglas PUD's ability to grant land use permits along the shoreline of the Columbia and Methow rivers. Section 7 of the ESA prohibits the destruction or adverse modification of critical habitat in connection with actions carried out, funded, or authorized by a federal agency or an entity that has a federal nexus such as funding, permits or FERC license.

Compliance with critical habitat designations requires Douglas PUD to ensure that each permit application has received an exception from critical habitat designation, from either NMFS or USFWS, prior to Douglas PUD issuing a conditional land use permit. Changes in critical habitat designations and regulations are frequent. Douglas PUD will require that applicants for land use permits consult both the NMFS and USFWS prior to submitting a land use permit application.

Cultural Resources

Compliance with the Douglas PUD Land Use Policy ensures the compatibility of public and commercial occupancy of Project land (public land) with project operations, compliance with FERC license articles, and federal and state laws. Significant cultural resource sites on Project lands are subject to protection under Articles 41 and 44 of the Wells FERC License and section 106 of the NHPA.

Under the NHPA, Douglas PUD is required to address potential impacts to cultural resources that may be affected by Project-related activities conducted in compliance with the FERC license. Procedures for addressing cultural resource issues are defined in Douglas PUD's proposed HPMP. Douglas PUD will follow the guidelines of the HPMP prior to issuing any land use permits. If a permit is issued, the proponent will be required to pay for any additional archaeological work related to the proposed land use activity.

Federal law prevents Douglas PUD from disclosing the location of archaeological and cultural sites. Permits for these locations will either not be issued, or will include special conditions to ensure protection of the cultural resource site.

1.2 Description of the Action Area

The action area includes all direct and indirect effects of the Federal action and not merely the immediate area involved in the action [50 CFR part 402.02]. In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment. Areas in the mainstem Columbia River are directly affected by the project operations. These are confined to the reservoirs, forebays, dams and tailraces of the Wells Dam (approximately 1,000 feet downstream). Flow regime and water quality impacts (i.e., elevated levels of total dissolved gas resulting from either voluntary or involuntary spill) from project operations at the Wells Dam are expected to extend as far downstream as the forebay of the Rocky Reach Hydroelectric Project, located immediately downstream of the Wells Hydroelectric Project. Effects of the Wells operations may extend further downstream due to the influence of additional effects from the Rocky Reach Dam or other involuntary spill. However, the Columbia River both upstream and downstream of Wells Dam is in compliance with state water quality standards at the time of this consultation. Direct downstream effects from project operation to habitat conditions are expected to occur downstream from the Rocky Reach Dam. However, best available information does not provide accurate information to separate the effects of the Wells Hydroelectric Project from those of the Rocky Reach Hydroelectric Project below Rock Reach Dam. Based on our current understanding of bull trout movements in the Mid-Columbia

(Appendix A), migratory fish are known to make long migrations within and between core areas. BioAnalysts, Inc. (2004) observed migrations of about 140 km; Nelson and Nelle (2007) reported migration distances of over 170 km; and post-spawning migrations over 222 km were described by Nelson *et al.* (2007). These studies document that bull trout can move from any core area in the Mid-Columbia and may be exposed to mainstem dam and tributary effects associated with the Wells Hydroelectric Project.

Indirect Project effects to bull trout habitat and populations from the proposed action are expected to occur within the Wenatchee, Entiat, and Methow basins from project activities. Although we expect the likelihood to be discountable, impacts to bull trout in the Yakima Basin may occur if they migrate out of these basins and encounter either mainstem Columbia River effects or tributary impacts. Habitat protection and enhancement projects resulting from implementation of the Wells AFA/HCP (i.e., the *Tributary Conservation Plan* proposed herein), monitoring programs, and hatchery supplementation are likely to affect bull trout and their habitat in tributary river systems upstream of the Wells Dam (i.e., the Entiat and Methow basins) and populations using the mainstem Columbia River (including the Yakima populations). This portion of the mainstem Columbia River provides essential foraging, migratory corridors, and overwinter habitat for bull trout which spawn in adjacent tributary systems.

In light of bull trout migratory movements (evidenced by genetic information and telemetry) and likely Project effects, which will last 30 to 50 years depending on the new license term length, it is anticipated that Yakima River bull trout populations using the mainstem Columbia River may be affected by the Project.

Based on the above considerations, the Service defines the action area as (i) the Columbia River from river miles (RM) 514.4 (approximately 1.2 miles downstream of the Wells Dam) to RM 544.9 (Chief Joseph tailrace), and (ii) the Okanogan, Methow, and Entiat river systems.

2.0 ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND DESTRUCTION/ADVERSE MODIFICATION DETERMINATION

2.1 Jeopardy Analysis

In accordance with policy and regulation, the jeopardy analysis in this Biological Opinion relies on four components: (1) the *Status of the Species*, which evaluates the bull trout's range-wide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the bull trout in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the bull trout; (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 bull trout; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the bull trout.

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 bull trout's 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 the bull trout in the wild.

Interim recovery units were defined in the final listing rule for the bull trout for use in completing jeopardy analyses. Pursuant to Service policy, when an action impairs or precludes the capacity of a recovery unit from providing both the survival and recovery function assigned to it, that action may represent jeopardy to the species. When using this type of analysis, the biological opinion describes how the action affects the recovery unit's functional relationship to both the survival and recovery of the listed species as a whole.

As discussed below under the *Status of the Species*, interim recovery units have been designated for the bull trout for purposes of recovery planning and application of the jeopardy standard. Per Service national policy (Director's March 6, 2006, memorandum), it is important to recognize that the establishment of recovery units does not create a new listed entity. Jeopardy analyses must always consider the impacts of a proposed action on the survival and recovery of the species that is listed. While a proposed Federal action may have significant adverse consequences to one or more recovery units, this would only result in a jeopardy determination if these adverse consequences reduce appreciably the likelihood of both the survival and recovery of the listed entity; in this case, the coterminous U.S. population of the bull trout.
The joint Service and National Marine Fisheries Service Endangered Species Consultation Handbook (USDI and USDC 1998), which represents national policy of both agencies, further clarifies the use of recovery units in the jeopardy analysis:

> "When an action appreciably impairs or precludes the capacity of a recovery unit from providing both the survival and recovery function assigned to it, that action may represent jeopardy to the species. When using this type of analysis, include in the biological opinion a description of how the action affects not only the recovery unit's capability, but the relationship of the recovery unit to both the survival and recovery of the listed species as a whole."

The jeopardy analysis for the bull trout in this Biological Opinion uses the above approach and considers the relationship of the action area and core area (discussed below under the *Status of the Species* section) to the recovery unit and the relationship of the recovery unit to both the survival and recovery of the bull trout as a whole. It is within this context that we evaluate the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

2.2 Destruction or Adverse Modification Analysis

This Biological Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this Biological Opinion relies on 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 primary constituent elements (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.

For purposes of the adverse modification determination, the effects of the proposed Federal action on bull trout critical habitat are evaluated in the context of the range-wide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat range-wide would remain functional (or would retain the current ability for the PCEs to be functionally established) to serve its intended recovery role for the bull trout. Generally, the conservation role of bull trout critical habitat units is to support viable core area populations. Thus, the intended purpose of critical habitat, to support viable core areas, establishes a sensitive scale for relating effects of an action on the critical habitat unit or the critical habitat subunit to the conservation function of the entire designated critical habitat (70 FR 63898).

The analysis in this Biological Opinion places an emphasis on using the intended range-wide recovery function of bull trout critical habitat, especially in terms of maintaining and/or restoring viable core areas, and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

3.0 STATUS OF THE SPECIES

3.1 Listing Status

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (64 FR 58910). The threatened bull trout occurs in the Klamath River Basin of south-central Oregon and in the Jarbidge River in Nevada, north to various coastal rivers of Washington to the Puget Sound and east throughout major rivers within the Columbia River Basin to the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Cavender 1978, Bond 1992, Brewin and Brewin 1997, Leary and Allendorf 1997).

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation and alterations associated with: dewatering, road construction and maintenance, mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; 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).

The bull trout was initially listed as three separate Distinct Population Units (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, plus two other population segments, into one listed taxon and the application of the jeopardy standard under section 7 of the ESA relative to this species (64 FR 58930):

> "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."

Thus, as discussed above under the *Analytical Framework for the Jeopardy and Adverse Modification Determinations,* the Service's jeopardy analysis for the proposed Project will involve consideration of how the Project is likely to affect the Columbia River interim recovery unit for the bull trout based on its uniqueness and significance as described in the DPS final listing rule cited above, which is herein incorporated by reference. However, in accordance with Service national policy, the jeopardy determination is made at the scale of the listed species. In this case, that is the coterminous U.S. population of the bull trout.

3.2 Current Status and Conservation Needs

A summary of the current status and conservation needs of the bull trout within these units is provided below. A comprehensive discussion of these topics is found in the Service's draft recovery plan for the bull trout (USFWS 2002a and 2004d).

The conservation and habitat needs of the bull trout are generally expressed as the need to provide the four Cs: cold, clean, complex, and connected habitat. Cold stream temperatures, clean water 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 at multiple scales ranging from the coterminous to local populations. The recovery planning process for the bull trout (USFWS 2002a and 2004d) has also identified the following conservation needs for the bull trout: (1) maintain and restore multiple, interconnected populations in diverse habitats across the range of each interim recovery unit; (2) preserve the diversity of life-history strategies; (3) maintain genetic and phenotypic diversity across the range of each interim recovery unit; and (4) establish a positive population trend. Recently, it has also been recognized that bull trout populations need to be protected from catastrophic fires across the range of each interim recovery unit.

As described in Chapter 1 of the draft recovery plan for the bull trout (USFWS 2002a), the foundation of conservation efforts for the bull trout and the Service's recovery planning efforts stress the importance of maintaining or restoring the migratory life history form. This emphasis is based on: (1) consideration of the tenets of metapopulation theory, which stresses the importance of connected, genetically diverse populations that the migratory component facilitates; and (2) the inherent difficulty in monitoring the status and trend of the resident life history. Furthermore, the resident life history form is inherently difficult to monitor, so little is known about the population dynamics of this life history form (Al-Chokhachy *et al.* 2005).

Specific details about important distinctions between the resident and migratory life history forms of the bull trout are described below.

Central to the survival and recovery of the bull trout is the maintenance of viable core areas (USFWS 2002a and 2004d). A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat, and in some cases in their use of spawning habitat. Each of the interim recovery units listed above consists of one or more core areas. About 114 core areas and 500 local populations are recognized across the United States range of the bull trout (USFWS 2002a and 2004d).

As noted above, in recognition of available scientific information relating to their uniqueness and significance, five segments of the coterminous United States population of the bull trout are considered essential to the survival and recovery of this species and are identified as interim recovery units: (1) Jarbidge River; (2) Klamath River; (3) Columbia River; (4) Coastal-Puget Sound; and (5) St. Mary-Belly River. Each of these segments is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions.

Jarbidge River

This interim recovery unit currently contains a single core area with six local populations. Less than 500 resident and migratory adult bull trout, representing about 50 to 125 spawners, are estimated to occur within the core area. The current condition of the bull trout in this interim recovery unit is attributed to the effects of livestock grazing, roads, angler harvest, timber harvest, and the introduction of non-native fishes (USFWS 2004a). The draft bull trout recovery plan (USFWS 2004a) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout within the core area; maintain stable or increasing trends in abundance of both resident and migratory bull trout in the core area; restore and maintain suitable habitat conditions for all life history stages and forms; and conserve genetic diversity and increase natural opportunities for genetic exchange between resident and migratory forms of the bull trout. As noted in the draft recovery plan, an estimated 270 to 1,000 spawning fish per year are needed to provide for the persistence and viability of the core area and to support both resident and migratory adult bull trout (USFWS 2004a).

Klamath River

This interim recovery unit currently contains 3 core areas and 12 local populations. The current abundance, distribution, and range of the bull trout in the Klamath River Basin are greatly reduced from historical levels due to habitat loss and degradation caused by reduced water quality, timber harvest, livestock grazing, water diversions, roads, and the introduction of non-native fishes (USFWS 2002a). Bull trout populations in this unit face a high risk of extirpation (USFWS 2002a). The draft bull trout recovery plan (USFWS 2002a) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout and restore distribution in previously occupied areas; maintain stable or increasing trends in bull trout abundance; restore and maintain suitable habitat conditions for all life history stages and strategies; conserve genetic diversity and provide the opportunity for genetic exchange among appropriate core area populations. As noted in the draft recovery plan, 8 to 15 new local populations and an increase in population size from about 3,250 adults currently to 8,250 adults are needed to provide for the persistence and viability of the 3 core areas (USFWS 2002a).

Columbia River

This interim recovery unit currently contains about 90 core areas and nearly 500 local populations. About 62 percent of these core areas and local populations occur in central Idaho and northwestern Montana. The condition of the bull trout within these core areas varies from poor to good but generally all have been subject to the combined effects of habitat degradation, fragmentation and alterations associated with one or more of the following activities: dewatering; road construction and maintenance; mining, and grazing; the blockage or impairment of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species.

In addition to core areas and local populations, the current condition of the bull trout has also been expressed in terms of subpopulations. For bull trout, a subpopulation is considered to be a reproductively isolated group that spawns within a particular area of a river system. The spatial scale of bull trout subpopulations corresponds roughly to geographic sub-basins. The Service analyzed data on bull trout relative to subpopulations because fragmentation and barriers have isolated bull trout throughout their current range, and most monitoring data is compiled at the subpopulation scale. In 1998, the Service recognized 141 subpopulations of bull trout in the Columbia River DPS/interim recovery unit within Idaho, Montana, Oregon, and Washington (63 FR 31647).

The Service (63 FR 31647) rated each subpopulation as either "strong," "depressed," or "unknown" using criteria from Rieman *et al.* (1997a) with some modifications. A subpopulation was considered "strong" if 5,000 individuals or 500 spawners were likely to occur in the subpopulation, abundance appears stable or increasing, and all currently present life history forms are likely to persist. A "depressed" subpopulation has less than 5,000 individuals or 500 spawners, abundance appears to be declining, or a life history form historically present has been lost. If information about abundance, trend, and life history information was insufficient to classify the status of a subpopulation as either "strong" or "depressed", the status was considered "unknown" (63 FR 31647).

Generally, where status is known and population data exist, bull trout subpopulations in the Columbia River DPS/interim recovery unit are declining (Thomas 1992; Pratt and Huston 1993). Bull trout in the Columbia River Basin occupy about 45% of their estimated historic range (Quigley and Arbelbide 1997). Quigley and Arbelbide (1997) considered bull trout populations strong in only 13% of the occupied range in the interior Columbia River Basin. Rieman *et al.* (1997a) estimated that populations were strong in 6-24% of the sub watersheds in the entire Columbia River Basin. The few bull trout subpopulations that are considered "strong" are generally associated with large areas of contiguous habitats such as portions of the Snake River

Basin in central Idaho, the upper Flathead Rivers in Montana, and the Blue Mountains in Washington and Oregon. Approximately 21% of the bull trout populations in the Columbia River DPS/interim recovery unit are threatened by the effects of poaching (63 FR 31647). The Service also identified subpopulations at risk of extirpation from naturally occurring events. At-risk subpopulations were: (1) unlikely to be reestablished by individuals from another subpopulation; (2) limited to a single spawning area; (3) characterized by low individual or spawner numbers; or (4) comprised primarily of a single life history form. In the Columbia River DPS/interim recovery unit, approximately 79 percent of all subpopulations are unlikely to be reestablished if extirpated and 50 percent are at risk of extirpation from naturally occurring events due to their depressed status (63 FR 31647). Many of the remaining bull trout subpopulations occur in isolated headwater tributaries, or in tributaries where migratory corridors have been lost or restricted. The listing rule characterizes the Columbia River DPS/interim recovery unit as generally having isolated subpopulations, without the migratory life form to maintain the biological cohesiveness of the subpopulations, and with trends in abundance declining or of unknown status. Recolonization of habitat where isolated bull trout subpopulations have been lost is either unlikely to occur (Rieman and McIntyre 1993) or will only occur over extremely long time periods.

The draft bull trout recovery plan (USFWS 2002a) identifies the following survival and recovery needs for the bull trout within the Columbia River interim recovery unit: maintain or expand the current distribution of the bull trout within core areas; maintain stable or increasing trends in bull trout abundance; maintain/restore suitable habitat conditions for all bull trout life history stages and strategies; and conserve genetic diversity and provide opportunities for genetic exchange. As noted above, it has also been recently recognized that bull trout populations need to be protected from catastrophic fires across the range of each interim recovery unit. Collectively, these criteria constitute the intended survival and recovery function of this interim recovery unit.

At a smaller scale, draft recovery criteria for the bull trout within the Entiat, Methow, and Wenatchee River basins (the action area for this consultation occurs in the Wenatchee River Basin), include the following: the area must contain at least 17 local populations; the area must have an estimated abundance between 6,322 to 10,246 migratory fish; the area must exhibit a stable or increasing population trend for at least two generations at or above the recovered abundance level; and migratory connectivity must be secure (USFWS 2004c). As discussed above, the draft recovery criteria emphasize the migratory life history form because of the unique contribution it provides to long-term persistence of the bull trout (USFWS 2002a). This interim recovery unit is especially important to the survival and recovery of the bull trout because it contains 90 of 114 (79%) of all core areas and 500 of 594 (84%) of all local populations within the coterminous U.S. range of the bull trout.

Updates to the 5-year review for the bull trout (USFWS 2008a) identified that rangewide, bull trout were determined to have an environmental specificity as a "narrow, specialist". This ranking was primarily due to the widespread historical range of the species, and the generally common occurrence of many bull trout habitat parameters within the remaining distribution. Rangewide, bull trout were also determined to be moderately vulnerable to intrinsic factors (factors that exist independent of human influence). This determination was based primarily on the species' relatively high potential reproductive rate and fecundity.

Within the Wenatchee Core Area, the status review found that adfluvial and fluvial migratory bull trout are present as well as the resident form of bull trout. The review also found a high degree of connectivity within the core areas with the lower bound being the watershed boundary and the upper bounds being natural barriers and headwaters. Population size for the Wenatchee Core Area was identified as between 250-1000 individuals.

The threats factor was determined to be "low severity threat for most or significant proportion of population, occurrences, or area. The severity of the threats was identified as "low", the scope "moderate", and the immediacy "high". The short-term trend for the Wenatchee Core Area was identified as "Stable" indicating that the population, range, area occupied, and/or number or condition of occurrences is unchanged or remaining within a +/- 10% fluctuation.

All Core areas were divided into one of four risk factors: C1 (high risk), C2 (at risk), C3 (potential risk) and C4 (low risk). The Wenatchee Core area was identified in category C3 based on the factors identified in the paragraphs above.

Coastal-Puget Sound

Bull trout in the Coastal-Puget Sound interim recovery unit exhibit anadromous, adfluvial, fluvial, and resident life history patterns. The anadromous life history form is unique to this unit. This interim recovery unit currently contains 14 core areas and 67 local populations (USFWS 2004b). Bull trout are distributed throughout most of the large rivers and associated tributary systems within this unit. With limited exceptions, bull trout continue to be present in nearly all major watersheds where they likely occurred historically within this unit. Generally, bull trout distribution has contracted and abundance has declined especially in the southeastern part of the unit. The current condition of the bull trout in this interim recovery unit is attributed to the adverse effects of dams, forest management practices (e.g., timber harvest and associated road building activities), agricultural practices (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation), livestock grazing, roads, mining, urbanization, angler harvest, and the introduction of non-native species. The draft bull trout recovery plan (USFWS 2004b) identifies the following conservation needs for this unit: maintain or expand the current distribution of bull trout within existing core areas; increase bull trout abundance to about 16,500 adults across all core areas; and maintain or increase connectivity between local populations within each core area.

St. Mary-Belly River

This interim recovery unit currently contains 6 core areas and 9 local populations (USFWS 2002a). Currently, the bull trout is widely distributed in the St. Mary River drainage and occurs in nearly all of the waters that it inhabited historically. Bull trout are found only in a 1.2-mile reach of the North Fork Belly River within the United States. Redd count surveys of the North Fork Belly River documented an increase from 27 redds in 1995 to 119 redds in 1999. This increase was attributed primarily to protection from angler harvest (USFWS 2002a). The current condition of the bull trout in this interim recovery unit is primarily attributed to the effects of dams, water diversions, roads, mining, and the introduction of non-native fishes (USFWS 2002a). The draft bull trout recovery plan (USFWS 2002a) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout and restore distribution in previously occupied areas; maintain stable or increasing trends in bull trout abundance; restore and maintain suitable habitat conditions for all life history stages and forms; conserve genetic diversity and provide the opportunity for genetic exchange; and establish good working relations with Canadian interests because local bull trout populations in this unit are comprised mostly of migratory fish, whose habitat is mostly in Canada.

3.3 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). 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, Goetz 1989). 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, Goetz 1989), or saltwater (anadromous) to rear as subadults or to live as adults (Cavender 1978, McPhail and Baxter 1996, WDFW 1997). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they can spawn more than once in a lifetime), and generally migrate upstream during high flow in late spring and early summer. Both repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Fraley and Shepard 1989, Pratt 1992, Rieman and McIntyre 1996).

The iteroparous reproductive system of bull trout has important repercussions for the management of this species. Bull trout require two-way passage up 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 therefore require only one-way passage upstream). Therefore, even dams or other barriers with fish passage facilities may be factors in isolating bull trout populations, if they do not provide a downstream passage route or the passage ladder does not accommodate smaller, weaker swimming fish.

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). The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

3.4 Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). 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; Goetz 1989; Sedell and Everest 1991; Pratt 1992; Rieman and McIntyre 1993, 1995; Watson and Hillman 1997). Watson and Hillman (1997) 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), fish are not expected to simultaneously occupy all available habitats (Rieman et al. 1997).

Cold water temperatures play an important role in determining bull trout habitat. Bull trout are primarily found in colder streams (below 59 °F) and spawning habitats are generally characterized by temperatures that drop below 48 °F in the fall (Fraley and Shepard 1989, Pratt 1992, Rieman and McIntyre 1993).

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 (Pratt 1992, Rieman and McIntyre 1993, Rieman et al. 1997). Optimum incubation temperatures for bull trout eggs range from 35 to 39 °F whereas optimum water temperatures for rearing range from about 46 to 50 °F (McPhail and Murray 1979, Goetz 1989, Buchanan and Gregory 1997). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 46 to 48 °F, within a temperature gradient of 46 to 60 °F. In a study relating bull trout distribution to maximum water temperatures across a landscape, Dunham et al. (2003a) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 52 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 (Fraley and Shepard 1989; Rieman and McIntyre 1993, 1995; Buchanan and Gregory 1997; Rieman et al. 1997a). Factors that can influence bull trout ability to survive in warmer rivers include availability and proximity of cold water patches and food productivity (Myrick 2003). In Nevada, adult bull trout have been collected at 63 °F in the West Fork of the Jarbidge River and have been observed in Dave Creek where maximum daily water temperatures were 62.8 to 63.6 °F (Werdon 2000). In the Little Lost River, Idaho, bull trout have been collected in water up to 68 °F; however, bull trout made up less than 50 percent of all salmonids when maximum summer water temperature exceeded 59 °F and less than 10 percent of all salmonids when temperature exceeded 63 °F (Gamett 1999). In the Little Lost River study, most sites that had high densities of bull trout were in an area where primary productivity increased in the streams following a fire. Increases in stream temperatures can cause direct mortality, increased susceptibility to disease or other sublethal effects, displacement by avoidance (McCullough et al. 2001, Bonneau and Scarnechia 1996), or increased competition with species more tolerant of warm stream temperatures (Rieman and McIntyre 1993; Craig and Wissmar 1993 cited in USDI (1997); MBTSG 1998). Brook trout (*Salvelinus fontinalis*), which can hybridize with bull trout, may be more competitive than bull trout and displace them, especially in degraded drainages containing fine sediment and higher water temperatures (Selong et al. 2001; Leary et al. 1993). Recent laboratory studies suggest bull trout are at a particular disadvantage in competition with brook trout at temperatures greater than 12° C (McMahon et al. 2001; Selong et al. 2001).

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, Goetz 1989, Sedell and Everest 1991, Pratt 1992, Thomas 1992, Sexauer and James 1993, Watson and

Hillman 1997). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1993). 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, Pratt 1992, Pratt and Huston 1993). Pratt (1992) indicated that increases in fine sediment reduce egg survival and emergence.

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

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993; Rieman et al. 1997). 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 be reestablished by bull trout migrants. However, it is important to note that the genetic structure of bull trout indicates that there is limited gene flow among populations, which may encourage local adaptation within individual populations and reestablishment of extirpated populations may take a very long time (Spruell et al. 1999, Rieman and McIntyre 1993).

Migratory forms of the bull trout appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes, where foraging opportunities may be enhanced (Frissell 1993). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River in Oregon (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. The benefits of the migratory strategy include greater growth in the more productive waters of larger streams and lakes, greater fecundity resulting in increased reproductive potential, and dispersing the population across space and time so that spawning streams may be re-colonized should local populations suffer a catastrophic loss (Rieman and McIntyre 1993, MBTSG 1998, Frissell 1999). In the absence of the migratory life form, isolated populations cannot be replenished when disturbance makes local habitats temporarily unsuitable, the range of the species is diminished, and the potential for enhanced reproductive capabilities are lost (Rieman and McIntyre 1993).

The importance of maintaining the migratory life-history form of the bull trout, as well as the presence of migratory runs of other salmonids that may provide a forage base for bull trout, is emphasized in the literature (summarized in USFWS 2005a; 70 FR 63898). The ability to migrate is important to the persistence of local bull trout populations (Rieman and McIntyre 1993; Rieman and Clayton 1997; Rieman *et al.* 1997a). Bull trout rely on migratory corridors to move from spawning and rearing habitats to foraging and overwintering habitats and back. Migratory bull trout become much larger than resident fish in the more productive waters of larger streams and lakes, leading to increased reproductive potential (McPhail and Baxter 1996). Migratory corridors are also essential for movement between local populations, as well as within populations. Local populations that have been extirpated by catastrophic events may become reestablished as a result of movements by bull trout through migratory corridors (Rieman and McIntyre 1993; MBTSG 1998). Corridors that allow such movements can support the eventual recolonization of unoccupied areas or otherwise play a significant role in maintaining genetic diversity and metapopulation viability.

3.5 Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987, Goetz 1989, Donald and Alger 1993). Adult migratory bull trout feed on various fish species (Fraley and Shepard 1989, Donald and Alger 1993). In coastal areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) in the ocean (WDFW 1997).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. In the Skagit River system of Washington, 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 migratory route (WDFW 1997). Anadromous bull trout also use marine waters as migratory corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman and Corbett, 2005).

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, mysids and small fish (Shepard et al. 1984, Boag 1987, Goetz 1989, Donald and Alger 1993). Bull trout that are 4.3 inches long or longer commonly have fish in their diet (Shepard et al. 1984), and bull trout of all sizes have been found to eat fish half their length (Beauchamp and Van Tassell 2001).

Migratory bull trout begin growing rapidly once they move to waters with abundant forage that includes fish (Shepard et al. 1984, Carl 1985). As these fish mature they become larger bodied predators and are able to travel greater distances (with greater energy expended) in search of prey species of larger size and in greater abundance (with greater energy acquired). In Lake Billy Chinook in Oregon, as bull trout became increasingly piscivorous with increasing size, the prey species changed from mainly smaller bull trout and rainbow trout for bull trout less than

17.7 inches in length to mainly kokanee for bull trout greater in size (Beauchamp and Van Tassell 2001).

Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. Bull trout likely move to or with a food source. For example, during past radio-telemetry studies at the Wells Project, migratory bull trout often frequented the Wells Hatchery outfall whenever hatchery Chinook were being released from the facility (BioAnalysts 2002; 2006). Some bull trout in the Wenatchee River Basin were found to consume large numbers of earthworms during spring runoff in May at the mouth of the Little Wenatchee River where it enters Lake Wenatchee (Kelly-Ringel and De La Vergne 2008). In the Wenatchee River, radio-tagged bull trout moved downstream after spawning to the locations of spawning Chinook and sockeye salmon and held for a few days to a few weeks, possibly to prey on dislodged eggs, before establishing an overwintering area downstream or in Lake Wenatchee (Kelly-Ringel and De La Vergne 2008).

3.6 Reproductive Biology

Bull trout become sexually mature between 4 and 9 years of age, and may spawn in consecutive or alternate years (Shepard et al. 1984; Pratt 1992). Spawning typically occurs from August through December in cold, low-gradient 1^{st}- to 5^{th}-order tributary streams, over loosely compacted gravel and cobble having groundwater inflow (Shepard et al. 1984; Brown 1992; Rieman and McIntyre 1996; Swanberg 1997; MBTSG 1998; Baxter and Hauer 2000). Surface/groundwater interaction zones that are typically selected by bull trout for redd construction have high dissolved oxygen, constant cold water temperatures, and increased macroinvertebrate production. Bull trout spawning sites frequently occur near cover (Brown 1992).

Bull trout eggs hatch in winter or early spring, and alevins may stay in the gravel for up to 3 weeks before emerging. The total time from egg deposition to fry emergence from the gravel may exceed 220 days.

Bull trout post-spawning mortality, longevity, and repeat-spawning frequency are not well known (Rieman and McIntyre 1996), but the lifespan of the bull trout may exceed 20 years (McPhail and Murray 1979; Pratt 1992; Rieman and McIntyre 1993). Data in the upper-Columbia suggest that adult migratory bull trout are 5-7 years with no 8 year olds or older present. In addition, USFWS data in the upper Columbia suggest that 12% of adult bull trout will not spawn in consecutive years (Appendix A). Adult adfluvial bull trout may live as long as 20 years, and may spend as long as 20 months in lake or reservoir habitat to gain adequate energy storage and develop gametes before they return to spawn (67 FR 71236).

Migratory bull trout are highly visible during spawning due to their large size and location in relatively small streams during periods of low flow. Channel complexity and cover are important components of spawning habitat to reduce both predation risk and potential for poaching.

3.7. Population Dynamics

Bull trout are considered to display complex metapopulation dynamics (Dunham and Rieman 1999). The size of suitable habitat patches appears to play an important role in the persistence of bull trout populations, along with habitat connectivity and human disturbance, especially road density. Analyses of spatial and temporal variation in bull trout redds indicate a weak spatial clustering in patterns of abundance through time (Rieman and McIntyre 1996). These analyses showed that spatial heterogeneity in patterns of abundance was high, however, at a regional scale. These patterns suggest that maintenance of stable regional populations of the bull trout may require maintenance of connected patches of high quality habitat where dispersal and demographic support can occur readily among patches (Rieman and McIntyre 1996).

The importance of maintaining the migratory life-history form of the bull trout, as well as migratory runs of other salmonids that may provide a forage base for bull trout, is repeatedly emphasized in the scientific literature (Rieman and McIntyre 1993; MBTSG 1998; Dunham and Rieman 1999; Nelson *et al.* 2002). Isolation and habitat fragmentation resulting from migratory barriers have negatively affected bull trout by: (1) reducing geographical distribution (Rieman and McIntyre 1993; MBTSG 1998); (2) increasing the probability of losing individual local populations (Rieman and McIntyre 1993; MBTSG 1998; Nelson *et al.* 2002; Dunham and Rieman 1999); (3) increasing the probability of hybridization with introduced brook trout (Rieman and McIntyre 1993); (4) reducing the potential for movements in response to developmental, foraging, and seasonal habitat requirements (MBTSG 1998; Rieman and McIntyre 1993); and (5) reducing reproductive capability by eliminating the larger, more fecund migratory form from many subpopulations (MBTSG 1998; Rieman and McIntyre 1993). Therefore, restoring connectivity and restoring the frequency of occurrence of the migratory form will reduce the probability of local and subpopulation extinctions. Remnant populations, that lack connectivity due to elimination of migratory forms, have a reduced likelihood of persistence (Rieman and McIntyre 1993; Rieman and Allendorf 2001).

The bull trout has multiple life-history strategies, including migratory forms, throughout its range (Rieman and McIntyre 1993). Migratory forms appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes, where foraging opportunities may be enhanced (Frissell 1999). For example, multiple life-history forms and multiple migration patterns have been recorded in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow for the free movement of bull trout between spawning and rearing areas and the mainstem of the Snake River. Such multiple life-history strategies help to maintain the stability and persistence of bull trout populations in the face of environmental changes. Migratory bull trout may enhance the persistence of metapopulations due to their high fecundity, large size, and dispersal across space and time, which promotes recolonization of areas from which bull trout have been extirpated should resident populations suffer a catastrophic loss (Frissell 1999; Rieman and McIntyre 1993; MBTSG 1998).

Barriers to migration are an important factor influencing patterns of genetic variability in the bull trout (Spruell *et al.* 2003; Costello *et al.* 2003). Although barriers increase the vulnerability of isolated populations to stochastic factors, they also insulate these populations from the homogenizing effects of gene flow. If isolated populations were founded by ancestors with rare alleles, genetic drift, unimpeded by gene flow, can lead to fixation of locally rare alleles. These populations may subsequently serve as reservoirs of rare alleles, and downstream migration from isolated populations may be important in maintaining the evolutionary potential of metapopulations (Costello *et al.* 2003).

Lakes and reservoirs provide important refugia for bull trout that display the adfluvial life-history strategy. In general, lake and reservoir environments are relatively more secure from catastrophic natural events than stream systems (67 FR 71236). They provide a sanctuary for bull trout, allowing them to quickly rebound from temporary adverse effects to spawning and rearing habitat. For example, if a major wildfire burns a drainage and eliminates most or all aquatic life (a rare occurrence), bull trout sub-adults and adults that survive in the lake may return the following year to repopulate the burned drainage. This underscores the need to maintain migratory life forms and habitat connectivity in order to increase the likelihood of long-term population persistence.

Results of the telemetry studies identified several notable bull trout life history characteristics. Within the Mid-Columbia Basin, bull trout utilized the mainstem Columbia River as a migratory corridor as data indicated that tagged fish passed through the Mid-Columbia projects (BioAnalysts, Inc. 2004). This establishes that bull trout may be in the mainstem Columbia River (i.e., Wells Reservoir) throughout the year.

Within the Wells Project area, the majority of radio-tagged bull trout were destined for the Twisp and Methow rivers located upstream of Wells Dam (86-88%), however some fish also migrated into the Entiat River (10-12%), which is located downstream of Wells Dam. Most of the radio-tagged bull trout passed Wells Dam during the months of May and June (BioAnalysts, Inc. 2004). Adults generally concluded spawning in the Methow by late October; some bull trout were observed returning to Wells Reservoir by mid-December. Bull trout did not select the Okanogan River system in both telemetry studies (one bull trout entered the Okanogan for a short period before leaving to enter the Methow system). PIT tag data from 2004-2011 suggests that only 17% (30 of 177) of Methow Core Area fish use Lake Pateros, and only 2% (3 of 177) use lake Entiat. A similar proportion, 15% (2/13) of radio tagged fish appear to overwinter in Lake Pateros (MCRFRO 2004, see Appendix A).

3.8. Genetic and Phenotypic Diversity

Genetic diversity promotes both short-term fitness of populations and long-term persistence of a species by increasing the likelihood that the species is able to survive changing environmental conditions. This beneficial effect can be displayed both within and among populations. Within a genetically diverse local population of bull trout, different individuals may have various alleles that confer different abilities to survive and reproduce under different environmental conditions (Leary et al. 1993; Spruell et al. 1999; Hard 1995). If environmental conditions change due to natural processes or human activities, different allele combinations already present in the population may be favored, and the population may persist with only a change in allele frequencies. A genetically homogeneous population that has lost variation due to inbreeding or genetic drift may be unable to respond to the environmental change and be extirpated. The prospect of local extirpation highlights the importance of genetic diversity among local populations.

Recolonization of locations where extirpations have occurred may be promoted if immigrants are available that possess alleles that confer an advantage in variable environmental conditions. Extending this reasoning to the entire range of the species, reduction in rangewide genetic diversity of bull trout through the loss of local populations can reduce the species ability to respond to changing conditions, leading to a higher likelihood of extinction (Rieman and McIntyre 1993; Leary et al. 1993; Spruell et al. 1999; Hard 1995; Rieman and Allendorf 2001).

The amount of genetic variation necessary for a population to adapt to a changing environment can be estimated using the concept of effective population size (N_e). Effective population size is the average number of individuals in a population which are assumed to contribute genes equally to the succeeding generation. Effective population size provides a standardized measure of the amount of genetic variation that is likely to be transmitted between generations within a population.

Specific benchmarks for the bull trout have been developed concerning the minimum N_e necessary to maintain genetic variation important for short-term fitness and long-term evolutionary potential. These benchmarks are based on the results of a generalized, age-structured, simulation model, called VORTEX (Miller and Lacy 1999), used to relate effective population size to the number of adult bull trout spawning annually under a range of life histories and environmental conditions (Rieman and Allendorf 2001). Using the estimate that N_e for the bull trout is between 0.5 and 1.0 times the mean number of adults spawning annually, Rieman and Allendorf (2001) concluded that (1) an average of 100 adults spawning each year would be required to minimize risks of inbreeding in a population, and (2) an average of 1,000 adults is necessary to maintain genetic variation important for long-term evolutionary potential. This latter value of 1,000 spawners may also be reached with a collection of local populations among which gene flow occurs.

Bull trout populations tend to show relatively little genetic variation within populations, but substantial divergence among populations (e.g., Spruell *et al.* 2003). For example, Spruell *et al.* (1999) found that bull trout at five different spawning sites within a tributary drainage of Lake Pend Oreille, Idaho, were differentiated based on genetic analyses (microsatellite DNA), indicating fidelity to spawning sites and relatively low rates of gene flow among sites. This type of genetic structuring indicates limited gene flow among bull trout populations, which may encourage local adaptation within individual populations (Spruell *et al.* 1999; Healey and Prince 1995; Hard 1995; Rieman and McIntyre 1993). However, more recent genetic analysis obtaining samples from across the Pacific Northwest Coterminous suggested that 2-69 genetic assemblages exist. Conclusive population segmentations appear to occur between costal populations of bull trout and those east of the Cascade divide (Arden *et al.* 2011). To date, local populations in the Wenatchee, Entiat and Methow River Core Areas have not been identified using non-genetic methods.

Current information on the distribution of genetic diversity within and among bull trout populations is based on molecular characteristics of individual genes. While such analyses are extremely useful, they may not reflect variability in traits whose expression is dependent on interactions among many genes and the environment (Hard 1995, Reed and Frankham 2001; but see Pfrender *et al.* 2000). Therefore, the maintenance of phenotypic variability (e.g., variability in body size and form, foraging efficiency, and timing of migrations, spawning, and maturation) may be best achieved by conserving populations, their habitats, and opportunities for the species to take advantage of habitat diversity (Healey and Prince 1995; Hard 1995).

Local adaptation may be extensive in bull trout because populations experience a wide variety of environmental conditions across the species' distribution, and because populations exhibit considerable genetic differentiation. Thus, conserving many populations across their range is essential to adequately protect the genetic and phenotypic diversity of bull trout (Hard 1995; Healey and Prince 1995; Taylor *et al.*1999; Rieman and McIntyre 1993; Spruell et al. 1999; Leary et al. 1993; Rieman and Allendorf 2001). If genetic and phenotypic diversity is lost, changes in habitats and prevailing environmental conditions could increase the likelihood of bull trout suffering reductions in numbers, reproductive capacity, and distribution.

Based on this information about the life history and conservation needs of bull trout, the Service concludes that each subpopulation or local population is an important genetic, phenotypic, and geographic component of its respective DPS/interim recovery unit. Adverse effects that compromise the persistence of a bull trout subpopulation or local population can reduce the distribution, as well as the phenotypic and genetic diversity of the DPS/interim recovery unit.

3.9. Global Climate Change

Global climate change has the potential to affect the baseline condition of bull trout habitat at all scales from the coterminous U.S. to the sub-watershed and action area. Available evidence also indicates climate change effects are reasonably certain to continue into the foreseeable future. Consequently, climate change could be addressed under multiple headings in this BO (e.g., rangewide status of the species, environmental baseline, and cumulative effects). Rather than dispersing our discussion of this important topic throughout the BO, we consolidate in this section our consideration of how climate change may alter baseline conditions across multiple scales through time.

Climate change is one of the most significant ongoing effects to baseline conditions for bull trout and their associated aquatic habitat throughout the state of Washington. Climate change, and the related warming of global climate, has been well-documented in the scientific literature (Bates *et al.* 2008; ISAB 2007). Evidence includes increases in average air and ocean temperatures, widespread melting of snow and glaciers, and rising sea level. Given the increasing certainty that climate change is occurring and is accelerating (Bates *et al.* 2008; Battin *et al.* 2007), we can no longer assume that climate conditions in the future will resemble those in the past.

Climate change has the potential to profoundly alter the aquatic habitat through both direct and indirect effects (Bisson *et al.* 2003). Direct effects are evident in alterations of water yield, peak flows, and stream temperature. Some climate models predict 10 to 25 percent reductions in late spring, summer, and early fall runoff amounts in coming decades. Indirect effects, such as increased vulnerability to catastrophic wildfires, occur as climate change alters the structure and distribution of forest and aquatic systems. Observations of the direct and indirect effects of global climate change include changes in species ranges and a wide array of environmental trends (ISAB 2007; Hari *et al.* 2006; Rieman *et al.* 2007). In the northern hemisphere, ice-cover durations over lakes and rivers have decreased by almost 20 days since the mid-1800s (WWF 2003). For cold-water associated salmonids in mountainous regions, where upper distribution is often limited by impassable barriers, an upward thermal shift in suitable habitat can result in a reduction in size of suitable habitat patches and loss of connectivity among patches, which in turn can lead to a population decline (Hari *et al*. 2006; Rieman *et al.* 2007).

Climate change is already affecting the frequency and magnitude of fires, especially in the warmer, drier regions of the west. To further complicate our understanding of these effects, the forest that naturally occurred in a particular region may or may not be the forest that will be responding to the fire regimes of an altered climate (Bisson et al. 2003). In several studies related to the effect of large fires on bull trout populations, bull trout appear to have adapted to past fire disturbances through mechanisms such as dispersal and plasticity. However, as stated earlier, the future may well be different than the past and extreme fire events may have a dramatic effect on bull trout and other aquatic species, especially in the context of continued habitat loss, simplification and fragmentation of aquatic systems, and the introduction and expansion of exotic species (Bisson *et al.* 2003).

In the Pacific Northwest, most models project warmer air temperatures and increases in winter precipitation and decreases in summer precipitation. Warmer temperatures will lead to more precipitation falling as rain rather than snow. As the snow pack diminishes, stream flow timing will change, and peak flows will likely increase in volume. Higher ambient air temperatures will likely cause water temperatures to rise (ISAB 2007). Data from long-term stream monitoring stations in western Washington indicate a marked increasing trend in temperatures in most major rivers over the past 25 years (WDOE 2002).

There is still a great deal of uncertainty associated with predictions of timing, location, and magnitude of climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007). Research indicates that temperatures in many areas will continue to increase due to the effects of global climate change. According to model predictions, average temperatures in Washington State are likely to increase between 1.7 °C and 2.9 °C (3.1 °F and 5.3 °F) by 2040 (Casola *et al.* 2005).

Bull trout rely on cold water throughout their various life stages and increasing air temperatures likely will cause a reduction in the availability of suitable cold water habitat. For example, ground water temperature is generally correlated with mean annual air temperature and has been shown to strongly influence the distribution of char species. Groundwater temperature can also be linked to bull trout selection of spawning sites and has been shown to influence the survival of embryos and early juvenile rearing of bull trout (Rieman *et al.* 2007). Increases in air temperature are likely to be reflected in increases in both surface and groundwater temperatures.

Migratory bull trout can be found in lakes, large rivers and marine waters. Effects of climate change on lakes are likely to impact migratory adfluvial bull trout that seasonally rely upon lakes for their greater availability of prey and access to tributaries. Climate-related warming of lakes will likely lead to longer periods of thermal stratification, forcing coldwater fish such as bull trout to be restricted to the bottom layers for greater periods of time. Deeper thermoclines resulting from climate change may further reduce the area of suitable temperatures in the deeper depths of lakes and intensify competition for food (WWF 2003).

Bull trout require very cold water for spawning and incubation. Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers. However, impacts on hydrology associated with climate change will cause shifts in timing, magnitude, and distribution of peak flows that are also likely to be most pronounced in these high elevation stream basins (Battin *et al.* 2007). The increased magnitude of winter peak flows in high elevation areas is likely to affect spawning and incubation habitat for bull trout and Pacific salmon. Although lower elevation rivers are not expected to experience as severe an impact from alterations in stream hydrology, they are generally not cold enough for bull trout spawning, incubation, and juvenile rearing.

As climate change progresses and stream temperatures warm, thermal refugia will be critical to ensure the persistence of bull trout and other species dependent on cold water. Thermal refugia are important for providing bull trout with patches of suitable habitat while allowing them to migrate through, or to make foraging forays into, areas with above optimal temperatures. Juvenile rearing may also occur in waters that are at or above optimal temperature, but these rearing areas are usually in close proximity to colder tributaries or other areas of cold water refugia (USEPA 2003).

Climate change is and will be an important factor affecting bull trout distribution and population dynamics. As distribution contracts, patch size decreases and connectivity is truncated; populations that are currently connected may become thermally isolated, which could accelerate the rate of local extinction beyond that resulting from changes in stream temperature alone (Rieman *et al.* 2007). In areas with already degraded water temperatures or where bull trout are at the southern edge of their range, they may already be at risk of impacts from current as well as future climate change. As these trends continue, the conservation role of bull trout populations in headwaters habitats may become more significant. Long-term persistence of bull trout.may only be possible in these headwater areas that provide the only suitable habitat refugia.

While we expect future climate change impacts to occur to bull trout and its designated critical habitat, the scope of this analysis (considering the proposed action) is limited to what we can reasonably predict. We can speculate the frequency of rain-on snow event may increase with warmer air temperatures, or that overall water temperatures may increase (which may cause additional impacts in lower Icicle Creek), or Spring run-off may occur earlier (which may cause the upstream migration period of bull trout to occur earlier). While these general expectations seem fairly reasonable, we lack the precision to predict the likelihood, frequency, duration, or magnitude of these events (and their effects) at the action area scale. Most climate modeling is conducted at much larger scales, either continental or sometimes regionally. As a result, the impacts of climate change may best be addressed through our evaluation of the Environmental Baseline (for future section 7(a)(2) analyses) and reinitiation of existing consultations to address changed conditions. Until our ability to predict climate change impacts at smaller scales improves, we must rely on methodologies that provide outputs of what is reasonable certain to occur. Some listing and recovery actions (including 5-year reviews and recovery planning) may be better analyses to capture broader trends in climate change.

3.10. Consulted-on Effects

Projects subject to section 7 consultation under the ESA have occurred throughout the range of the bull trout. From the time of its listing in June of 1998 until August of 2003, the Service issued 137 biological opinions that address the effects of various Federal actions on the bull trout. All of these opinions included a determination that the proposed Federal action was not likely to jeopardize the continued existence of the bull trout, based on consideration of the range-wide and action area conditions and conservation needs of the bull trout, the effects of the action and any cumulative effects in the action area. An assessment of these actions is described in the Service's biological opinion for the Rock Creek Mine in Montana prepared by our Region 6 office (USFWS 2006a); this document is herein incorporated by reference.

The 137 biological opinions referenced above involve 24 different activity types (e.g., grazing, road maintenance, habitat restoration, timber sales, hydropower, etc.); 20 of these opinions involved multiple projects, including restoration actions for the bull trout. The geographic scale of projects analyzed in these biological opinions varied from individual actions (e.g., construction of a bridge or pipeline) within one basin, to multiple-project actions, occurring across several basins. Some large-scale projects affected more than one DPS/interim recovery unit of the bull trout. Overall, 124 of the 137 biological opinions (91 percent) applied to activities affecting bull trout in the Columbia River Basin interim recovery unit, 12 (9 percent) applied to activities affecting bull trout in the Coastal-Puget Sound unit, 7 (5 percent) applied to activities affecting bull trout in the Klamath River unit, and 1 (less than 1 percent) applied to activities affecting the Jarbidge and St. Mary Belly units.

For each of the 137 actions considered in the above biological opinions, the causes of adverse and any beneficial effects were identified as were the anticipated consequences for spawning streams and/or migratory corridors, if possible (in most cases, these consequences were known).

Actions whose effects were "unquantifiable" numbered 55 in migratory corridors and 55 in spawning streams. The Service also attempted to define the duration of anticipated effects (e.g., "short-term effects" varied from hours to several months) for each action.

Between August 2003 and July 2006, the Service issued 198 additional biological opinions on the effects of proposed Federal actions on the bull trout. All of these opinions included a determination that the proposed Federal action was not likely to jeopardize the continued existence of the bull trout, based on consideration of the range-wide and action area conditions and conservation needs of the bull trout, the effects of the action and any cumulative effects in the action area. Since July 2006, a review of the data in our national Tracking and Integrated Logging System (TAILS) reveal this trend has held true to date; no jeopardy opinions have been issued for the bull trout. Also, the Service has developed the Consulted-on Effects Database (COED), an internal online electronic effects and take data collection, storage and retrieval system for bull trout. This will provide a powerful tool to assess the rangewide status of bull trout; the COED system is currently being populated with detailed effects and take data from past Federal consultations and is scheduled for full implementation in 2012.

4.0 STATUS OF BULL TROUT CRITICAL HABITAT

This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat within 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act and the August 6, 2004, Ninth Circuit Court of Appeals decision in Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service (No. 03-35279) to complete the following analysis with respect to critical habitat.

Critical habitat is defined in section 3(5) (A) of the Act as "the specific area within the geographic area occupied by the species on which are found those physical or biological features essential to the conservation of the species, and that may require special management considerations or protection, and specific areas outside the geographical area occupied by a species at the time it is listed, upon determination that such areas are essential for the conservation of the species." The Act defines conservation as the procedures necessary to bring about the eventual recovery and delisting of a listed species.

4.1 Legal Status and History

The Service published a final critical habitat designation for the coterminous United States population of the bull trout on October 18, 2010 (70 FR 63898), replacing the previous final critical habitat designation published in 2005; the 2010 final 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 U.S. range, as listed on November 1, 1999 (50 FR 63898), which includes the Jarbidge River, Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River interim recovery units (previously known as distinct population segments)[1]. Rangewide, the Service designated critical habitat in five states in a combination of reservoirs/lakes and streams/shoreline (Table 8). Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing (SR), and 2) foraging, migration, and overwintering (FMO). Some critical habitat is unoccupied and is designated to provide for connectivity or for potential local populations as described in the Services draft recovery plan.

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.

The 2010 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

[1] The Service's 1999 coterminous listing rule (50 CFR Part 17, pg. 58910) and five year review (USFWS 2008a, pg. 9) identified six draft recovery units. Until the bull trout draft recovery plan is finalized, the current five interim recovery units will be used for purposes of section 7 jeopardy analysis and recovery planning. The adverse modification analysis does not rely on recovery units but on the newly listed critical habitat and its units/subunits and waterbodies.

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.

Table 2. 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

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 low 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.

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 9 and 10 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 3.—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
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 4. 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

4.2 Primary Constituent Elements for Bull Trout

Within the designated critical habitat areas, the PCEs for bull trout critical habitat are those physical and biological features 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 the bull trout 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.
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.

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, PCE 6 does not apply to FMO habitat designated as critical habitat. Also, although PCE 9 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.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to "destroy or adversely modify" critical habitat to an extent that it no longer serves the intended conservation role for the species nor retains the function of those PCEs that relate to the ability of the area to 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; USFWS 2004d, Vol. 1. pp. 140-193, Vol. 2. pp. 69-114).

4.3. 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). 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. The 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 and 78 associated subunits within the geographical area occupied by bull trout at the time of listing are designated under the 2010 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.

The primary function of individual CHUs and subunits 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 and, in part, provide habitat conditions that encourage movement of migratory fish (MBTSG 1998, pp. 48-49; Rieman and McIntyre 1993, pp. 22-23); 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; MBTSG 1998, pp. 48-49; Rieman and McIntyre 1993, pp. 22-23); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Hard 1995, pp. 321-322; MBTSG 1998, pp. 13-16; Rieman and Allendorf 2001, p. 763; Rieman and McIntyre 1993, p. 23).

To determine what should be designated as critical habitat for bull trout, the Service identified specific areas that contain the physical and biological features essential to bull trout conservation, considering distribution, abundance, trend, and connectivity needs. The objective was to ensure the areas designated as critical habitat would effectively serve the following recovery goals:

- Conserve opportunity for diverse life-history expression
- Conserve opportunity for genetic diversity
- Ensure bull trout are distributed across representative habitats
- Ensure sufficient connectivity among populations
- Ensure sufficient habitat to support population viability (e.g. abundance, trends)
- Consider threats to the species
- Ensure sufficient redundancy in conserving population units

The Bull Trout Final Critical Habitat Justification document (USFWS 2010a) provides the rationale for the designation of areas to meet the conservation needs of bull trout, including the uniqueness of some CHUs. For example, the Olympic Peninsula and Puget Sound CHUs are the only CHUs that support amphidromous[2] bull trout and are unique to the Coastal-Puget Sound population segment. These two CHUs contain marine nearshore and freshwater habitats, outside of core areas, that are used by bull trout that seasonally migrate from one or more core areas. These habitats contain physical and biological features that are critical to adult and subadult foraging, overwintering, and migration, and are essential for the conservation of this unique life history.

<u>Activities that May Affect PCEs</u>

The final rule (75 FR 63898) states that "A variety of ongoing or proposed activities that disturb or remove primary constituent elements may adversely affect, though not necessarily 'adversely

[2] Amphidromous species leave the marine environment and return seasonally to fresh water as subadults, sometimes for several years, before returning to spawn (Brenkman and Corbett, 2005, p. 1075).

modify' bull trout critical habitat as that term is used in section 7 consultations." Actions that may destroy or impact critical habitat could occur within the waterbody and/or on lands adjacent to or upstream of waterbodies designated as critical habitat. Activities that have been identified as directly and/or indirectly affecting bull trout critical habitat PCEs include but are not limited to the following: mining, agriculture, grazing, water use, flood control, bank stabilization and other instream construction work, recreation, transportation development, road maintenance, timber harvest, dams, and the introductions of nonnative invasive. These activities may affect bull trout critical habitat by altering the water chemistry, creating instream barriers (both permanent and temporary), increasing water temperature, reducing the food base, and precluding natural stream and hydrologic functions.

4.4 Current Critical Habitat Condition Rangewide

Although still relatively widely distributed across its historic range, bull trout occur in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). The condition of bull trout critical habitat varies from good to poor across its range. 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 and 64 FR 17112).

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.

4.5 Effects of Climate Change on Bull Trout Critical Habitat

One objective of the final rule designating critical habitat for the bull trout 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). For additional information, see the previously described Status of the Species (Section *I. Global Climate Change*).

4.6. 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. For additional information, see the previously described Status of the Species (Section *J. Consulted-on Effects*). Although the Status of the Species describes effects over somewhat different areas and time periods than critical habitat (due to the differences in the scope of various final rules for critical habitat as compared to the coterminous listing of bull trout), the Status of the Species characterization should provide an indication of the overall rangewide condition for critical habitat. A more precise assessment of the rangewide baseline and effects is forthcoming through the Service's COED database.

5.0 ENVIRONMENTAL BASELINE

Regulations implementing the Act (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 these consultations. This section analyzes the current condition of the bull trout in the action area, the factors responsible for that condition, and the intended role of the action area in the conservation of the Columbia River interim recovery unit.

Characterizing the environmental baseline for highly mobile species requires a multi-scale analysis that evaluates the condition of all areas used by the affected population. The population of bull trout found in the action area of a project often inhabits a much larger area through the course of its life cycle. For example, bull trout often migrate over 100 km between spawning and overwintering habitat. For bull trout, the Service primarily considers two different spatial scales: (1) the watershed or specific reaches in a watershed affected by the proposed project, and (2) the "core area" scale, which typically incorporates multiple watersheds occupied by separate, but potentially interacting, local populations of bull trout. The watershed or reach scale is used to characterize habitat conditions in the vicinity of the proposed action. The condition of habitat at this scale is evaluated in terms of habitat indicators in the Matrix of Pathways and Indicators (USFWS 1999d). The condition of bull trout metapopulations at the core area scale is evaluated in terms of "subpopulation" indicators in the Matrix of Pathways and Indicators (USFWS 1999d). The Service uses these hierarchial scales to structure its evaluation of baseline condition as well as its subsequent analysis of project effects and jeopardy analysis.

The action area is located in the Columbia River, which is a migratory corridor for the upper Columbia River management unit. The Entiat core area is the closest core area to the action area, and based on radio telemetry studies (BioAnalysts, Inc. 2004, Nelson and Nelle 2008; LGL and Douglas PUD 2008) it contributes the majority of the bull trout to this portion of the Columbia River (86-88% of the fish detected at Wells dam used the Methow tributary). Baseline conditions for the Entiat and Wenatchee are also described since bull trout within the action area originated from these core areas as well (10-12 and 0-4% respectively, see Appendix A). Baseline conditions for the Methow and Wenatchee are also described since bull trout within the action area originated from these core areas as well. Habitat conditions within these three core areas will be impacted by the proposed action through the implementation of the Tributary Conservation Plan and the proposed Douglas PUD Land Use Policy.

5.1 Bull Trout

Three life history forms (adfluvial, fluvial, and resident) are known to occur in the action area. The Action Area, as described in Section 1.2, encompasses a portion of bull trout foraging, migratory, and overwintering (FMO) habitat in the mainstem Columbia River, and spawning, rearing, and FMO habitat within the Wenatchee, Entiat, Methow, and Yakima River basin core areas of the bull trout.

5.1.1 *Status of the Bull Trout in Mainstem Columbia River FMO Habitat*

Current bull trout presence in the mainstem Columbia River may reflect the strength of the local populations within tributaries and the presence of suitable migration corridors between the tributaries and the Columbia River. For example, bull trout occur in greatest numbers in the upper Columbia River where populations are larger and suitable habitat conditions for migration exist in the lower reaches of tributaries (Methow, Entiat, and Wenatchee Rivers). There are fewer occurrences of bull trout in the Columbia River where poorer habitat conditions in tributaries have fragmented migration corridors or reduced populations (Yakima, Walla Walla, Umatilla, and John Day Rivers). Greater bull trout use of the mainstem Columbia River would be expected if habitat conditions improve and populations increase in these tributaries. Upstream passage, in the form of fishways or ladders constructed for salmon, allows bull trout to migrate upstream past dam facilities. Downstream passage through dam facilities occurs through the turbines, spillways, and juvenile bypass systems. Currently, within the action area there are three juvenile fish bypass systems of differing configurations that are constructed and operating specifically for salmon and steelhead, and may also provide for bull trout. These systems are located at the Wells, Rocky Reach, and Wanapum, hydroelectric projects.

Bull trout have been documented both upstream and downstream of the Project in the mainstem Columbia River, including Chief Joseph, Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids reservoirs and forebays. Current information also suggests the presence of bull trout in the Hanford Reach of the Columbia River, located downstream of the Project (Gray and Dauble 1977 and Pfeifer et al. 2001). They have been observed upstream of the Project in the mainstem Columbia River near Chief Joseph Dam (T. McCracken, Service, 2006, pers. comm.).

5.1.1.1 Juvenile Bull Trout Abundance in the Mainstem Columbia River

Downstream passage of juvenile anadromous fish at dams occurs through juvenile fish passage facilities, by spilling water over dam spillways, or traveling through the powerhouse turbines. Migratory sized bull trout are observed each year using the adult fish passage facilities to pass the Rocky Reach, Rock Island, and Wells dams (Appendix a). Despite observations of juvenile bull trout at lower river project, juveniles have not been observed at Wells Dam. Juvenile bull trout have been infrequently observed in the juvenile sampling facilities at these dams as well. Bull trout were sampled in the Rocky Reach Dam prototype juvenile bypass collector in 1998, 1999, 2000, 2001, and 2002, with 23, 30, 8, 4, and 5 fish observed, respectively (Service 2004a). In 2003, no juvenile bull trout were sampled at the new Rocky Reach Dam juvenile collector sampling facility. Length measurements were not taken on these fish; however, anecdotal information from sampling facility personnel indicated that most were juvenile or sub-adult fish. Facility personnel could recall observing only two or three adult bull trout in the sampling facility during all years of prototype operation (S. Hemstrom, CPUD, pers. comm., 2003). Juvenile fish sampling in 2003 occurred for only 2 hours (8-10 am) each day, and also in the evening (4-6 pm and 7 to 9 pm) one day per week. It is probable that some juvenile and adult bull trout pass undetected at night during periods when the sampling facility is not operating. More recently, one juvenile bull trout has been observed in the juvenile fish bypass system at Rocky Reach each year from 2005-2007 (BioAnalysts, Inc. 2004, 2006, 2007, and 2008). This bypass will be used in future years to collect juvenile salmon (sockeye, spring Chinook, summer/fall Chinook) and steelhead to conduct juvenile fish passage studies for passage efficiency and survival at Rocky Reach and Rock Island dams. Study fish are captured at the juvenile collection facility during index sampling periods (normally two hours, Monday-Friday 0800 to 1000 hours), or until 1,500 fish are collected, whichever comes first. In addition, sampling is conducted in the evenings (from 1400 to 1600, and 1900 to 2100 hours) once each week to assess how well the morning sampling period represents the migration timing. Juvenile bull trout may be captured during periods when study fish are being collected.

Numbers of bull trout captured at the Rock Island Bypass smolt trapping facility from 1997 through 2006 were 2, 7, 14, 1, 8, and 8, 2, 3, and 5 respectively (www.fpc.org, Service 2004a). From 1998-2006 there were a total of 18 juvenile bull trout (when only including actual juvenile data) captured at the Rock Island Dam smolt trap facility generally between June-August. No juvenile bull trout were captured in the Rock Island Juvenile Bypass trap in 2003 (L. Praye, WDFW, pers. comm., 2003). Additionally, between 1998 and 2007 there were an additional 30 bull trout observed generally between May-August (the size was not determined) at the Rock Island Bypass smolt trap facility. We assume that since adult bull trout are generally identified that these fish were either juvenile or sub-adult bull trout. Most of the bull trout captured at the Rock Island smolt bypass are small bull trout. Some mortality of juvenile salmon and steelhead occurs with the operation of the Rock Island bypass.

For the purposes of this analysis, we will assume a survival rate of 98-99% for juvenile and sub-adult bull trout passing through the Wells bypass system. These levels of survival are based upon rates of survival observed for salmon and steelhead passing through surface collection bypass systems found at other Columbia and Snake river dams (NMFS 2003).

The number of juvenile bull trout captured in the Carlton screw trap on the Methow River has ranged from 0-6 fish for a mean of less than two subadults a year for the years 2005-2011. Subadults are captured more fervently in the Twisp River screw trap for an average annual capture count of 25 annually (range 10-50) over the same 6 year period (Figure 5.1-1). Low counts in the Methow may suggest that sub-adults use higher elevation habitats in the Methow Core Population, rather than emigrating to the Columbia or Lake Pateros. This hypothesis appears to be supported by much larger counts in the Twisp River.

Although observations of juvenile and sub-adult fish have not occurred at Wells dam, adult fish pass Wells in the month of May and June (90%). Adult counts occur year round at Wells dam. Since 1998 to 2011 adult bull trout counts at Wells dam have ranged between 17-108 fish, with the 13 year average being 61 fish and the most recent ten year average being slightly higher at 63 fish (Appendix A). This data is summarized and provided to FPC and FERC on an annual basis.

Additionally, juvenile bull trout were observed at other smolt trapping facilities and adult ladders on the mainstem Columbia River. For example, there was one juvenile bull trout observed at McNary Dam in December of 2004 and an additional juvenile bull trout at Bonneville Dam in Powerhouse 2 at the smolt trapping facility in March of 2005. BioAnalysts, Inc. 2004, 2006, 2007, and 2008 also reported that 24, 17, 15, and 5 juvenile bull trout were observed passing upstream through the adult fishway at Rocky Reach Dam from April 14-November 1 for each year from 2006-2007, respectively. Observations of adult and juvenile bull trout within close proximity of fishway maintenance periods at Rocky Reach Dam have been noted as well. BioAnalysts, Inc. 2006 observed 1 adult bull trout at Rocky Reach dam in 2005 ascending the ladders in 2005 (November 15-December 4). BioAnalysts, Inc. (2007) reported one juvenile bull trout in the early season just following fishway maintenance on February 7, 2006 and 35 sub-adults that ascended the during the fall season (November 15-December 4th, 2006) typically when ladders would be shut off for maintenance activities. This is the highest recorded number for annual juvenile use of upstream fishways/ladders recorded at Rocky Reach and in the Mid-Columbia area.

Numbers of juvenile bull trout have been collected from 1997-2006 at screw traps, during downstream movements within the Methow, Entiat, and Wenatchee Rivers for multiple years. There has been some information collected in the Yakima River and in the N. Fork Teanaway River in multiple years during downstream monitoring as well. In the Wenatchee Basin, average numbers of juvenile bull trout collected at the screw traps are 302 in the Chiwawa River with a range of 76-605 juveniles, 4 in Nason Creek with a range of 0-13 juveniles, 2 in the Lake Wenatchee outlet with a range of 0-5 juveniles, 106 in Peshastin Creek with a range of 99-112, and 2 in the Wenatchee River at Monitor with a range of 0-4. The screw trap at Monitor on the Wenatchee River is the furthest downstream location in the Wenatchee River, and it is likely that these fish travel downstream to the Columbia River for feeding opportunities and overwintering conditions.

One screw trap in the lower part of the Entiat River averaged 15 juvenile bull trout captured, but has had as many as 38 captured (www.cbr.washington.edu/dart/dart.html). All of these juveniles are expected to migrate out of the Entiat and into the FMO habitat in the Columbia River because of the increased feeding and high quality overwinter habitat there.

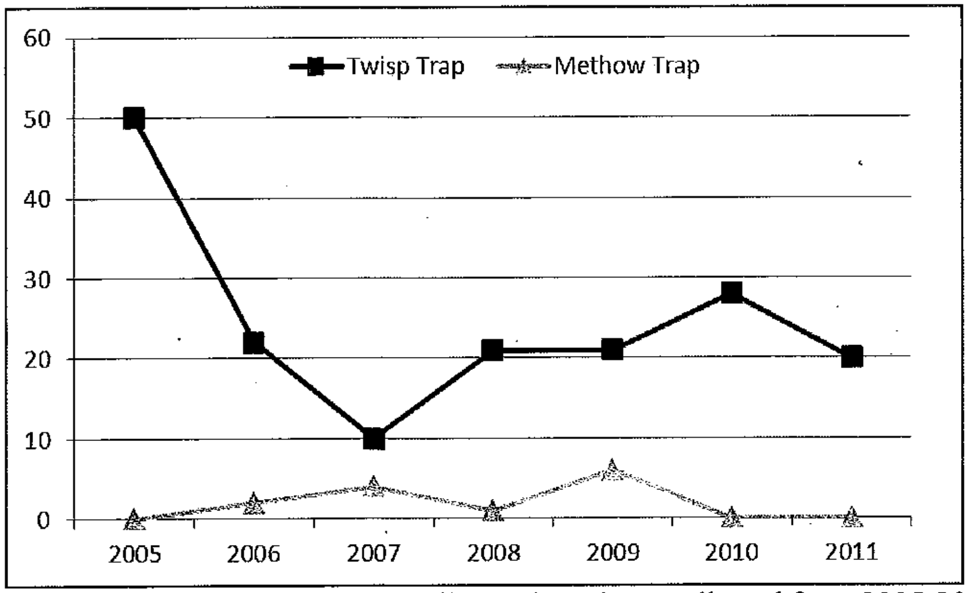


Figure 3. Numbers of juvenile bull trout have been collected from 2005-2011 at screw traps, during downstream movements within the Methow.

Not all screw trap data is collected year round or similarly. Not all bull trout that could be passing downstream are collected at these traps because not all of the water goes through them. Some screw traps are located in places that may not be conducive to the collection of bull trout which are stream bottom oriented, as compared to other salmonids. Depending on geology and flow conditions, the traps may be located in a portion of the channel that bull trout do not use. Traps are also shut down for safety in high flows during the spring or fall. Little correction factors are available for the quality of the screw trap data for bull trout. However, the Service believes that information likely represents the minimum number of bull trout moving downstream into the mainstem Columbia River.

There are also some data available on juvenile bull trout in the N. Fork Teanaway Basin. Three bull trout juveniles were counted in a panel weir in Jungle and Jack Creeks and one bull trout juvenile counted in a fyke net in the N. Fork Teanaway (Pearsons et al. 1998).

In summary, we estimate that annually 76 adult and 31 juvenile and sub-adult bull trout use the Wells Reservoir (see Appendix A). BioAnalysts, Inc. has data which seems to suggest that about 30% of adult bull trout used multiple core areas for some portion of their life history, and 10% appeared to spawn in different core areas in succeeding years (BioAnalysts, Inc. 2004; LGL and Douglas PUD 2008)

5.1.1.2 Sub Adult Bull Trout Abundance in the Mainstem Columbia River and at Project Facilities

Bull trout have not been consistently accounted for in terms of their life history stage. They may have been counted as being juveniles, sub-adults, or adults during upstream passage events at the Project as well as downstream at the Rock Island Project. Also, see the juvenile discussion in the paragraphs above. However, data described in visual evaluations of fishway counts suggest that some individual bull trout fit into the sub-adult age class category (BioAnalysts, Inc. 2004). These individuals have typically migrated upstream through the aforementioned projects from April through July. Other information gathered at hydroelectric projects further downstream from the Project, in the mainstem Columbia River, indicates sub-adult use the mainstem Columbia River. These individuals have typically migrated upstream through the aforementioned projects from April through July.

Public Utility District No. 2 of Grant County (Grant PUD), owner and operator of the Priest Rapids and Wanapum dams, conducted a multi-gear, multi-season sampling effort over numerous habitat types in 1999 for the purpose of relicensing its dams. This evaluation suggests infrequent bull trout use within close proximity of the Priest Rapids and Wanapum dams (Pfeifer *et al.* 2001). Only 2 sub-adult bull trout were captured during this effort.

Other data indicate that bull trout use of the Priest Rapids and Wanapum fishways is limited at this time. Grant PUD conducts regular operations to remove fish collected within gatewells at both the Wanapum and Priest Rapids dams during the juvenile salmonid outmigration. During these activities, no bull trout have been observed at Priest Rapids Dam. During similar gatewell operations at Wanapum Dam for the period of 1997-2003, only 3 bull trout have been observed (1 in each of the years 1998, 1999, and 2000).

5.1.1.3 Adult Bull Trout Abundance in Fish Ladder Passage Counts and Smolt Trap Monitoring Systems in the Mainstem Columbia River

Bull trout are routinely observed and counted by Chelan and Douglas PUD employees while the fish are passing through the fish ladders at the Rock Island, Rocky Reach, and Wells projects (Service 2004a) (Table 1). Before the installation of computer video-monitoring, bull trout were documented by direct observation at fish ladder windows. Since 1992, fish have been counted using round-the-clock computer video recordings during adult salmon passage periods. Counts prior to 1998 did not differentiate bull trout from other trout. Chelan and Douglas PUDs, owners and operators of the Rock Island, Rocky Reach, and Wells hydroelectric projects, began to enumerate bull trout using the adult passage facilities in 1998. With the new license issued the Priest Rapids Hydroelectric Project, bull trout will be monitored regularly at the Priest Rapids and Wanapum dams in accordance with the terms and conditions outlined in the Service's March 14, 2006 Biological Opinion. Bull trout will also be monitored regularly at the Rocky Reach Hydroelectric Project in accordance with the terms and conditions outlined in the Service's December 5, 2008 Biological Opinion.

Table 5 **Tabulated Summary of Bull Trout Passage Up Adult Fish Ladders at Three Mid-Columbia Projects (FPC.org).**

Count	Rocky Reach	Rocky Island	**Wells**
1998	83	67	**17**
1999	128	61	**49**
2000	216	87	**93**

2001	204	82	**108**
2002	194	84	**76**
2003	246	102	**53**
2004	161	114	**47**
2005	155	69	**49**
2006	142	35	**100**
2007	77	46	**65**
2008	100	36	**43**
2009	83	60	**43**
2010	124	53	**44**
2011	168	49	**66**
13 Year Average	148.6	67.5	**60.9**
10 Year Average	150.4	66.4	**63.1**

5.1.1.4 Rock Island

Generally, fewer bull trout are observed at Rock Island Dam each year compared with Rocky Reach Dam. In 1998, 1999, 2000, and 2001, the numbers of bull trout observed at Rock Island were 48, 56, and 88, and 82, respectively for these years (Chelan PUD 2002 unpublished data and http://wwwcbr.washington.edu/dart/adult.html). Between 55 and 70% of the fish that passed Rock Island Dam in those years did so in May and June. In 2002, 87 bull trout passed Rock Island Dam from April 14 to November 14; most of these fish passed in May and June (75%). From April 14 to September 3, 2003, 77 bull trout passed Rock Island Dam, 55 of those during May and June. Between the years of 2004-2007 a total of 114, 69, 35, and 46 bull trout, respectively passed Rock Island Dam, most in May through August. For most years, the counting period was limited to 3 to 8 months. More recently, counting may occur for up to 10 months of a year. BioAnalysts, Inc. (2006) observed one adult bull trout ascend Rock Island fishway in the fall (Nov. 15th-December 31st) of 2005, when ladders are typically shut down for maintenance activities. In 2009-2010, 60 and 53 bull trout passed upstream of Rock Island dam from June 5 to August 7, respectively. In 2011, 49 bull trout were observed at Rock Island Dam.

In addition, adult bull trout are also counted in the mainstem Columbia River at the Rock Island smolt trapping facilities. There were 8 adults observed from 1998-2006 in the smolt trapping facilities at Rock Island Dam. Bull trout are also seen at other smolt trapping facilities in the mainstem Columbia and other tributaries (Rock Island, Snake, Grand Rhonde, John Day, etc.).

5.1.1.5 Rocky Reach

Bull trout utilization of Rocky Reach's fishways and associated facilities has been documented for several years. A total of 83 bull trout passed Rocky Reach Dam between May 3 and July 31in 1998 (Chelan PUD 2002 unpublished data and http://wwwcbr.washington.edu/dart/adult.html). In 1999, from May 10 to November 14, 128 bull trout passed the project. In 2000, 2001, and 2002, counts of bull trout using the fish ladder from April 20 to November 14 were 216, 204, and 201, respectively. More than 80% of bull trout passage for these years occurred from May 1 to July 31. In 2003 (April 14 to September 3), 206 bull trout passed Rocky Reach Dam. Between 2004 and 2006 a total of 161, 155, and 132 bull trout, respectively passed Rocky Reach Dam, with most between May and August. In 2009-2010, 83 and 124 bull trout passed upstream of Rocky Reach Dam from June 5 to August 7, respectively. In all years on record, the majority of the bull trout passed the Project in May and June (75 to 90%). Although the extent of information denoting bull trout passage at other times of the year is limited at this time, some bull trout do use fish ladder facilities to pass the facilities in September, October, and November (Service 2004a and www.cbr.washington.edu/dart/dart.html). Fish counting ends around November 15 each year. For most years, the counting period was limited to 3 to 8 months. More recently, counting may occur for up to 10 months of a year. For example, Chelan PUD has been an active participant in extending the counting period at the Rocky Reach Project to account for additional bull trout upstream passage that occurs outside the typical salmonid timeframe. In 2003, 2004, 2005, 2006, and 2007, counts of bull trout using the upstream fishway during this timeframe at Rocky Reach Dam were 31, 7, 2, 35, and 0 for these years. (BioAnalysts, Inc. 2004, 2006, 2007, and 2008). A majority of these individuals were encountered during the months of November and December with a lower percentage noted during January and February. These fish were predominantly classified as adults in the over 12-inch size category. A lower percentage were either classified as juveniles or sub-adults in the under 12-inch size category (Steve Hemstrom, pers. comm. 2007). Bull trout have also been documented to have passed downstream through Rocky Reach's juvenile fish bypass system, powerhouse, and spillways (BioAnalysts, Inc. 2004, 2006, 2007, and 2008).

5.1.1.6 Wells Dam

Upstream passage of bull trout at Wells Dam has also been documented for several years. At the Wells Dam upstream fishway, counts of bull trout passing the dam began in 1998. Data from 1998-2011, indicate that 17 to 108 (fpc.org) pass the dam through the upstream fishway in any given year; most pass through the upstream fishway in May and June. An average of 61 adult bull trout have been counted at Wells dam over the last 13 years with the more recent 10 year average being slightly larger at 63 adult bull trout observed annually (2001-2011). In accordance with the portion of the Service's 2004 Biological Opinion addressing the Wells AFA/HCP, off-season fishway passage of adult and juvenile bull trout have been monitored at Wells Dam. Off-season video monitoring of both Wells Dam fishways winter period began on November 16, 2004 and continues today. During this period no adult bull trout have been observed utilizing the fishways (LGL 2006). To date no, juvenile bull trout appear to use this project's fishways (LGL and Douglas PUD 2006; 2007).

In summary, the adult fishway or ladder counts suggest an average of 66 fish passing Rock Island Dam, 150 at Rocky Reach Dam, and 63 at Wells Dam. Adult bull trout are also seen at other mainstem dams in smolt trapping facilities both upstream and downstream of the Project. Although fish counts at adult fishways generally only cover 5-8 months and sometimes 10 months during a year, most fish are believed to pass through the dams in May and July. We estimate that annually 76 adults use the Wells reservoir (see Appendix A). BioAnalysts, Inc. have data that suggest that about 30% of adult bull trout used multiple core areas for some portion of their life history, and 10% appeared to spawn in different core areas in succeeding years (BioAnalysts, Inc. 2004; LGL and Douglas PUD 2008).

5.1.1.7 Twisp Weir and Methow Hatchery

Telemetry studies indicate that bull trout utilizing Wells Reservoir spawn in the mainstem Twisp River and upper mainstem Methow River more than 50 miles and 1,500 ft MSL in elevation above the Wells Project Boundary (BioAnalysts, Inc., 2004; BioAnalysts, Inc. 2006). Literature and investigative research did not locate any report documenting spawning habitat within the Wells Project Boundary. Migratory bull trout have been observed passing upstream through Wells Dam in the spring and summer with peak counts in late May and early June. The majority of tagged fish move into the Methow River by the end of June (BioAnalysts, Inc., 2004). For migratory life history types, juveniles rear in tributary streams for 1 to 4 years before migrating downstream into a larger river or lake to mature (Rieman and McIntyre 1993).

Within the Methow River Basin, the Twisp Weir is the only Project-related structure that has bull trout passage. Radio telemetry studies appear to demonstrate successful passage and that no bull trout were injured during passage over the Twisp Weir. Water quality in the Twisp and lower Methow rivers is considered to be excellent (NMFS 1998).

An incidental capture of a bull trout was documented at the Methow Hatchery during broodstock collection activities conducted by the Yakama Nation at this facility. This is the first documentation of a bull trout incidentally captured at this facility within the past ten years.

5.1.1.7 Radio Telemetry Data for Adult Bull Trout

Mid-Columbia River Bull Trout Study and Other Related Studies

In an effort to evaluate the status of the bull trout in the Mid-Columbia River, Douglas PUD, along with Grant PUD and Chelan PUD, initiated research which focused primarily on fish passage at the Wells, Priest Rapids, Wanapum, Rock Island, and Rocky Reach, hydroelectric projects (BioAnalysts, Inc. 2004). This research investigated: 1) passage at the five hydroelectric facilities, specifically, migration rate from the tailrace of the projects to the ladder entrances, from the ladder entrances to the ladder exits, and from the ladder exits to the next upstream project or the tributary of residence, and fallback rate at each project; 2) tributary selection and residence; and 3) mainstem Columbia River residence. A second series of studies took place during 2005-2008 and were associated with the implementation of the PUD's respective *Bull Trout Management Plans*. The goals of the 2005-2008 studies included the measurement of incidental take for migratory and sub-adult bull trout passing through the Rock Island, Rocky Reach, and Wells projects.

Results of the telemetry studies identified several notable bull trout life history characteristics. Within the Mid-Columbia Basin, bull trout utilized the mainstem Columbia River as a migratory corridor as data indicated that tagged fish passed through the Mid-Columbia projects (BioAnalysts, Inc. 2004; LGL and Douglas PUD 2008). This establishes that bull trout may be in the mainstem Columbia River (i.e., Rock Island, Rocky Reach, and Wells reservoirs) throughout the year.

Results also indicate that some bull trout reside for considerable periods of time in the mainstem reservoirs, and then move upstream through the adult fish ladders in spring and early summer to enter tributary habitats, presumably to spawn. A total of 79 bull trout were tagged in 2001 and 2002 (15 fish at Rock Island Hydroelectric Project, 45 fish at Rocky Reach Hydroelectric Project, and 19 fish at Wells Hydroelectric Project). Approximately half of the fish were released upstream of the dam where they were captured, and the other half were released downstream of the respective project. All of the tagged fish, despite their release location, migrated into the Wenatchee, Entiat, or Methow rivers. Eighty eight percent of the fish tagged a Wells Dam were destined for the Methow and the other 12% were destined for the Entiat River. Of all the fish tagged by Chelan and Douglas 86% of the fish either tagged or detected at Wells dam were destined for the Methow. After exiting tributaries in late fall, some of the tagged bull trout moved downstream of Wells Dam through the turbines. Of all tags released from 2001 to 2004, there were 2 downstream passage events and 41 upstream passage events by radio-tagged bull trout recorded or tagged at Wells Dam (BioAnalysts, 2004). Of these, 2 downstream and 38 upstream passage events occurred within one year of release.

One fish passed downstream through turbines at both Rocky Reach and Rock Island Dams after exiting the Entiat River in November 2001. This fish overwintered downstream of Rock Island Dam, then migrated back through adult ladders at Rock Island and Rocky Reach in May of 2002. Again, it entered the Entiat River in mid-June 2002, three days later than it did in 2001. Entiat PIT tagged fish have shown similar behavior recently; since 30 PIT tagged fish have been detected at Mid-Columbia fish ladders and 23 of these detections have occurred at Rocky Reach, 12 at Rocky Island and 1 at Wells Dam (PITAGIS.org). This data suggest that Entiat River fish are bound for lower river projects more often than upstream movement towards Wells.

As mentioned previously, Chelan PUD and Douglas PUD have continued bull trout monitoring activities at the Rocky Reach, Rock Island, and Wells dams through implementation of their *Bull Trout Management Plans* (BTMP). In accordance with the 2004 Biological Opinion, Chelan PUD and Douglas PUD have radio-tagged bull trout at these respective fishways. These tagging activities have been conducted for the specific purpose of monitoring incidental take within the action area.

During the Douglas PUD monitoring, for the 2005 tagging period, a total of 6 bull trout were radio-tagged and released downstream at Wells Dam. Of the 6fish released upstream of Wells Dam, all entered the Methow River. One of those fish was observed entering the Methow again in 2006. In 2006, ten fish were tagged at Wells and 7 of them were subsequently detected in the Methow following release, whereas 3 were detected entering the Entiat. In 2007, ten more bull trout were tagged and all ten were subsequently detected in the Methow. Together, over three years of radio tagging at Wells Dam 23 of 26 (88%) fish were destined for the Methow. In addition, Chelan PUD tagged 12 fish over this three year period at their Project, which were subsequently detected at Wells Dam. All of these 12 fish appeared destined for the Methow in their first year of release except one, which entered the Methow one year after tagging. Three of these 12 fish was observed using a different tributary a year after entering the Methow (2 used the Entiat and 1 used the Wenatchee). Travel time from Rocky reach to Wells Dam appears to be 1.69 days (n= 6 fish, range, 1.31-2.46 days), ladder residency and passage appears to be 5.45 days (n = 7 fish, range, 5.14-12.48 days), and fish ladder exit to the mouth of the Methow appears to be from Wells Dam to the Methow River was 0.40 days (n=13, range, 0.27-6.15 days) (BioAnalysts 2002).

Together, there were 27 downstream and 93 upstream total passage events at Wells Dam by radio-tagged bull trout, and 19 downstream and 79 upstream passage events at Wells Dam by radio-tagged bull trout within one year of release over the six years of tagging and eight years of monitoring. Radio-tagged bull trout passed downstream through the turbines or spillways as no downstream passage events were recorded via the fishways. No bull trout injury or mortality was observed at the Wells Project during either study period, by fish passing within one year of release or by fish passing greater than 1 year, as indicated by subsequent movement and detections (LGL and Douglas PUD 2008).. However, detection of mortality that is attributable to project operations is difficult to detect. Mortality may be delayed due to injury or infection, or immediate mortality may not be observed due to scavengers and the difficulties of carcass retrieval. When radio-tagged fish appear to be stationary (suggesting death or a shed tag), the radio-transmitter is sometimes not recovered. Even when the tag is recovered, a carcass is not always found or the mechanism of mortality is not clear. Further detailed information regarding Douglas PUD's bull trout monitoring efforts at the Rock Island, Rocky Reach, and Wells dams can be found in Chelan PUD 2006, Chelan PUD 2007, and Douglas PUD 2010.

For the purposes of this consultation, Douglas PUD proposes to continue this monitoring to help inform incidental take and effects, at specific intervals over the course of the Project's new license term. This would be achieved through continued implementation of Douglas PUD's BTMP (Douglas PUD 2010 and FERC 2011).

Finally, the Service's Mid-Columbia River Fishery Resource Office (MCRFRO) radio-tagged adult fluvial bull trout in the Entiat and Methow Core Areas of the Upper Columbia Recovery Unit and tracked all bull trout tagged concurrently by Mid-Columbia PUDs in the Columbia River that entered the tributaries. The MCRFRO conducted studies in the Twisp River in 2002, the Entiat River from 2003 – present, and the Methow River from 2005 – present. Through a cooperative approach of monitoring tagged bull trout between the Mid-Columbia PUDs and MCRFRO, extensive information on movement patterns of bull trout is collected in a cost effective manner. For tagged bull trout using the Columbia River, MCRFRO reports only on our fish that used the mainstem in 2003/2004 and 2004/2005, and does not report details on PUD tagged bull trout. Movements in the Columbia River of PUD tagged bull trout are reported in the annual monitoring reports of the PUDs and in their 2001–2008 study reports. The objectives of these radio telemetry studies are to define migration timing, movement barriers, spawning locations, factors affecting populations, and seasonal movements of adult bull trout in the Upper Columbia Recovery Unit.

Tagging location of radio-tracked fish seems to be related to the observed migratory behavior. Most fish radio-tagged at mainstem dams showed extensive movements within and between core areas (BioAnalysts, Inc. 2003 and 2004; LGL and Douglas PUD 2008). However, only 2 of 13 fish tagged in the Methow River migrated into the Columbia (Nelson *et. al* 2007). By comparison, 3 of 4 fish tagged at Douglas and 8 of 8 fish tagged at Chelan PUD dams made extensive migratory behaviors during this same period (Nelson et. al 2007). Since 2004 over 550 bull trout have been PIT tagged in the Methow Core Area. Of these, 177 unique fish have been recaptured on an instream array in the Methow Basin. However, only 30 of the 177 (17%) have been detected at the LMR PIT tag array near the confluence of the Columbia and Methow. In addition less than 2% of these 177 fish have been detected at Wells Dam Fish ladders. This supports the observations by Kelly-Ringel and De La Vergne (2006), who suggested bull trout in the Wenatchee, may exhibit multiple movement patterns, some of which made short migratory movements. Location of tagging may influence the sampling or selection of the movement patterns observed.

In summary, these data represent the best available information to characterize bull trout use of the mainstem Columbia River. About 2% are long-distance migratory fish, capable of moving over 200 km, and can make multiple movements within and between core areas. Use of the mainstem Columbia was extensive and occurred year–round, but most adult bull trout moved into tributaries by July and reentered the Columbia in November. About 92% of bull trout leave the Columbia when temps >15 C, and 5% stayed in Columbia year-round. Some core areas (e.g., the Entiat) provide a high proportion of individuals into the Columbia River, possibly due to poor habitat conditions, proximity to the Columbia, or also due to unique expressions of their life history. Comparing PIT tagged fish in the tributaries compared to radio tagging in the Methow highlights the fact that tagging location influences observed migratory patterns (i.e., short versus long migratory movements), as can small sample sizes. Multiple upstream and downstream movements through the dams may lead to an overestimate of the actual number of bull trout ascending dam ladders by about 12 to 28 percent at lower river project and only 4% at Wells dam (50 of 52 detections at Wells Dam over 3 years of observations were from unique fish in a given year).

5.1.1.8 Productivity (growth and survival)

Bull trout less than 5 inches in length (11cm) feed on aquatic insects. Once they are larger, their diet shifts to a mix of insects and fish or primarily fish (Pratt 1992). Migratory bull trout incrementally increase in size once they begin to feed on a diet of fish. A recent radio telemetry study in the Columbia River mainstem (BioAnalysts, Inc. 2004) determined the age classes of 36 of the fish tagged in the mainstem; they ranged from 12 fish at age 4, 19 at age 5, 3 at age 6, and 3 at age 7. Five of these tagged fish spawned previously on one or more occasions as reported by WDFW for the BioAnalysts Inc., 2004 Study Report. 92% (11/12) and 53% (8/15) of radio tagged bull trout detected in the vicinity of Wells Dam entered the Wells Hatchery Outfall in 2001 and 2002, respectively. It is possible that the bull trout frequented the outfall in search of prey. (LGL and Douglas PUD 2008). Given that bull trout are opportunistic feeders, these fish could have been taking advantage of the large concentrations of juvenile fish within the hatchery outfall system. Data collected from Wells Dam and analyzed by WDFW seemed to indicate that fish in the Columbia River that had scales analyzed showed large growth spurts once they reached a certain age; this can be associated with migratory behavior. The growth spurts observed were assumed to have occurred when bull trout enter the Columbia River, where the prey base is abundant.

The mainstem Columbia River, including the reservoirs, provides an abundant food source for migratory bull trout during the fall, winter, and spring. Forty-four species of resident fishes are listed as likely to occur in the Mid-Columbia River reach between Chief Joseph and Rock Island dams (NMFS, 2000). Twenty seven species of fish were collected in the Wells section of the Columbia River during relicensing studies conducted for the Wells Project (Beak and Rensel 1999). Forage fish such as juvenile salmon and steelhead, whitefish, sculpins (family Cottidae), suckers (family Catostomidae), and minnows (family Cyprinidae) that are present throughout the Columbia River were collected in these studies (Service 2004a). Prey base may include more warm water species than originally existed before the reservoirs.

Bull trout largely prey on juvenile salmonids. Large numbers of hatchery-raised salmon and steelhead are released into the Columbia River system annually and provide an abundant source of prey for bull trout. In 2000, about 83 million hatchery salmon and steelhead were released into the Columbia/Snake River system (Fish Passage Center, 2010).

5.1.1.9 Connectivity (Habitat Access and Condition)

The Columbia River (from the Pacific Ocean to Chief Joseph Dam) serves as a migration corridor, providing foraging, habitat, and overwintering area for bull trout, specifically for fluvial bull trout that spawn in the major tributary systems (Brown 1992; Service 2001; and BioAnalysts, Inc. 2004, 2006, 2007, and 2008).

Although there are no natural physical barriers between each of the major tributaries and the mainstem Columbia River, 9 mainstem dams likely influence upstream migration and downstream passage of bull trout when fish ladders are not being operated. Overall, this timeframe represents a relatively short period of time in which bull trout reside in the mainstem Columbia River. These structures were originally designed and operated primarily for anadromous salmonids and not specifically for bull trout. In the upper Columbia River basin, there are higher numbers of bull trout using the mainstem than anywhere else in the Columbia River. It is the Service's interpretation of data presented by BioAnalysts, Inc., where bull trout had to move through upstream fishways, turbines, juvenile fish bypass system, or spillways, that bull trout incurred some level of delay at dams due to contact with physical structures and devices, thereby affecting the migration of bull trout between dams and tributaries (BioAnalysts, Inc. 2004, 2006, 2007, and 2008). However, Wells dam has both fish ladders operating from February to November. Winter maintenance requires the dewatering of one ladder in December and one in January. Therefore, passage is possible 12 month of the year at Wells at one or both fish ladders depending on the month. At no time during the year are both ladders dewatered, and dewatering occurs at a time of year when fish 1% of bull trout passage occurs. On average, adult bull trout with implanted radio transmitters took longer to pass dams than to move through reservoirs depending on the passage metric used for analysis (BioAnalysts, Inc. 2004, 2006, 2007, and 2008). Although researchers have demonstrated that adult salmon and steelhead take longer to migrate through dams, they also more than make up for the at dam delay during their migration through the reservoirs. Overall, project passage times for adult salmon and steelhead appear to be at least as fast, if not faster, than migration speed for adult salmon and steelhead migrating through unimpounded sections of the Columbia and Snake rivers and well as other major undammed western rivers (English et al. 2001; Bjorn 1998; NMFS 2002). It is unclear if the apparent delays observed at Rocky Reach Dam is linked solely to the maintenance periods or a bull trout's contact with physical structures and devices associated with hydroelectric projects (i.e., fishways). At Wells Dam, delays may be attributed to bull trout taking advantage of foraging opportunities within the tailraces of hydroelectric projects or natural barriers located in tributaries which may affect this species' ability to reach spawning grounds in a timely manner. Other evidence linked to surrogate fish species (i.e., steelhead) adds to this discussion. Dams on the mainstem Columbia River in general can cause injury or death, delay passage, cause fallback (with a 7-10% mortality rate through turbines), affect water quality, and hydrographic variation, as evidenced in many studies implemented on the mainstem Columbia River (NMFS 2002; Mendel and Milks 1995, Service 2000a). As noted before however, numerous radio telemetry studies and 56 downstream passage events, suggest that adult bull trout have a high rate of survive through the powerhouse and spillways at Wells Dam (BioAnalysts 2008, 2006, 2005) The fallback rate for salmon and steelhead at the Project has been documented to range between 0-7% (NMFS 2003. Between 2005-2005, 52 passage events from radio tagged fish were recorded and only 2 (4%) were from repeat upstream movements from fish (LGL and Douglas PUD 2008).

Downstream passage at dams for juvenile anadromous fish is provided by fish passage facilities, by spilling water over dam spillways, or traveling through the powerhouses. Bonneville, John Day and McNary dams have fish screens and bypass facilities for juvenile anadromous salmonids. The Dalles Dam turbines are not screened and fish pass the dam through an ice-trash sluiceway. Fish pass the Upper Columbia River projects via the spillways, surface collection bypass systems, screen bypass systems or other similar passage devices. Wells Dam has a hydrocombine structure that incorporates spillway above the turbine intakes. This unique configuration allowed for the development of a highly efficient surface bypass system that provides a non-turbine passage route for 92-96% of the juvenile salmon and steelhead migrating downstream through the dam. The Wells JBS does not utilize screens or dewatering structures that separate fish from the bulk river flows. Fish are attracted into the JBS with a combination of turbine and spillway flows. The behavioral and biological preference of juvenile fish to migrate in the upper water column (water depths less than 70 feet deep), allows them to be collected in the bypass gallery and then passed safely through the five JBS systems and reintroduced back into the turbine discharge immediately downstream of the face of the dam. Small numbers of juvenile and adult bull trout have been collected at the Rock Island Dam Smolt Monitoring Facility and at the Rocky Reach Dam surface collector (http://www.fpc.org).

While juvenile fish passage facilities were not specifically developed for the downstream passage of larger fish such as migrating steelhead kelts or adult bull trout, most of these systems have not been shown to injure or kill these life stages. However, a 1-3% mortality and up to a 10% injury rate has been measured in some years to adult salmonids passing through the juvenile fish bypass system at McNary Dam (NMFS 2002, NOAA 2003).

The mortality rate for adult bull trout passing through turbines has not been studied but a surrogate (steelhead) can be used. Mortality estimates ranging between 22% and 57% for adult steelhead that passed through turbines was described in a summary of adult fish fallback rates and mortality at high head dams (Service 2000c). Fourteen to 26% mortality was reported for fallback rates through turbines at federal dams on the Snake River by Mendel and Milks (1995) in the Federal Columbia River Power System (FCRPS) Biological Opinion (Service 2000c). The fallback rate for salmon and steelhead at the Project has been documented to range between 0-7% (NMFS 2002). "Fallback" rates relate to the potential for fish to "fallback" through the dams, resulting in contact with structural features of the dam (spillways, turbines, or fish ladders). Adult mortality is likely to be higher than for juveniles (Service 2000c, 2004a). Further, incidents of fallback or downstream passage of adult bull trout through the Project appeared to be low (4%) and show no apparent mortality (LGL and Douglas PUD 2008).

Water temperatures can develop into thermal barriers reducing or eliminating fish passage and migration. During the fall, winter, and spring when bull trout are foraging, overwintering, and migrating in the Columbia River, water temperatures range from approximately 28 to 70°F (-2 to 21°C), depending on life history stage and form, geography, elevation, diurnal and seasonal variation, and local groundwater influence. Water temperatures typically exceed 70°F (21°C) during late August and early September.

During fall, winter, and spring when bull trout are more likely to be foraging, migrating and overwintering in the mainstem Columbia River, water temperatures typically range from 28 to 60° F. Average maximum daily water temperature readings for the last ten years have been less than 68°F (20°C) in the forebays of Rock Island, Rocky Reach, and Wells dams (Service 2004d). The 10-year average maximum daily water temperatures at Bonneville, The Dalles, John Day, and McNary dam forebays are lower than 70°F (21°C) except from early August to early September.

The degree of historic movement among core areas before construction of the mainstem dams is difficult to infer. Preliminary analysis of a limited number of microsatellite loci suggest that allele frequency patterns in the Yakima River basin have been influenced by gene flow from the upper Columbia as well as the lower Columbia and the Snake River (Y. Reiss, USFS, pers. comm. 2004, 2008). The consistency of this pattern across a larger sample of loci remains to be investigated. Bull trout movement data reported in telemetry studies conducted by BioAnalysts, Inc. and LGL and Douglas PUD suggests that gene flow among the Wenatchee, Entiat, and Methow core areas is likely and gene flow between these core areas and the Yakima Core Area is still possible due to the long migrations observed and downstream migration into the Wanapum reservoir. In addition, a radio-tagged bull trout was detected passing downstream through the Wanapum and Priest Rapids dams (BioAnalysts, Inc. 2004).

Downstream of the Action Area passage of bull trout is also limited or reduced by 4 federally operated dams, [Bonneville (Rkm 235, Rm146.1), The Dalles (Rkm 308.1, Rm191.5), John Day (Rkm 346.9, Rm 215.6), and McNary (Rkm 469.8, Rm 292)]. These facilities are operated by the Corps and form a series of reservoirs in the lower Columbia River (Service 2004d). Flow in the Columbia River upstream and downstream of each of these dams is affected by operations for hydropower, navigation, flood control, and anadromous fish migration. The Columbia River is free-flowing downstream from Bonneville Dam.

Five dams operated by the public utility districts of Grant, Douglas, and Chelan counties form a series of reservoirs in the Upper Columbia River: Priest Rapids (Rkm 638.9, Rm 397.1), Wanapum (Rkm 669, Rm 415.8), Rock Island (Rkm 729.5, Rm 453.4), Rocky Reach (Rkm 762.2, Rm 473.7), and Wells (Rkm 828.8, Rm 515.1) dams (Service 2004d). River flows within this reach of the Columbia River are controlled by releases from these projects and releases from Federal and Canadian dams that are located upstream. Flows are controlled for flood control, hydroelectric power, recreation, irrigation, cultural resource protection, resident fish protection, and anadromous fish migration.

The Columbia River is free flowing from Priest Rapids Dam downstream to McNary Reservoir near the City of Richland, Washington. Flows downstream from Priest Rapids Dam are also affected by power peaking operations at that project.

Columbia River dams downstream from Chief Joseph Dam have fish passage facilities that have been designed for upstream passage of migrating anadromous fish, primarily for salmon and steelhead. Bull trout have been observed by fish counters in the fish ladders at Bonneville and The Dalles dams (http://www.fpc.org). Records at lower Columbia River dams may not accurately represent bull trout passage because adult fish counts and juvenile anadromous fish monitoring cease after October 31, and fish counters do not always record bull trout sightings. Bull trout have been observed passing the fish ladders at Wanapum, Rock Island, Rocky Reach, and Wells dams. These bull trout have been observed passing through the ladders at a similar time of year as salmon and steelhead (Chuck Peven, CCPUD, pers. comm. 2004).

Bonneville, John Day, and McNary dams have fish screen and bypass facilities for juvenile anadromous salmonids. The Dalles Dam turbines are not screened and fish pass the dam through an ice-trash sluiceway. Fish pass the upper Columbia River dam projects via spillways or similar passage devices. During the summer, fish that are collected at juvenile fish facilities at McNary Dam are transported by barge or truck and released at a site downstream from Bonneville Dam. It is uncertain if the juvenile fish facilities are effectively passing bull trout because these structures were designed for juvenile anadromous salmon and steelhead. Only 3 bull trout have been officially recorded at the juvenile fish facilities at the lower Columbia River dams; one at McNary Dam on 12/21/2004 (http://www.fpc.org, 1/11/2007); 1 at the John Day Dam Smolt Monitoring Facility in May, 2002 (http://www.fpc.org, 1/11/2007); and 1 at the Bonneville power house 2 on 3/21/2005(http://www.fpc.org, 1/11/2007). There is also a possibility that bull trout have not been recorded properly in the past at some of the smolt monitoring projects on the mainstem Snake and Columbia Rivers. Small numbers of juvenile and adult bull trout have been collected at the Rock Island Dam Smolt Monitoring Facility and at the Rocky Reach Dam surface collector (http://www.fpc.org).

5.1.1.10 Summary of Habitat Conditions

Analysis of habitat conditions for bull trout within the mainstem Columbia River uses the Service's Matrix for assessing bull trout habitat conditions for water quality, habitat access, habitat elements, channel condition, flow/hydrology, and watershed conditions at the tributary/local population and river basin/core area scales. The mainstem Columbia River is considered to be functioning at high risk or (i.e. functioning at unacceptable condition) for bull trout. In general, this is due to the fact that the area is functioning at high risk for: water quality, habitat access, channel condition, flow/hydrology, and non-native fish presence. It is also because the other remaining pathways are functioning at moderate risk (i.e. functioning at risk) for habitat elements and watershed condition. Refer to the Services Bull Trout Matrix (USFWS 1999d) for definitions of these rankings.

5.1.1.11 Consulted-on and Other Effects that have Influenced the Condition of the Bull Trout in the Mainstem Columbia River FMO Habitat

The assessment in the Rock Creek Mine BO (USFWS 2006a) of all of the biological opinions from the time of listing, until July 2006 (a total of 335 biological opinions), confirmed that no actions that have undergone section 7 consultation, considered either singly or cumulatively, will appreciably reduce the likelihood of survival and recovery of the bull trout or result in the loss of any local populations, and that many of them will benefit bull trout. Since July 2006, a review of the data in our national Tracking and Integrated Logging System (TAILS) reveal this trend has held true to date; no jeopardy opinions have been issued for the bull trout. Also, the Service has developed the Consulted-on Effects Database (COED), an internal online electronic effects and take data collection, storage and retrieval system for bull trout. This will provide a powerful tool to assess the rangewide status of bull trout; the COED system is currently being populated with detailed effects and take data from pas Federal consultations and is scheduled for full implementation in the Spring of 2012.

Locally there have been a few biological opinions on the Mainstem Columbia River, in the action area, based on potential adverse effects such as: the Service's Biological Opinion for the Vernita Bar Site Selection Project by the Corps (USFWS 2005d, Ref: 1-09-2005-F-0363) which will accrue only sub-lethal take; the *Mid-Columbia Anadromous Fish Agreement and Habitat Conservation Plan* (USFWS 2004a, Ref: 04-0203) which will accrue both lethal and sub-lethal take; the Chief Joseph Dam Hatchery; Lake Entiat Estates Project, the FCRPS Project, and the relicensing of Priest Rapids Dam, will accrue both lethal and sublethal take; and several minor Corps overwater structure projects and a blanket permit (RGP5) project, which will accrue minimal sub-lethal take.

Available information indicates implementation of section 6 and/or section 10(a)(1)(A) permits in the basin have resulted in direct effects to bull trout due to capture and handling and indirect mortality [(Bureau of Reclamation (BOR), Washington Department of Fish and Wildlife (WDFW), Environmental Protection Agency (EPA), Central Washington University (CWU), Yakama Nation, and Service fisheries studies)]. Although projects associated with the restoration programs may result in long-term benefits for bull trout and their habitat, all projects included in the proposed action resulted in take of this species.

It is unknown how many non-Federal actions have occurred in the mainstem FMO habitat since the listing of bull trout. Activities such as emergency flood control, development, and infrastructure maintenance are conducted on a regular basis and affect riparian and instream habitat. Hydraulic Permits issued by the State also affect bull trout and their habitat. Recent land-use changes from agriculture to urban development along the riparian areas may also affect bull trout and their habitat. County permits have likely increased for construction of homes in floodplain and riparian areas.

Statewide Federal restoration programs which include riparian restoration, restoration of fish passage at barriers, and habitat improvement projects have been authorized in the Core Areas. The watershed groups have coordinated to apply for monies to complete stream habitat work along the mainstems. The Biological Opinion for the Chelan and Douglas County PUD Anadromous Fish Agreement and HCP requires bull trout monitoring and the associated tributary funding is providing restoration for salmonid habitats. The FCRPS Biological Opinion also provides for bull trout monitoring and associated restoration project that will benefit bull trout. The Washington State Forest Practice Rules HCP Biological Opinion will include some adverse impacts but will allow for restoration actions on or near state forested lands, including fish barrier (i.e. culverts) removal/replacement. The Services consultation with the EPA describes adverse effects in the Mainstem from the current criteria for temperatures, DO, and TDG to bull trout (Service 2008b).

Natural events such as fire and flooding cause changes in the environment. The mainstem Columbia River was subject to 100-year flood events in 1990, 1995/1996, 2006, and 2011 as well as several other flood events that caused the dams to open flood gates and remove woody debris accumulations. These caused extreme hydrologic fluctuations, extreme velocities and quantities of water to spill over the flood gates, ladders, and through turbines. This likely caused degradation of habitat, including a loss of habitat for protection from high water, and a loss of woody debris for habitat complexity in the action area and may have directly harmed bull trout at the project dams due to the hydrologic fluctuations.

Climate change is contributing to stream temperature changes in the mainstem of the Columbia River. Because the size and connectivity of patches of bull trout habitat appears to influence the persistence of local populations, climate warming could lead to increasing fragmentation of remaining habitats and accelerated decline of this species (Reiman et al. 2007).

Specifically, changes in the region's temperatures and precipitation will likely alter the Mid-Columbia Basin's snow pack, streamflow, and water quality. Warmer temperatures will result in more precipitation falling as rain rather than snow; snow pack will diminish, and streamflow will be altered; peak river flows will likely increase; and water temperatures will continue to rise.

Hydrologic changes to Columbia Basin streams will be driven primarily by the reduction of snow pack as temperatures warm and the snowline moves upward. In the Mid-Columbia region's mid-elevation river basins that now carry a substantial snow pack, the result of these changes will be a higher frequency and intensity of flood flows, earlier snowmelt runoff, and reduced summer and early autumn flows. In the coldest, highest elevation basins of the Northwest, a warmer climate would reduce the risk of large summertime snowmelt floods because of the trend to more winter precipitation falling as rain rather than snow. Moderate to high risks will extend across the interior Columbia River basin where even limited warming may produce dramatic increases in the extirpation of local populations of bull trout (Reiman et al. 2007)

Warmer air temperatures and increasing frequency of rain on snow events due to winter rainstorms contribute to changes in habitat conditions for bull trout. Warmer water in the FMO habitat makes it more difficult for bull trout to migrate and feed because they are trying to thermo-regulate. Increased severity of hydrologic events may lead to a higher frequency of disruptions and less stability in habitat conditions (i.e. streambeds, pools, and other habitats may have more sediments or may be altered more frequently to develop complex spawning or rearing habitat, etc.).

5.1.1.12 Threats

Bull trout habitat conditions within the mainstem Columbia River are highly altered, with degraded habitat conditions such as: high temperatures, poor water quality that exceeds established thresholds and regulations, altered hydrologic patterns, and passage barriers being the key concerns. Specifically, EPA's analysis of water temperatures in the Columbia River, in their efforts to establish a temperature TMDL, found that natural peak summer temperatures were as high as, or higher than, present. The primary change, since construction of Grand Coulee Dam, has been to delay the onset of peak summer temperatures and to delay the cooling of temperatures in the fall. Of particular concern is the maintenance of habitat connectivity at the Project's dam. The adult fishways at the Project are closed or non-operational due to maintenance at these facilities so they appear to temporarily block access to adult bull trout for upstream migration based on radio-tagged migratory adult bull trout movements (FERC 2006). These maintenance periods equate to approximately 21.4% of the time that radio-tagged migratory bull trout are expected to use the mainstem Columbia River FMO habitat (Stevenson 2008). More recently, Chelan PUD has tracked bull trout use through its fishway facilities outside the typical salmonid timeframes starting in 2003.

5.2 Environmental Baseline for the Methow, Entiat, and Wenatchee Core Areas

5.2.1 *Methow Core Area Baseline*

In the Methow Core Area, populations persist at low numbers, in fragmented, local populations. Since 2000, redd counts have varied from 117 to 174, averaging 152. This is slightly higher than the 127 redds at the time of listing. The overall trend for the Methow Core Area is slightly increasing, however redd surveys are conducted differently every year and there is high variability. The Methow Core Area is considered to be at risk of inbreeding and genetic drift. Given the lack of consistent population-census information, the low numbers of spawning migratory bull trout in most of the local populations, and the large distances between populations of bull trout, the Methow Core Area is considered to have low resiliency and to be at increased risk of extirpation from stochastic events.

Threats to the bull trout in the Methow Core Area include destruction of habitat and losses of populations that occurred from historical dams and due to logging; power generation; irrigation diversions and water withdrawls; effects from residential development and urbanization; areas of subsurface flow in the Twisp and Upper Methow rivers; high road densities; effects from recreational developments; presence of non-native brook trout; grazing related erosion in private bottom lands in the Methow River area; effects from activities in the mainstem Columbia River that adversely impact FMO habitat for populations that spawn in the Methow Core Area; effects of degraded habitat and degraded passage conditions at dams on juvenile, sub-adult, and adult life-history stages of the bull trout; effects from fire suppression including large fires in 20001-2006; increased frequency of high-intensity crown fires and fire severity due to past fire suppression; and contamination in the Methow River from pesticides and other agriculturally related chemicals.

5.2.1.1 Habitat Conditions in the Methow Core Area

The upper Methow River from rm 75 – 50 is comprised of various dikes which have disconnected historic side channels from the floodplain. These disconnected side channels have limited access to spawning and rearing habitat, and have constricted the historic active floodplain. Portions of riparian habitat primarily between the Lost River confluence and Mazama Bridge have been converted to agricultural and residential use. Large woody debris, though increasing from past years, is still inadequate. The contribution of fine sediments from upslope activities are considered to be somewhat of a limiting factor in parts of the mainstem. Specifically, upslope activities in the Goat and Wolf creek watersheds are thought to contribute to fine sediments in the upper mainstem. There is also a potential risk of increased channel width to depth ratio, particularly in the Goat Creek to Lost River confluence due to bank erosion and loss of LWD for sediment retention. The pool to riffle ratio for the upper Methow reach is thought to be low, caused by primarily low counts of large woody debris to create scour pools. The Methow River, at the inflow to the Winthrop National Fish Hatchery (RM 50.4), is listed on the State of Washington 303(d) list for exceedences of state water quality temperature criterion. WDFW data shows numerous excursions beyond State water quality criterion. Brook trout are also deemed a potential threat to native salmonids and bull trout in the upper Methow reach.

The upper Methow tributaries such as Early Winters Creek experience low summer flows which may impede fish migration to spawning and rearing habitat. The alluvial fan (downstream to rm 1.4) has been confined to a single channel to protect Highway 20, Early Winters Campground, and private lands. Side channels associated with the alluvial fan have been disconnected from the main channel. Negative impacts to the riparian corridor are confined primarily to USFS campgrounds. Diking and bank hardening on the alluvial fan has resulted in loss of side channel habitat, accelerated stream velocities, an incised channel, and loss of pool habitat.

Many of the floodplains in the Lost River are influenced by a dike on the alluvial fan which has created a constricting effect. In addition, ongoing residential development is occurring on the historic alluvial fan of the Lost River. Pool habitat is poor in the lowermost river mile in association with the Lost river Road Bridge and the dike located on the alluvial fan. Channelization and diking has resulted in the loss of off channel habitat in the lowermost river mile.

The mainstem Chewuch River, a tributary of the Methow River, has been simplified at various locations from large woody debris removal, bank hardening and road building in the floodplain. Bank erosion is an isolated problem, usually in association with dispersed recreation sites and/or agricultural and residential land use. The riparian component of the Chewuch River has experienced loss of mature timber along the stream banks from past timber harvest. Loss of riparian cover is largely due to excessive recreational use, primarily confined to the USFS lands. The lowermost portion of the Chewuch River is large woody debris deficient, mostly as a result of past large woody debris removal, and streamside harvest which limits future recruitment. Sedimentation and bank erosion are also problematic resulting from upslope conditions in tributary subbasins.

The middle portion of the mainstem Methow River consists of five floodplain reaches which were identified as having been disconnected from the mainstem as a result of diking and/or channel downcutting. The Methow Valley Irrigation District East Canal Fish Screen is deemed inadequate to afford proper exclusion and sage passage of downstream outmigrants. Portions of the floodplain have been diked reducing the active functioning floodplain. Bot grazing practices and road construction along large section of the mainstem have reduced healthy riparian vegetation. The mainstem lacks adequate large woody debris due to past removal projects, and is impeded from accumulating large woody debris due to increased channel velocity resulting from the loss of side channels in the floodplains. The state highway and secondary county roads have confined portions of the mainstem

Finally, the mainstem Twisp River experiences summer water temperatures which may be suboptimal for salmonids, but needs further temperature monitoring to substantiate. The mainstem in the vicinity of the Popular Flats Campground goes dry or is very low in late summer due to natural conditions. The channel has been simplified in the lowermost portion of the Twisp River as a result of adjacent road construction and diking. This has resulted in the disconnection of side channels and associated wetlands. Fragmented cottonwood galleries occur along the lowermost portion of the mainstem. Recruitment potential for large woody debris is poor due to conversion (in part) of the riparian corridor to agricultural and residential use. The pool/riffle ratio is low, especially in the lowermost portion of the Twisp River from past channel activities such as diking, road construction, and wood removal.

5.2.2 *Entiat Core Area Baseline*

Currently two local populations of bull trout are found in the Entiat Core Area, one in the upper mainstem Entiat River, and one in the Mad River. Since 2000 the number of redds in the Entiat River has fluctuated between 1 and 50 with great inter-annual variation. Redd counts in the Mad River have varied from 7 to 52, and average about 26. Therefore the total redd counts in this core area ranged between 28 to 87 since procedures were standardized. The Entiat Core Area is considered to be at risk of inbreeding and genetic drift. Given the lack of consistent population census information and the low numbers of spawning migratory bull trout in the local populations, the Entiat Core Area is considered to have low resiliency and to be at increased risk of extirpation from stochastic events.

Threats to the bull trout in the Entiat Core Area include destruction of habitat and losses of populations that occurred from logging; power generation; irrigation diversions and water withdrawls; effects from residential development urbanization; high road densities; effects from recreation developments; presence of non-native brook trout; grazing related erosion in private bottom lands; effects from activities in the mainstem Columbia River that adversely impact FMO habitat for populations that spawn in the Entiat Core Area; effects of degraded habitat and degraded passage conditions at dams on juvenile, sub-adult, and adult life-history stages of the bull trout; effects from fire suppression including large fires between 1994 and 2006; increased frequency of high-intensity crown fires and fire severity due to past fire suppression; and contamination in the Entiat River from pesticides and other agriculturally related chemicals.

5.2.3 *Wenatchee Core Area Baseline*

In the Wenatchee Core Area all bull trout populations but one persists in low numbers and are at risk for genetic drift and inbreeding. The range of redd numbers in the Wenatchee Core Area varies from 283 in 2001 to 706 in 2006. Since 2000, an average of 452 redds have been counted in the Wenatchee Core Area. This greater than the 391 redds which existed for the Wenatchee populations in 1998 at the time of the listing. Overall, the trend for the Wenatchee Core Area seems to be stable and suggests a slightly increasing trend. Given the lack of consistent population census information in the record of redd count surveys and the low numbers of adult spawning bull trout in most of the local populations, this core area is considered to be at moderate resiliency and intermediate risk of extirpation from stochastic events.

Threats to the bull trout in the Wenatchee Core Area include destruction of habitat and losses of populations that occurred from historical dams due to logging, irrigation, and power generation; current migratory delay, injury, or death caused at Tumwater dam other fish collection weirs; irrigation diversions and water withdrawls; small-scale gold mining; effects from residential development and urbanization; effects from recreational developments, presence of non-native brook trout; historical harvest of large numbers of adult bull trout and incidentally caught bull trout in the current sockeye fishery in Lake Wenatchee; effects from activities in the mainstem Columbia River that adversely impact FMO habitat for populations that spawn in the Wenatchee Core Area; effects of degraded habitat and degraded passage conditions at dams on juvenile, sub-adult, and adult life-history stages of bull trout; increased frequency of high-intensity crown fires and fire severity due to past fire suppression, grazing, silvicultural practices, and timber harvest practices; and contamination in the Wenatchee River from pesticides and other agriculturally related chemicals.

5.3 Characterization of the Environmental Baseline: Matrix of Pathways and Indicators

Since 2008, the Service has begun the development of the Consulted-on Effects Database (COED). Its core organizing principle is based on the Matrix of Pathways and Indicators (MPI or "Matrix"; see USFWS 1999). The Matrix evaluates both population and habitat conditions in terms of seven broad classes of habitat features (pathways), each of which has a related set of specific metrics (indicators) that are rated based on their functional condition. Baseline conditions for each indicator are described on a relative scale of functionality ("functioning appropriately," "functioning at risk" or "functioning at unacceptable risk").

The Matrix evaluates population pathways and indicators at the 4th field subbasin scale (i.e., in the case of the proposed action, the Wenatchee, Entiat, and Methow Core Area metapopulations) and habitat pathways and indicators at the 5th or 6th field watershed scale (i.e., in the case of the proposed action, the mainstem Columbia River watershed). Additional evaluation of population characteristics at the watershed scale provides a useful evaluation for understanding the context of the action area to the entire metapopulation. The following characterizes the baseline condition in terms of Matrix parameters, summarizing information provided in the BA, sections 5.1 and 5.2 of the Environmental Baseline, and other sources. Tables 2-6 summarizes indicator conditions. For more details on the rationale for assessing baseline condition, see the Project BA.

Table 6. Matrix of Pathways and Indicators: Summary of the Wenatchee metapopulation.

Pathway (bold) and Indicator	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk

Population Characteristics			
Population Size		X	
Growth and Survival		X	
Life History Diversity & Isolation		X	
Persistence and Genetic Integrity		X	

Table 7. Matrix of Pathways and Indicators: Summary of the Entiat metapopulation.

Pathway (bold) and Indicator	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Population Characteristics			
Population Size			X
Growth and Survival			X
Life History Diversity & Isolation		X	
Persistence and Genetic Integrity		X	

Table 8. Matrix of Pathways and Indicators: Summary of the Methow metapopulation.

Pathway (bold) and Indicator	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Population Characteristics			
Population Size			X
Growth and Survival		X	
Life History Diversity & Isolation		X	
Persistence and Genetic Integrity		X	

Table 9. Matrix of Pathways and Indicators: Mainstem Columbia River Habitat Indicators.

Pathway (bold) and Indicator	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Water Quality			
Temperature			X
Sediment		X	
Chemical Contamination/Nutrients			X
Habitat Access			

Physical Barriers		X	
Habitat Elements			
Substrate Embeddedness			X
Large Woody Debris			X
Pool Frequency and Quality			X
Large Pools		X	
Off-Channel Habitat			X
Refugia		X	
Channel Conditions and Dynamics			
Wetted With/Max. Depth Ratio		X	
Streambank Condition		X	
Floodplain Connectivity		X	
Flow/Hydrology			
Changes in Peak/Base Flows			X
Drainage Network Increase		X	
Watershed Conditions			
Road Density and Location		X	
Disturbance History		X	
Riparian Conservation Areas		X	
Disturbance Regime		X	

Table 10. Matrix of Pathways and Indicators: Habitat Indicators in the Methow River.

Pathway (bold) and Indicator	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
Water Quality			
Temperature			X
Sediment		X	
Chemical Contamination/Nutrients	X		
Habitat Access			
Physical Barriers			X
Habitat Elements			
Substrate Embeddedness			X
Large Woody Debris		X	
Pool Frequency and Quality			X
Large Pools		X	
Off-Channel Habitat		X	
Refugia		X	
Channel Conditions and Dynamics			
Wetted With/Max. Depth		X	

Ratio			
Streambank Condition		X	
Floodplain Connectivity			X
Flow/Hydrology			
Changes in Peak/Base Flows			X
Drainage Network Increase		X	
Watershed Conditions			
Road Density and Location		X	
Disturbance History		X	
Riparian Conservation Areas		X	
Disturbance Regime		X	

6.0 ENVIRONMENTAL BASELINE FOR CRITICAL HABITAT

6.1 Mainstem Upper Columbia CHU (Unit 22)

Approximately 323 miles of stream has been designated as bull trout critical habitat in the Mainstem Upper Columbia River CHU. The mainstem Columbia River was designated as FMO habitat. The Mainstem Upper Columbia River CHU is essential for maintaining bull trout distribution within this unique geographic region of the Mid-Columbia interim recovery unit and conserving the fluvial migratory life history types exhibited by many of the populations from adjacent core areas. It is essential for conservation by maintaining broad distribution within the Mid-Columbia interim recovery unit across Washington, Idaho, and Oregon. Its location between Chief Joseph Dam in the most northern geographical area and John Day Dam in the most southern area provides key connectivity for the Mid-Columbia River interim recovery unit. It is essential for maintaining distribution and genetic contributions to the Lower Columbia and Snake River Mainstems and 13 CHUs. Bull trout are known to reside year-round as sub-adults and adults, but spawning adults may utilize the mainstem Columbia River for up to as least 9 months as well. Several studies in the upper Columbia and lower Snake Rivers indicate migration between the Mainstem Upper Columbia River CHU and core areas, generally during periods of cooler water temperatures. FMO habitat provided by the mainstem Columbia River is essential for conservation because it supports the expression of the fluvial migratory life history forms for multiple core areas. In addition, there are several accounts of amphidromous life history forms present between the Yakima and John Day rivers that may still have the potential to express anadromy. Within the Mainstem Upper Columbia River CHU, all of the PCEs, which are further described in section 7, have experienced some degree of degradation. The reasons for the degraded PCEs are similar to the reasons for the decline in local populations of bull trout, which were described in the preceding section.

Due to the vast size of this CHU, we will limit our overall characterization of the current condition of each PCE in general qualitative terms. To maintain consistency in our analytical process, we will use the terminology and categories described in the Matrix of Pathways and Indicators (MPI or "Matrix"; see USFWS 1999d). The Matrix evaluates both population and habitat conditions in terms of seven broad classes of habitat features (pathways), each of which has a related set of specific metrics (indicators) that are rated based on their functional condition.

Baseline conditions for each indicator are described on a relative scale of functionality ("functioning appropriately," "functioning at risk" or functioning at unacceptable risk"). Here, we will restrict our assessment of the CHU to the habitat indicators, and acknowledge this CHU is much larger than 5th and 6th field watersheds the Matrix was designed to characterize.

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

  Although hyporheic flows are likely a small proportion of total streamflow, they are often much cooler than surface waters and may provide cold water refugia in localized areas. In the mainstem Columbia River, surface water temperature typically rises to over 15°C by June or July and remains so until September. During this period, bull trout use of the CHU is reduced since temperatures higher than the >15°C are reported to limit bull trout distribution (Allan 1980, Brown 1992, Fraley and Shepard 1989, Goetz 1991, BioAnalysts, Inc. 2004). However, a small proportion of bull trout are known to remain in the mainstem Columbia River year-round (BioAnalysts, Inc. 2004) and may rely on hyporheic flows and deep pools for refugia. Hyporheic flows that result from geologic formations are generally intact, but hyporheic flows can be impaired by development. Floodplain connectivity has been altered across the CHU, with multiple roads, railroad grades, and other features that have disconnected the hydrologic linkage of off-channel areas with the main channel and overbank-flow processes and maintenance of wetland function and riparian vegetation and succession. This can reduce the connections between relatively cooler hyporheic flows with surface waters. However, a number of oxbow and side channel reconnection restoration projects have occurred in recent years. Several reaches of the Columbia River are listed with multiple 303(d) impairments. Overall, it would appear that PCE 1 is "functioning at risk."

- *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.*

  Within the CHU, many major hydroelectric dams operate within the mainstem Columbia River—John Day, Priest Rapids, Wanapum, Rock Island, Rocky Reach, Wells, and Chief Joseph. All of these dams have fish passage with the exception of Chief Joseph, which is the upstream limit of anadromous and native fish passage (upstream). While ladders are typically operated year-round, they may be closed seasonally (usually winter) for maintenance. When this occurs, only one ladder is shut down and the remaining ladder remains open so upstream passage opportunities exist. However, upstream passage is often slower through the ladders compared to swimming speed between projects or from ladder exit to tributary mouth. Construction and operation of these dams has essentially transformed the Columbia River into a series of reservoirs, with the Hanford Reach being the last remaining free-flowing segment of the Columbia River. The current reservoir environment may actually have improved passage conditions as compared to historic (pre-dam) seasonal impairments (e.g., rapids, falls, etc.), although many other negative effects are associated with major hydroelectric dams. Overall, PCE 2 is "functioning at risk."

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

  We have no direct information regarding this PCE, but may infer its functionality through evaluating the general condition of riparian areas, water quality/quantity, and overall habitat complexity. The condition of riparian areas and habitat complexity is variable across the CHU and is generally related to the degree of influence of development, agricultural uses, and other human management. Riparian areas are generally narrow in this dry portion of the state and their structure and condition are influenced by daily fluctuations in river level (due to hydroelectric dam operation). Habitat complexity is degraded, since river channels are homogenized through conversion into reservoirs. The food base is likely much larger and more productive now than prior to their conversion into reservoirs, but species assemblages are likely different. Water quality is degraded, with the mainstem Columbia River showing many 303(d) impairments (WDOE 2008), including temperature, dissolved oxygen, pH, total dissolved gas, metals, PCBs, DDT and its derivatives, dioxin, and several pesticides. But considering the food base at the scale of the CHU, PCE 3 is likely "functioning at risk."

- *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.*

  Many of the features or outcomes associated with development and land management (e.g., roads, dams, conversion of shrub-steppe to agriculture, loss of wetlands and riparian areas) impair habitat complexity. Roads and development impinge on stream channels, and riprap and levees designed to protect property and reduce flooding simplify habitat complexity and alter hydrologic function. The construction and operation of seven major hydropower dams in the CHU has converted riverine habitat into reservoir habitat, homogenized habitat conditions with the exception of the Hanford reach. Current reservoir habitat condition is much different than the historic riverine condition, and many important habitat features have been altered. Large woody debris is extremely limited, and often captured and removed/burned at each dam. Pools have been inundated and essentially replaced by deep water habitat. Sediment transport and deposition processes have been disrupted, with large amounts of sediment accumulating behind each dam. However, a variety of restoration activities have occurred in recent years and have including reconnection of off-channel habitats, improved road maintenance, culvert replacement, road relocation, and installation of large woody debris. Overall, PCE 4 is "functioning at unacceptable risk."

- *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; streamflow; and local groundwater influence.

Multiple segments of the CHU are 303(d) listed with temperature impairments. In the mainstem Columbia River, surface water temperature typically rises to over 15 °C by June or July and remains so until September. During this period, bull trout use of the CHU is reduced since temperatures higher than the >15 °C are reported to limit bull trout distribution (Allan 1980, Brown 1992, Fraley and Shepard 1989, Goetz 1991, BioAnalysts 2004). However, a small proportion of bull trout are known to remain in the mainstem Columbia River year-round (BioAnalysts 2004) and may rely on hyporheic flows and deep pools for refugia. PCE 5 is "functioning at risk."

- *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.*

  This PCE is not present in this CHU.

- *PCE 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.*

  The hydrograph is significantly different with the construction and operation of seven major hydropower dams. Peak and base flows are moderated, with the river level only changing a few feet annually. Conversion of the flows from a natural riverine environment to a series of reservoirs is a substantial departure from the historic hydrograph. This PCE is "functioning at unacceptable risk."

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

  Range wide water quality has been degraded, with the mainstem Columbia River showing many 303(d) impairments (WDOE 2008), including temperature, dissolved oxygen, pH, total dissolved gas, metals, PCBs, DDT and its derivatives, dioxin, and several pesticides. Within the Wells Reservoir only water temperature and TDG show impairment. At the same time, the mainstem Columbia River is generally regarded as valuable FMO habitat for bull trout (and suggests it contributes positively to normal growth and development). Although the literature suggests bull trout may live 12 or more years, BioAnalysts (2004) radio-tagged 79 bull trout in the mainstem Columbia and all were determined to be 4-7 years old. Environmental contaminants may be a contributing factor and further investigation is warranted. Overall, PCE 8 is "functioning at unacceptable risk."

- *PCE 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.*

  A variety of non-native fish are present throughout the CHU. Many were originally stocked to provide additional sport fishing opportunities, but this practice has largely ended or involves only presumably sterile individuals. Nonetheless, non-native species appear to be thriving in the reservoir environment of the mainstem Columbia, and likely leads to the competition and predation of native fishes. Hybridization between brook and bull trout has been documented in the Icicle Creek drainage (Nelson *et al.* 2009) and this radio-tagged hybrid moved a considerable distance into the Columbia River (Nelson *et al.* 2011). So while we know that negative non-native interactions are occurring, we have few data to describe the magnitude of this effect. Until we have more information to quantify the degree of this impact, we assume PCE 9 to be "functioning at risk."

Overall, the functionality of all PCEs across the Mainstem Upper Columbia River CHU is marginal, with considerable variability across its vast area. No individual PCE is "functioning appropriately," 5 PCEs are "functioning at risk" (PCEs 1, 2, 3, 5, and 9), and 3 PCEs are "functioning at unacceptable risk" (PCEs 4, 7, and 8). PCE 6 is not present. But at the same time, the CHU is considered valuable FMO habitat for bull trout from 7 core areas (and 52 local populations): Methow (10), Entiat (2), Wenatchee (7), Yakima (15), Umatilla (3), Walla-Walla (3), and John Day (12).

6.2 Upper Columbia River Basins (Unit 10)

The Upper Columbia River Basins CHU is comprised of the three CHSUs in central and north-central Washington on the east slopes of the Cascade Range and east of the Columbia River between Wenatchee, Washington, and a small segment of the lower Chelan River. The CHU includes portions of Chelan and Okanogan Counties in Washington. A total of 931.8 km (579.0 mi) of streams and 1,033.2 ha (2,553.1 ac) of lake surface area in this CHU are designated as critical habitat. The subunits within this unit provide spawning, rearing, foraging, migratory, connecting, and overwintering habitat.

In 2006, the Service characterized bull trout habitat statewide as part of completing a HCP for Washington's Forest Practices (FWS ref: 1-3-06-FWI-0301). Although no critical habitat was designated in the Upper Columbia at this time, the HCP analysis characterizing habitat conditions are likely similar for critical habitat since many of the same indicators (e.g., water quality, habitat access, sediment) were considered. Characterization of the baseline for bull trout can inform the baseline condition of critical habitat.

Overall, the general habitat conditions in the Wenatchee, Entiat, and Methow CHSU show a similar pattern; lower reaches of each CHSU are fairly degraded, likely influenced by the high degree of development, roads, forestry, agriculture, irrigation diversions, grazing, mining, and other infrastructure and land management. These reaches may also have 303(d) listed impairments of water quality, with temperature and instream flow being fairly common. In contrast, the upper reaches of each CHSU are generally of higher quality and have less anthropogenic impacts, although there is substantial variation across the CHSU's. For example, some SR habitats are predominately in wilderness and in excellent condition, whereas others may be in an area with high densities of forest roads and are degraded.

6.2.1 Environmental Baseline for the Methow CHSU

The Methow River CHSU is essential for bull trout conservation in the Methow core area. The Methow CHSU supports 10 local populations of bull trout, only 2 of which consistently have greater than 50 redds detected annually. Most populations have far less than 50 redds per year, despite relatively good connectivity among populations. Spawning areas are mostly within designated Wilderness on the Okanogan and Wenatchee National Forest and are managed by standards and guidelines in the U.S. Forest Service's forest plan. Populations of bull trout in this CHSU rely heavily on mainstem rivers, including the Columbia River mainstem, for feeding, migration, and overwintering, which are essential for conservation. This CHSU supports bull trout known to migrate long distances; one radio-tagged adult was found moving between the Okanogan River and below the Priest Rapids Dam in the mainstem Columbia River, a distance of about 120 miles (193 km). Remnant glaciers at the headwaters of streams in this CHSU may increase the resilience of habitats to climate change (USFWS 2010).

We described the general characteristics and baseline status of bull trout in the Methow River in section 3.1, above. Here, we use the information presented in section 3.1 and additional sources to describe the current condition of each PCE of critical habitat in the Methow CHSU, acknowledging there is substantial variation among watersheds within the CHSU.

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

  Hydrology in the Methow CHSU is dominated by a pattern of fall and winter snow accumulation, with snowmelt and runoff during spring and summer driving the annual hydrograph. Glaciers provide cold meltwater through the summer in some watersheds. During the late summer, the proportion of flow resulting from snowmelt decreases and groundwater becomes an increasing contributor to instream flow (Golder Associates 2002). During base flow in fall and winter, stream flow is predominantly groundwater discharge (Golder Associates 2002).

  Unconsolidated sediments were deposited by fluvial and glacial processes along the bottoms and lower slopes of valleys in the Methow CHSU. These sediments are largely coarse-grained materials (sands and gravels) and constitute the primary aquifer in the Methow River Basin for maintaining streamflow during seasonal dry periods and for domestic and public-water supplies (Konrad et al. 2003, pg. 55). This sediment deposit is nearly continuous along the valley bottom from above Lost River to the confluence of the Methow and Columbia Rivers, covering over 45 square miles of the basin's surface. The deposit is 0.5 mile wide and more than 1,000 ft thick at its upper end near Mazama, decreases to less than 100 ft thick near Winthrop, and increases again south of Twisp to 200 ft thick or more in places (Konrad et al. 2003, pg. 55).

Ground-water discharge from the unconsolidated aquifer to the Methow River from Lost River to Pateros was determined from daily gains in streamflow and was relatively steady both years of study, ranging from an estimated 153,000 acre-ft in water year 2001 to 157,000 acre-ft in water year 2002 (Konrad et al. 2003, pg. 55). Ground-water discharge to the Methow River contributed 37 to 57 percent of the streamflow near Pateros during low-flow conditions. The Methow River gained most of the flow between Goat Creek and Winthrop. Ground-water discharge to the lower Twisp River from Newby Creek to near Twisp ranged from 4,700 acre-ft in water year 2001 to 9,200 acre-ft in water year 2002. Ground-water discharge to the lower Twisp River contributed 45 to 52 percent of streamflow near Twisp during September (Konrad et al. 2003, pg. 55). The Methow and Twisp Rivers, among others in the basin, are major sources of recharge for the unconsolidated aquifer, particularly during high-flow periods in May and June (Konrad et al. 2003, pg. 55).

Both surface and ground water generally are of high quality. Water-quality results from sampling at wells indicated the possibility of ground-water contamination from nitrate and arsenic concentrations at only two locations in the basin. In both cases, potential contamination was isolated to a single well (Konrad et al. 2003, pg. 55).

Water storage in wetlands occurs in the upper reaches of several tributaries (USFS 1994). Abundance of beaver (*Castor canadensis*) has been severely reduced in the watershed, reducing the water storage capacity and habitat complexity of the watershed (USFS 1994). An ongoing program of beaver restoration has been successful in moving beaver from areas where they were in conflict with people to secure headwaters areas.

Some tributaries in the Methow CHSU, such as the Chewuch River, have been evaluated using forward-looking infrared technology that detects surface temperatures of entire streams and can identify sources of cold water inputs. These analyses suggest that cold-water refugia remain well distributed along the migratory corridors in the lower reaches of some tributaries.

In certain years, moisture availability is limited by climatic conditions and streamflow become severely reduced, resulting in dewatered reaches, winter icing, and higher summertime water temperatures (Washington Conservation Commission, 2000). In drought conditions, the extent of dewatered reaches can expand, restricting access to habitat by fish, dewatering redds (nests where females deposit eggs), and stranding adult and juvenile fish (Ely et al. 2003; Nelson 2004; Nelson and Nelle 2007). Human alteration of the basin, including construction of roads and dikes, conversion of riparian habitat to agriculture and residential development, and water diversions may exacerbate naturally limiting conditions (Washington Conservation Commission, 2000). Because these alterations are concentrated in the lower watershed, this PCE illustrates the general pattern described above of degraded conditions in the lower watershed and good conditions in the upper reaches of tributaries. Considering the scale of the entire subunit, we believe the baseline condition of this PCE is "functioning at risk."

- *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.*

  As described in section 3.1 above, migratory habitats in the Methow CHSU are relatively free of impediments due to dams and culverts, with substantial improvements in connectivity being achieved during the last decade through replacement of culverts and improvements of irrigation diversion dams. Some partial seasonal impediments to passage remain, including dewatering of the Methow and Twisp rivers in late summer and early fall, which occurs nearly every year (Nelson 2004; Nelson and Nelle 2007). The timing of these dewatering events typically does not impede upstream migration of adult bull trout spawners, but can impede downstream migration after spawning, and can lead to the entrapment of adults, sub-adults, and juveniles in upstream areas (Nelson 2004; Nelson and Nelle 2007). Entrapment likely reduces survivorship (Nelson 2004). Although this pattern of dewatering is likely a natural event, it reduces habitat quality and survivorship of populations that are subject to potential entrapment (Nelson 2004). The combination of a low number of purely anthropogenic barriers to migration and the common occurrence of barriers due to dewatering in the mainstem Methow River and key spawning tributaries such as the Twisp River lead us to consider the overall condition of this PCE to be "functioning at risk."

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

  We have no direct information regarding this PCE, but may infer its functionality through evaluating the general condition of riparian areas, water quality/quantity, and overall habitat complexity. The condition of riparian areas and habitat complexity generally improves in the upper portions of the watershed, as the influences of development, agricultures uses, and other human management decreases. The exception may be commercial forestry, which can have locally significant effects on habitat condition and generally occurs in the mid- to upper- elevation areas in the CHSU.

  In most watersheds, roads parallel waterways and degrade riparian function, as well as channel dynamics and habitat complexity. Forest road location and density significantly degrade riparian conditions in some watersheds, likely to a degree that influences the food base for bull trout. In some watersheds, such as the Chewuch, large wildfires have burned through and removed many miles of riparian vegetation. The pace of riparian recovery after wildfire is rapid, however, suggesting that reductions in riparian-derived food base may be brief.

The diminished abundance of anadromous salmon is probably the most serious and persistent effect on bull trout food availability in the Methow CHSU. This factor, in combination with the effects of roads, leads us to consider this PCE as "functioning at risk."

- *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.*

  Similar to PCE 3, the functionality of PCE 4 generally improves as you move up the watershed and development and land management pressures decrease. In lower portions of the Methow CHSU, many of the features or outcomes associated with development and land management (e.g., roads, residential development, agriculture, and livestock grazing) contribute to loss of wetlands and riparian areas and impair habitat complexity in aquatic environments. Roads and development impinge on stream channels, and riprap and levees designed to protect property and reduce flooding simplify habitats and alter hydrologic function, especially when large woody debris is removed or reduced in size or distribution. This in turn can alter sediment deposition patterns, large woody debris transport, and pool development. A variety of restoration activities have occurred in recent years, including reconnection of off-channel habitats, improved road maintenance, culvert replacement, road relocation, and installation of large woody debris. Many of these projects have occurred in the lower and middle portions of the watershed, where conditions were most limiting. High variability among watersheds regarding the condition of this PCE makes it especially challenging to specify a synthetic rating for the entire CHSU. Because bull trout require complexity in both FMO (lower watershed) and SR (upper watershed) habitats, we consider this PCE to be "functioning at risk," overall.

- *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; streamflow; and local groundwater influence.*

  The mainstem Methow River is the only waterway in this CHSU that is 303(d) listed with temperature impairments. Most areas monitored during a broad assessment of water temperatures in the mainstem Methow River were consistent with a rating of "functioning at unacceptable risk" (Bureau of Reclamation 2008, pg. 1-11). Monitoring in tributaries suggested temperatures in tributaries were generally "functioning appropriately" or "functioning at risk." However, much of the monitoring data for the Bureau of Reclamation study were collected during a severe drought year, suggesting they may not be representative of typical conditions. Based on the combination of temperature monitoring information available from the Washington Department of Ecology and the U.S. Forest Service, in addition to the Bureau of Reclamation study, we believe this PCE is "functioning at risk."

- *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 overall condition of substrate in spawning and rearing areas is generally good, because these areas are predominantly located in wilderness of other areas subject to little development or management pressures. Conditions among tributaries in the subunit are, however, highly variable, and are influenced by the specific hydrologic, geologic, and other processes occurring in different watersheds. Some areas (e.g., spawning and rearing areas in the upper Chewuch River) are currently transporting high sediment loads in response to natural disturbance (wildfire). Bull trout rearing in this sub-unit occurs in the mainstem Methow River and other areas where extensive bank armoring and other changes associated with residential developments have occurred. Substrate characteristics in these areas have likely been modified in ways that reduce survival. Considering both transient changes in substrate characteristics due to natural disturbance, and more chronic changes associated with development, we believe the overall condition of PCE 6 is "functioning at risk" in this CHSU.

- *PCE 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.*

  Surface water diversions for agricultural, residential, and other purposes have extensive impacts on the lower reaches of the Methow subunit. Multiple reaches of the mainstem Methow River are 303(d) listed for in-stream flow impairments (WDOE 2008a). Both the mainstem Methow River and Twisp River frequently dewater. This may be a natural condition, but the frequency and duration of its occurrence likely have been increased by water withdrawals. Most rivers and streams in this CHSU have a natural hydrograph in its timing (since the basin is largely unregulated), but overall in-stream flow has been reduced. These reductions were as high as 50% in the past, but recent increases in water use efficiency by irrigation districts have reduced water withdrawals. Overall the condition of this PCE is "functioning at risk," due primarily to reductions in base flows.

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

  The condition of this PCE is variable across the CHSU. In spawning areas, water quality and quantity is generally good. In rearing areas, conditions are variable, with some degradation in both water quality (primarily due to increased sedimentation) and quantity. In FMO habitat in the lower portions of the CHSU, numerous reaches are 303d listed for impairments due to pollutants. As described above, water withdrawals have also reduced water quantity sufficient to warrant 303d listing for low in-stream flow. Overall, PCE 8 is "functioning at risk" based on our qualitative integration of variable conditions across the entire CHSU.

- *PCE 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.*

  A variety of non-native fish have been stocked throughout the CHSU in the past for a variety of purposes including increased recreational angling opportunities. While this no longer occurs in connected waterways, several species of non-native fish are present throughout the CHSU and likely have negative effects to bull trout including competition, hybridization, and predation. Brook trout are widely distributed in the subunit. While we know that negative interactions are occurring with non-native fish species, we cannot quantify the magnitude of this effect. Given this uncertainty, we assume this PCE to be "functioning at risk" at the scale of the CHSU.

Integrating across PCEs, the overall condition of the Methow CHSU is "functioning at risk," with considerable variability within and between watersheds. Spawning and rearing areas are generally in more functional condition than FMO habitat.

6.3 Factors Affecting Critical Habitat in the Action Area

Many of the same factors described in the Environmental Baseline likely affect the condition and functionality of critical habitat in the action area in a similar manner. Activities associated with habitat access and migrations barriers, reductions in flow and altered flow regimes, groundwater pumping and surface diversion water supply systems, species interactions, surplus protocol, sportfish angling, and release of effluent are ongoing and impact critical habitat in the action area. For more information, see the Environmental Baseline.

7.0. EFFECTS OF THE ACTION

"Effects of the action" refers to the direct and indirect effects of an action on the listed species or critical habitat; these effects together with the effects of other activities that are interrelated or interdependent with that action are added to the environmental baseline of the species or habitat. Direct effects are immediate effects of the project on the species or its habitat. Indirect effects occur later in time, but are reasonably certain to occur as a result of the proposed action. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consultation. Both interrelated and interdependent activities are assessed by applying the "but-for" test which asks whether any action and its resulting impact would occur "but-for" the proposed Federal action.

Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

One important aspect of the analysis of project effects is the term of the proposed action. The proposed license for the Project is 30-50 years. In general, when multi-year effects to listed species and their habitat are aggregated over a long period of time, the resulting impacts can be substantial.

7.1 Summary of Adult Bull Trout Populations Affected

The effects of the action are anticipated to impact bull trout from the Methow, Entiat, Wenatchee, and Yakima core areas. Included for each core area is a qualitative assessment of resiliency of each local population to provide some context for the effects of the action (we assumed resiliency is primarily a function of population size). We acknowledge this is likely an over-simplification, but in most cases, we have information to suggest multiple populations are contributing individuals into the Wells Reservoir. Project monitoring (particularly deriving a genetic baseline and additional monitoring) would greatly enhance our understanding of the effects of the project elements. (For a complete description of the population analysis, see Appendix A and the Environmental Baseline section).

7.1.1 *Methow Core Area*

The Methow core area is expected to contribute 67 fish (of the 76 total) into the Wells Reservoir. Those 67 fish may originate from all local populations in this basin, including the Beaver, Early Winters, Goat, Gold, Lake, and Wolf creeks, and the Chewuch, Lost, upper Methow, and Twisp rivers. However, radio telemetry of fish tagged at Wells Dam has located fish in the Methow, Twisp and Gold Creek only. The Methow has been characterized as stable but with low numbers, and is influenced by a single large local population (i.e., the Twisp River). Since 1998 to 2004, redd counts have varied from 117 to 174, averaging 152 (152 x 2 = 304 total adult bull trout). This estimate was derived from 7 years of comparable data from 7 of 10 local populations. Overall, the core area is considered to have low resiliency, but some local populations are considered more resilient than others. From most resilient to least, they are: Twisp River, Methow River, Wolf Creek, Chewuch River, Goat Creek, Gold Creek, Early Winters, Lost River, and Beaver Creek. Radio-telemetry suggests that about 86-88% of adult bull trout that use the Wells Reservoir originated from the Methow core area, but identification by local population was not possible since genetic assignments have not been completed and may not exist (Appendix A).

The Twisp River contributes about 186 bull trout; however, the Twisp River is important FMO habitat and may be used by multiple local populations in the Methow core area. When we account for alternate-year spawning, the population size of migratory adult bull trout in the Twisp River is 208 (mean annual redd count of 93 x 2.24). Using the same methodology as described in Appendix A, our population estimate is 228.

What is critical to understand is the number of bull trout adversely affected. To that end, information provided by WDFW (Charlie Snow, pers. comm.) suggests an average of 64 (range

36-91) bull trout are trapped at the Twisp Weir each year, although annual operations are variable and are influenced by streamflow. As a result, we will use 91 as our estimate of the number of bull trout trapped, reflecting the highest number encountered. We further assume that these 91 bull trout may also experience adverse effects due to delay in migration.

7.1.2 *Entiat Core Area*

The Entiat core area, which includes the Mad and Entiat river local populations, is anticipated to contribute 9 fish (of the 76 total) into the Wells Reservoir. The local populations within the Entiat core area are in low abundance and have been characterized as unstable with a decreasing population trend. Since 1998, redd counts have varied from 33 to 53, averaging 45. This estimate was derived from 7 years of comparable data from 2 local populations. Although a new spawning reach was discovered in the Entiat in 2004, this data was not factored into the core area trend because the information was not comparable and was outside the index reach. The core area is considered to have low resiliency, with the Mad River typically having four times the redds of the Entiat River. Radio-telemetry shows a large proportion of the Entiat local populations use the mainstem Columbia River and suggests that about 12% of these adult bull trout use the Wells Reservoir. Given the mortality rate (7-10%) associated with adult turbine passage (NMFS 2002), the chronic low redd numbers (averaging 6.3) and the relatively high proportion of fish originating from the Entiat local populations, the Service suggests this core area will remain at depressed levels under current management. This may result in an increased risk of extirpation due to stochastic events.

7.1.3 *Wenatchee Core Area*

The Wenatchee core area is anticipated to contribute 3 fish (of the 76 total) into the Wells Reservoir. The 3 fish may originate from 5 of 7 local populations from the Chiwaukum, Icicle, Nason, Peshastin, and Chiwawa local populations. The Wenatchee is characterized as having moderate abundance; however, redd numbers appear to be unstable and exhibit a slightly increasing trend. It is influenced by a single large local population (i.e., the Chiwawa River). Since listing in 1998, redd counts have varied from 242 to 706, averaging 452. This estimate was derived from 7 years of comparable data from 4 of 7 local populations. The core area is considered to have moderate resiliency, but some local populations are considered more resilient than others. From most resilient to least, they are: Chiwawa River, and Chiwaukum, Nason, Ingalls, and Icicle creeks. Radio-telemetry suggests that about 0-4% of adult bull trout that use the Wells Reservoir originated from the Wenatchee core area, but the local populations were not identified.

7.1.4 *Yakima Core Area*

It is unknown whether the Yakima core area contributes any individuals into the Action Area. The Yakima core area is comprised of 15 local populations (although its overall numbers are influenced by 3 relatively large populations), it is unstable, redd counts suggest a decreasing trend, and habitat conditions in the lower Yakima are highly degraded. The Yakima is also about 292 river kilometers from the Wells Project (i.e., from the mouth of the Yakima River to Wells Dam), marginally within the movement distances recorded in the literature. As previously described, our existing radio-telemetry, PIT tag, and other data are limited but have not detected bull trout movements into or from the Yakima Basin. Genetic data suggests that bull trout moved between the Yakima and adjacent core areas in the past. The Yakima is located at a major intersection in the Columbia basin, where the upper Columbia and Snake River evolutionary groups meet (see Spruell et al. 2003). Assessments of bull trout population genetic structure at the scale of the entire Columbia Basin indicated some apparent relationships among populations in the Yakima River, Upper Columbia River, and the Snake River (Spruell and Maxwell; 2002; P. Spruell, pers. comm. 2004; M. Small, WDFW Yakima Genetics baseline, 2009; Arden et al, 2011;). The 2011 draft genetics report "Analysis of Genetic Variation Within and Among Upper Columbia River Bull Trout Populations (Dehaan and Neibauer 2011) show similarities between fish in the Methow, Wenatchee, and Yakima core areas as well. The Yakima core area may be a "mixing zone" between these areas in terms of demographic and genetic exchange (Reiss 2003; Y. Reiss, pers. comm. and USFS 2004, p. 6; Ardren et. al 2010, p. 26). So while some degree of genetic exchange among the Yakima, Snake, and Upper Columbia must have occurred in the past, current data is limited and we are unable to establish what frequency (if any) inter-basin exchange occurs today. Considering all of this, and the uncertainty associated with the long-term of relicensing, it is unclear to what degree genetic or demographic connectivity currently exists (see Appendix A).

So while we acknowledge Yakima core area bull trout are capable of migrating long distances (approximating the distance between the Yakima River and the Wells action area), we do not currently have enough information to suggest adverse effects are reasonably certain to occur. This is due to a number of factors, including degraded habitat conditions in the lower Yakima, reduced population sizes, reduced expression of the migratory life history form, and a lack of specific monitoring to detect this event if it is occurring. As a result, we do not believe the available information supports the notion that Yakima core area bull trout will be adversely affected by the effects of the proposed action.

7.2 Effects of the Action on the Bull Trout by Project Element

7.2.1 Project Operations

The assessment of the effects of project operations includes the following three actions: Turbine Operation (Action -1); Spillway Operation (Action -2); Reservoir Operation (Action 3).

7.2.1.1 Turbine Operation (Action 1)

Turbines are typically the most hazardous route for downstream passage of fish species. Operation of the hydroelectric turbines at the Project is expected to result in injury and mortality of bull trout as a result of downstream movement through turbines at Wells Dam. These effects may include physical injury or mortality from pressure changes, cavitation, and contact with turbine structures including wicket gates, turbine runners, or the spiral case. Injuries are commonly shear-related, including eye injuries, gill and operculum damage, and decapitations, as well as strike-related injuries such as head trauma and hemorrhaging. Indirect effects may include increased susceptibility to predation caused by disorientation following turbine passage or increased susceptibility to infection caused by scale loss or non-lethal wounds incurred during turbine passage. In an effort to minimize the scope and magnitude of these types of effects, Douglas PUD completed installation of modern high efficiency replacement turbine runners on all ten units in 1990.

The best information that is available to quantify the effects of turbine operations is highly variable depending on a number of factors including project design. Telemetry data outlined in BioAnalysts, Inc. 2004, 2006, 2007, and 2008; LGL and Douglas PUD 2008) suggest that the effect of turbine operations on adult bull trout does not result in a high level of mortality. Related turbine studies on anadromous fish (Eicher Associates, Inc. 1987) found that, in general, smaller fish survive at a different rate than do larger fish in turbine passage. The combined adult and juvenile salmonid survival performance standard for fish passing through the turbines at the Wells Dam is 91% (NMFS 2002). This 91% standard, as specified in the Wells AFA/HCP, includes a 93% Juvenile Project Survival standard and a 95% Juvenile Dam Passage Survival standard. Juvenile project survival for salmon and steelhead migrating through the Wells Project has been directly measured through the implementation of four years of survival studies. The average of these four years of study is 96.3% (Bickford *et al.* 2011). The Wells AFA/HCP acknowledges that no scientific methodology currently exists that would allow the WCC to assess adult project survival for Plan Species. This is because available methods are unable to differentiate between mortality caused by the project versus other sources of non-detection (such as mortality from natural causes, injuries resulting from passage at downstream projects, or injuries sustained by harvest activities; or fish not detected for other reasons, such as spawning in locations downstream from Wells Dam).

The likely number of adult bull trout passing through hydroelectric turbines during upstream and downstream migration has been studied in the Mid-Columbia River. With regard to the likelihood of turbine passage during upstream migration, data presented in BioAnalysts, Inc. 2004, 2006, 2007 and 2008, and LGL and Douglas PUD 2008 for adult and sub-adult bull trout appear to suggest that the incidence of fallback events for bull trout at the Project is minimal. However, little information exists to detect if mortality of study fish (bull trout) occurred at a later time, if stationary radio tags were expelled, or study fish experienced direct mortality. "Fallback" is a term used to describe the potential for adult bull trout migrating upstream through the fishladder to retreat to the base of the Project's dam, resulting in increased contact with structural features of the dam (spillways, turbines or fish ladders) and potential injury (described in detail under *Adult Dam Passage Plan* effects (section 7.2.2.3).

The potential for adult bull trout to fallback is not a clear distinction when compared to other anadromous fishes. Anadromous salmonids migrating upstream generally do not move downstream unless forced. In contrast, bull trout tend to meander both upstream and downstream to foraging opportunities creating a hazy dichotomy between volitional downstream passage and fallback. Telemetry studies specific to the Project have shown that bull trout have safely passed through spillways and turbines and to date no tagged fish appear to have been injured or killed. However, this conclusion has not be verified with a high level of certainty. Therefore, movement downstream may not be referred to as fallback, but rather downstream passage events.

During the six years of study and eight years of telemetry monitoring, a total of 27 downstream passage events took place at Wells Dam, 19 of which occurred within one year of release and used in incidental take calculations (LGL and Douglas PUD 2008). Radio-tagged bull trout passed downstream through the turbines or spillways as no downstream passage events were recorded via the fishways. Out of all the downstream passage events recorded, zero bull trout mortality was observed at the Wells Project.

Incidents of downstream passage of adult bull trout through the Project turbines appears to be unclear as route-specific information to differentiate between downstream passage of bull trout through turbines versus the spillways is lacking. However, route-specific telemetry data for bull trout in BioAnalysts, Inc. 2007 and 2008 and in LGL and Douglas 2008 suggest a relatively high proportional use of turbines as a passage route during downstream migrations at the Rocky Reach and Wells Hydroelectric projects after spawning events have occurred in the associated upstream tributaries. Based on the population estimate and radio-telemetry data, we anticipate 76 adult bull trout to use the Wells Reservoir. LGL and Douglas PUD 2008 conclude that 17 of 41 radio-tagged bull trout and 19 of 79 radio tagged bull trout between 2001 and 2008 (i.e., 24-41% of the fish that use Wells fish ladders annually) have migrated both upstream and downstream indicating movement through the Project's turbines/spillways. This suggests that 18-31 bull trout to pass through the Project dam turbines/spillways annually. For the purpose of this analysis, we will assume that 31 bull trout will pass downstream through the Project's turbines/spillways.

To estimate mortality caused by passage through the turbines, we used salmonids as a surrogate for bull trout. Salmonid adult mortality is expected to be higher than for juvenile fish (Service 2000c and Service 2004a). Mortality estimates ranging between 22% and 57% for adult steelhead that passed through turbines were reported in a summary of adult fish fallback rates and mortality (Service 2000c); and a 14% to 26% mortality estimate was reported for fallback through turbines at FCRPS projects on the Snake River (Mendel and Milks 1995). Fallback estimates at Wells Dam, have ranged from 3.6% to 5% for spring and summer/fall Chinook (NMFS 2002). Fallback rates for steelhead adults have ranged from 6-7% (NMFS 2002). Sockeye adults experienced a fallback rate of 4% during a study in 1997 at Wells (NMFS 2002). Most of these fallback events took place through the Wells bypass and spillways. These estimates are consistent with bull trout from 2005-2007 where 50 of 52 upstream passage events at Wells came from unique fish at Wells, suggesting that fallback for bull trout is 4% a year (LGL and Douglas PUD 2008). For the purposes of this analysis, we used 10% as our mortality estimate for bull trout that pass through turbines because it is consistent with mortality estimates for dams on the mainstem Columbia River for salmon and steelhead (NMFS 2002).

The Service anticipates that all bull trout that go through the turbines will be injured or killed by a number of direct and indirect effects mentioned above; specifically, 10% will be killed and all survivors injured. Data available for Wells suggests that this percentage may be lower (BioAnalysts, Inc. 2004, 2006, 2007 and 2008, and LGL and Douglas PUD 2008). Based on our population estimate, on an annual basis, we anticipate that 3 of the 31 adult bull trout that go through the turbines at Wells Dam will be killed and 28 survivors injured. Based on radio-telemetry data (BioAnalysts, Inc. 2004, 2006, 2007 and 2008; LGL and Douglas PUD 2008), these 31 bull trout are anticipated to originate from core areas as follows: 26 from the Methow, 4 from the Entiat, and 1 from the Wenatchee core areas.

Bull trout that make multiple passes through the Project's dam due to downstream passage or their normal movement patterns would experience additive effects. Similarly, alternate-year spawners (estimated to be about 12% of adults, approximately 4 of the 31 bull trout subject to additive turbine operation effects) may experience a greater frequency and additive impact of effects. This is because they spend more time in FMO habitats (months to years) including the mainstem Columbia, than bull trout that migrate into tributaries to spawn annually. An average fallback rate of 4% was calculated for salmon and steelhead at Wells Dam (NMFS 2002) and 4% (2 of 52 upstream passage events) fallback at Wells has been seen for bull trout (LGL and Douglas PUD 2008). Using an average 4% fallback rate, approximately 1 additional bull trout would have to pass through the turbines again and be subject to mortality; however, when a small local population is impacted, the corresponding indirect effects are proportionally large. As a result, our estimate represents the minimum anticipated effect of turbine operations to adult bull trout.

Currently, assessment of downstream passage of sub-adult bull trout through turbines at hydroelectric projects has been constrained by a lack of sufficient sample size to accurately depict effects on this life history stage. The second objective outlined in Douglas PUD's proposed BTMP includes an assessment of Project-related impacts on upstream and downstream passage of sub-adult bull trout (fish <400 mm in length) through PIT tagging and off-season passage monitoring. During the development of the BTMP, stakeholders agreed that because of the inability to collect a sufficient sample size of sub-adult bull trout at Wells Dam, it was not feasible to assess sub-adult passage at this time. However, when encountered at Wells Dam, or in tributary traps, sub-adult bull trout would be PIT tagged. Douglas PUD provided funding, equipment, training, and coordination for the sub-adult bull trout PIT tag program. From 2004 to 20011, 185 sub-adult bull trout were PIT tagged in the Methow River sub-basin during standard tributary smolt trapping operations. Douglas PUD operated PIT tag detection systems year-round within the Wells Dam fishways during the study period (2005 to 2011) and no PIT tagged sub-adult bull trout were detected. Additionally, sub-adult bull trout were to be PIT tagged opportunistically when encountered at the Wells Project; however, no sub-adult bull trout were encountered at Wells Dam during the study period. No sub-adult bull trout were observed utilizing the fishways at Wells Dam during the 2004-2010 winter count seasons. Since sufficient information is lacking regarding the downstream passage of sub-adult bull trout at the Project, the Service considered additional information related to the downstream passage of salmon and steelhead at the Project in an attempt to provide a surrogate analysis.

Between 4 and 8 percent of the juvenile salmon and steelhead outmigrants pass through the turbines at the Wells Dam (NMFS 2002). Based upon information collected at other hydroelectric projects, juvenile fish survival is estimated to range from 90 to 93 percent for turbines, 98 to 99 percent for bypass systems, and 98 to 99 percent for spillways (NOAA 2003). Some juvenile mortality is associated with all dam passage routes; although the highest levels of mortality typically occur during passage through turbines. Consequently, an important objective of project operations aimed at improving juvenile survival is to route the highest possible proportion of juveniles past the Project in a manner that avoids passage through turbines.

Survival standards outlined in the Wells AFA/HCP ensure that survival will be at or above 93 percent. Douglas PUD has conducted three years of juvenile survival studies at Wells Dam which have shown an average survival rate of 96.3 percent for yearling Chinook and steelhead (Bickford *et al.* 1999; Bickford *et al.* 2000; Bickford *et al.* 2001). This is the highest survival rate for any dam on the Columbia or Snake rivers. In 2010 Douglas County also conducted a study to confirm that survival through the Wells Project for yearling Chinook and steelhead remains equal to or above the 93% juvenile project survival standard (Bickford *et al.* 2011). This study demonstrated a 96.4% survival estimate for yearling Chinook which was not significantly different from the aforementioned 96.2% survival estimate. For the purposes of this analysis, we will assume a survival rate of 96.4% for sub-adult bull trout, and that only 8% of all fish pass through the turbines (i.e., due to the high attraction flows, screens, and other mechanisms to direct juvenile and sub-adults away from the turbines and toward spillways or bypass structures).

Based on the population estimate described in the Environmental Baseline (Section 3) and in Appendix A, the Service anticipates that at least 31 juvenile or sub-adult bull trout are likely to use the Wells Reservoir but may be largely represented by Methow Core Area fish. Assuming all juveniles migrate downstream of the dam, then 1 juvenile or sub-adult bull trout (4% of 31 using the Reservoir) will not be diverted toward the spillway or bypass structures, will pass through turbines, and be injured or killed. Considering an estimated survival rate of 96.4% at the dam, 30 of 31 fish will be injured and 1 of 31 will be killed. We acknowledge that this estimate is low considering bull trout are more substrate-oriented than salmon and steelhead during downstream migration and bull trout migrate lower in the water column, thereby further exposing bull trout to the Project's turbines.

For the overall impact to all life stages of exposed bull trout we anticipate 4 adult and 1 sub-adult bull trout will be impacted by turbine operations annually. The significance of this effect depends in part on the resiliency of the local population(s) impacted annually and over the 30-50 year term of the Project. In general, we assume that unless a significant annual impact is observed, that the aggregated effect of the action over the 30-50 year term of the Project is unlikely to result in a measurable change in the persistence of any given local population within a core area (considering their reproduction, numbers, and distribution). As described above, this is estimated to some degree for adult bull trout, but is unknown for sub-adult bull trout. Impacts to adults are assumed to be more significant than to sub-adult bull trout. Impacts to adult bull trout which have relatively high mortality rates and, as a result, relatively few are expected to be recruited into the breeding population (Downs *et al.* 2006).

Turbine operations are anticipated to impact adult bull trout from all core areas in the action area. Impacts to the Methow core area are likely to be the most significant. Impacts to bull trout from the Entiat and Wenatchee core areas are anticipated to be moderate. Based on the population trends, connectivity between populations, and the number of individuals anticipated to be affected, bull trout in the Entiat and Wenatchee are not expected to experience the same level of impacts from the Project as compared to the Methow core area populations. The status and trend of bull trout from the Methow core area suggests unstable population trends, neither increasing nor decreasing, at low abundance. With only 10 local populations in the entire core area and only 1 (Twisp) contributing a large proportion of individuals relative to the population size, any significant Project impacts may have core area implications. Turbine operations are likely to contribute to maintaining the Methow core area in a depressed condition, which may result in an increased risk of extirpation due to stochastic events. Information for bull trout from the Methow core area suggests a degree of connectivity between adjacent core areas. Although turbine operations are anticipated to affect a relatively large number of fish, the Methow core area population is moderate in size and data shows that not all Methow bull trout migrate to the Columbia River. Current and future restoration activities in the action area are expected to continue, potentially increasing the condition of bull trout habitat and in turn population abundance. Project monitoring would greatly enhance our understanding of the effects of this project element, especially deriving a genetic baseline and additional monitoring that will improve our understanding of which local populations are impacted.

7.2.1.2 Spillway Operation (Action 2)

Fish passage spill occurs only during the juvenile fish migration season, generally from April through August. Spring spill (April through June) targets spring migrants (stream-type Chinook, sockeye, and steelhead), and summer spill (July through August) targets ocean-type Chinook juveniles. Douglas PUD utilizes its JBS in tandem with its spillways to reduce the number of juveniles that pass through turbines. Wells Dam spillway operations consist of forced spill (inflows in excess of powerhouse capacity) and bypass spill (spill of a portion of the total river volume to assist the out migration of juvenile salmonids). Forced spill through the spill bays occurs any time the total river discharge exceeds the powerhouse's total capacity. Excessive flows may result from low demands for power, high total river flows (>220 kcfs at Wells Dam), or in the event of equipment failure. JBS spill at Wells Dam typically occurs between April and August comprising a percentage of the total project discharge divided between spillbays 2, 4, 6, 8, and 10 as a function of the operating turbines. JBS spill is dependent on project operations and total river flow and generally results in spills of 5-12% of the total project discharge. Spillbays 2 and 10 have top-spill gates, while the remaining bays have underflow gates.

Juvenile fish passing through the spillbays at the Project face several risks. First, the juveniles can sustain physical injuries, such as descaling, that may incapacitate or even kill them. Second, increasing spill may result in higher total dissolved gas (TDG) levels downstream, which in turn, may cause gas bubble disease and reduce the survival rates of juvenile and adult anadromous salmonids. Juveniles that become injured or disoriented while passing through the spillway are also more susceptible to predation.

The elevation of the Mid-Columbia River reservoirs is generally regulated during high flow periods using spillway gates, which open individually and allow water to pass through separate spillway bays. The gates pass water seasonally that is surplus to power generation needs, or as directed by the Wells Coordinating Committee for assisting downstream migration of juvenile salmon and steelhead. Chapman *et al.* (1994a; 1994b) concluded that spillways are currently the most benign routes for juvenile salmonids to pass the Mid-Columbia River dams. Douglas PUD does not have route-specific survival rates of juvenile fish passing through the spillways; however, as discussed in the project description, five of eleven spill bays at the Wells Dam have been modified to function as a juvenile bypass system. Survival rates of juvenile fish passing through the JBS were discussed in Section 7.2.2. Best available information suggests a high proportional use of the Project's spillways by adult bull trout (LGL and Douglas PUD 2008).

Regardless, spill may result in supersaturated levels of TDG. Historically, exceedances of Washington State's TDG criteria (greater than 120% total dissolved gas) at the Project have occurred seasonally at varying degrees during the months of April, May, June, and July (Douglas PUD 2011). Similar to other hydroelectric facilities on the Columbia River system, probabilities for exceedances are higher during late spring periods of high river flow and low electrical demand. Information provided for this biological opinion suggests that supersaturated gases may extend from the Wells Dam downstream to the forebay of the next subsequent downstream dam, Rocky Reach Dam (Douglas PUD 2011).

In 2011, Columbia River flows at Wells Dam were the third-highest on record. A Douglas PUD mid-season analysis has shown that spill season started and peaked early and total river flow past Wells was almost twice the long-term historic average. Two of the ten turbines were down due to mechanical and maintenance problems. The 125% hourly standard for the tailrace was exceeded on 19 out of 126 days when flows exceeding the 7Q10 flood flow are discounted. This type of flow is defined as the lowest 7-day average flow that occurs on average once every 10 years. However, for each of those 19 days, the average incoming TDG in the Wells forebay exceeded 115%. Of the 75 days when forebay 12C-High TDG was below 115% and flows were below 7Q10, the highest hourly average exceeded 125% on one day, and that was most likely due to a sensor malfunction. Results for the 120% 12C-High standard for the tailrace were very similar. The 115% 12C-High standard for the downstream forebay (at Rocky Reach dam) was exceeded 41 out of 126 days when 7Q10 flows are discounted. The Wells forebay exceeded 115% due to incoming TDG on 35 of those 41 days.

Supersaturated gases in fish tissues tend to pass from the dissolved state to the gaseous phase as internal bubbles or blisters; this condition, called gas bubble trauma (GBT) or gas bubble disease (GBD), can be debilitating or even fatal. For these reasons, the Mid-Columbia River PUDs limit voluntary spillway discharge levels during the fish passage season to ensure that TDG does not exceed 120% of saturation in Project tailraces, or 115% of saturation in project forebays for more than 12 hours over a 24-hour period, or as otherwise ordered by TDG waivers issued by the Washington Department of Ecology. Due to these operational constraints, spill can be limited under normal operating conditions. In a regulated river environment, the ability of a fish to survive high TDG levels may depend on its ability to avoid supersaturated water conditions (Weitkamp and Katz 1980). Stevens *et al.* (1980) found that in laboratory conditions, coho, sockeye and Chinook salmon smolts, and rainbow trout avoided water saturated at 125% to 145%. Avoidance behavior of saturated water was not as strongly correlated at levels reduced to 115%. Other laboratory and field experiments suggest that juvenile salmonids will remain in deeper water, if it is available, to compensate for TDG of 120% - 125% (Weitkamp and Katz 1980). Hydrostatic pressure at depth compensates for approximately 10% of gas saturation for each 1 meter of depth.

In a review of hydropower effects on the bull trout, Miller and Hillman (1994) found no information on TDG effects on this species. Ryan *et al.* (2000) reported that 3.9% of all resident non-salmonid fish sampled in the lower Snake and Mid-Columbia rivers, Washington, showed signs of GBD, and at continuous level of 120 to 125%, approximately 5% showed signs of GBD. More recently, Weitkamp *et al.* (2003a; 2003b) studied fish behavior during high TDG periods in the Lower Clark Fork River, Idaho, and the effects of supersaturation and incidence of GBD on bull and other resident freshwater fish. During spill periods in 1999, TDG levels ranged between 120 and 130 percent of saturation continuously for nearly two months in May and June. Only 5.9 percent of all fish sampled (2,709) showed any signs of GBD. Eight bull trout captured by electrofishing (sampling efficient to only 6-7 feet of depth) during this period showed no signs of GBD; the highest incidence of GBD was observed in large scale suckers (14.3%) and yellow bullhead (11.4%) in 1999. During the 2000 spill season, TDG commonly spiked from 115 to 130 percent of saturation for a few hours on a daily basis; three bull trout captured in this period showed no signs of GBD. Very few (0.1 %) of the fish sampled during the 2000 spill season showed any signs of GBD (Weitkamp *et al.* 2003a).

With regard to the Project, Douglas PUD has not conducted specific studies targeted at the biological effects of TDG on bull trout. However, in recent years, Douglas PUD has conducted biological sampling of juvenile fish captured juvenile sampling facility located at the Rocky Reach Hydroelectric Project after high flow events which may result in exceedance of TDG criteria. For example, biological monitoring to assess fish downstream migration of juvenile fish was conducted during high TDG periods in 2011. Following an hourly exceedance of 125% TDG in the Wells tailrace, Douglas PUD biologists examined juvenile and adult fish on the day following the exceedance. Adult monitoring took place at the Wells Dam fishways and juvenile monitoring at the Rocky Reach juvenile fish bypass facility. Adult sampling occurred concomitantly with broodstock collection activities, whereas juvenile sampling took place alongside index sampling conducted at the Rocky Reach facility. At the approval of the DOE, 2011 biological monitoring was decreased to three times a week following sustained TDG values above 125%, resulting largely from sustained high spill conditions at Grand Coulee Dam.

Over the course of the biological monitoring period five anadromous fish species were examined, including spring and summer Chinook, steelhead, sockeye and coho. Douglas PUD biologists sampled juveniles 28 days over a two month span (May 21 to July 21). Approximately 50 juveniles were sampled on each of these sampling days, across a TDG range of 120-134% (daily mean; Rocky Reach forebay). Together, Douglas PUD staff examined over 1200 juvenile fish across this TDG spectrum. In addition, District staff and the Washington Department of Fish and Wildlife examined nearly 500 adult Chinook salmon captured at Wells Dam fish ladders during broodstock collection activities.

Species specific differences in GBT symptoms were apparent during the sampling of juvenile fishes. Together, results indicate that the 125% TDG value, as a threshold that requires biological monitoring, is consistent with the level where GBT begins to be expressed in juveniles at Rocky Reach. GBT symptoms occurred in 0-20% of the juvenile population when TDG levels were between 125-130%. When TDG concentrations were found to exceed 130%, GBT symptoms could be found in 0-90% of the juvenile population. Data suggests that positive, linear relationships exist between the percent TDG found in the Rocky Reach forebay and the percent of GBT expression exhibited by sampled juveniles. However, adult sampling at Wells suggests that large bodied upstream migrating fish show little to no signs of GBT, even when exposed to TDG levels above 130%.

For the purpose of this analysis, we will assume 4% of all sub-adult bull trout may show signs of GBD. However, the mainstem Columbia River in the vicinity of the Project contains considerable habitat with depths exceeding 30 feet, which may provide adequate hydrostatic compensation for fish during the short periods when TDG levels exceed 120% of saturation. The degree to which fish successfully avoid high TDG levels by using the depth of the water column is unknown.

Based on the information described in the Environmental Baseline and Appendix A, the Service estimates 76 adults and 31 sub-adult bull trout will be present during spill operations. If spillways are used to assist the downstream movement of fish, we anticipate 2 adult and 1 sub-adult bull trout will be killed (i.e., 98% survival for 76 adults and 31 sub-adult fish). We also anticipate 1 of the 31 sub-adult bull trout will be injured by GBD. Overall, the adverse effects to sub-adult bull trout are considered relatively minor given they have naturally high mortality rates and relatively few are expected to be recruited into the breeding population (Downs *et al.* 2006). The Service has little information to suggest from which local population these sub-adult bull trout originated from, but they are presumably from the Methow, Entiat, and Wenatchee core areas. The effect of 1 adult bull trout dying depends in part on the resiliency of the local population(s) impacted annually and over the 30-50 year term of the Project. However, the loss of a single adult fish may not make a measurable difference in terms of the persistence of the local population.

7.2.1.3 Reservoir Operation (Action-3)

The above Project elements are all closely related to hydropower generation. However, describing the interrelated nature of the effects of these Project elements is very complex. Some of the above Project elements (and impacts) are obviously related to others, whereas others have no clear linkage. As a result, in this section we summarize the interrelated and indirect effects of hydropower generation.

A general effect of the operation of any hydroelectric facility is a change to the natural hydrograph. Modification of the hydrograph may be expressed in a number of different ways, but may be most pronounced in changes to the pool/river elevation, water quality, water velocity, and peak and base flows. For these reasons, the Service has termed this Project element "reservoir operation" which can be closely aligned with hydrograph variation. The timing and magnitude of peak and base flows in the highly modified mainstem Columbia River has the effect of moderating the intensity of peak and base flow fluctuations, which in turn alters a large number of ecosystem processes and impacts key aspects of fish behavior. For example, spring freshets, which are known to be instrumental in maintaining the health of a river (e.g., as a habitat forming or restoring event), are also key triggers for both upstream and downstream migration of fishes. Moderation of the hydrograph has the effect of limiting to some extent, or in some cases, completely eliminating this key ecosystem process.

Changes in pool elevation, including the impounding of water that may fluctuate 1-2 feet per day, can lead to a variety of effects. These include increased bank erosion and sedimentation (observed as increased turbidity), an increased proportion of deep-water habitat, and inundation of habitat for bull trout, their fish and macroinvertebrate prey. Habitat access and availability (especially off-channel habitat) and riparian vegetation (vigor, percent cover, species composition, etc.) including large woody debris, can also be decreased. Water velocity is often slowed behind (i.e., upstream of) dams, typically increasing water temperatures which can facilitate habitat conditions that may favor competitors and predators of native fishes including the bull trout. These effects to temperature will be additive to those described in the Environmental Baseline as a result of global climate change. Water quality may be degraded through increased sedimentation from bank erosion and fluctuating water levels, gas super-saturation, and increased temperature from project activities. Other key considerations of an altered hydrograph include the disruption of processes and functions of sediment and large woody debris, pool frequency and quality, and the numerous impacts to fish habitat.

Beyond habitat effects, the response of the bull trout to disturbance (i.e., human presence, noise, etc.) is not well understood. However, it is known that fishes, like other animals, can detect a wide range of external stimuli. Environmental factors that most often affect fish behavior are sound, light, chemicals, temperature, and pressure. For instance, the classic fright response of salmonids to sounds is the "startle" or "start" behavior (Moore and Newman 1956; Burner and Moore 1962; Vander Walker 1967; Popper and Carson 1998). Such behaviors involve sudden bursts of swimming that are short in duration and length and are characterized as "startle" or general avoidance of the site (McKinley and Patrick 1986). This could result in the disruption of normal bull trout feeding (USFWS 2004b).

From 2001through 2005, the daily fluctuation frequency of the reservoir was less than three ft 93.3 percent of the time and minimum elevations fell below 777 ft MSL only 3.8 percent of the time (DTA 2006). Infrequent reservoir operations resulting in fluctuations over four ft in a 24-hour period occurred only 1.1 percent of the time. From 1990 to 2005, the Project forebay maintained a minimum water surface elevation of at least 777 ft MSL 95.1 percent of the time (DTA 2006). From 2001 through 2005, reservoir operations resulting in fluctuations beyond six ft occurred only 0.1 percent of the time and never resulted in fluctuations past seven ft. Such infrequent reservoir operations are generally brief in duration as well (i.e., 1 to 5 hours), and reservoir stage may rise and fall several times in the course of an event. Infrequent reservoir operations of four ft or more occurred a total of 21 times between 2000 and 2005, and ranged in frequency from one in 2003 to seven in 2005. The mean duration of occurrences was 7.1 hours, and the median value was 3.0 hours. This type of infrequent reservoir operation has occurred in each month except February, August, September, and December in the course of the last five years, and occurred most frequently in July (5 events) and April (4 events). However, the pattern of occurrence was highly variable, and infrequent reservoir operations rarely occurred in the same month in successive years.

Based on the information described in the Environmental Baseline (Section 5) and Appendix A, the Service estimates 76 adult and 31 sub-adult bull trout will use the Wells Reservoir and may be impacted by hydrologic variations. The effects of hydrologic variation to adults are likely sub-lethal in nature because adult bull trout are more tolerant of a wide range of environmental conditions and are more mobile. However, sub-adult bull trout are more susceptible to environmental conditions and are less mobile and may experience some level of mortality (i.e., the Service estimated that 5% of sub-adult bull trout [or 2 of 31 fish] will be killed or experience a significant disruption of their normal behavior). As a result, the Service believes that 10% or 3 sub-adult and 8 adult bull trout will be injured, and 2 sub-adults will be killed. However, it may be possible for a sick, injured, or otherwise stressed adult bull trout to be killed as a result of the additive effect of injury from use of the juvenile bypass system. As a result, 1 adult bull trout may be killed.

Overall, the adverse effects to sub-adult bull trout are considered relatively minor given they have naturally high mortality rates and relatively few are expected to be recruited into the breeding population (Downs *et al.* 2006). The Service has little information to suggest from which local population these bull trout originated from, but they are presumably from the Methow, Entiat, Wenatchee core areas. The effect of a single adult bull trout dying depends in part on the resiliency of the local population(s) impacted annually and over the 30-50 year term of the Project. However, the loss of a single adult fish may not make a measurable difference in terms of the persistence of the local population.

7.2.2 Wells AFA/HCP

Implementation of the Wells AFA/HCP contains the following component plans that contain actions that may have an effect on bull trout: (1) Passage Survival Plan; (2) Wells Dam Juvenile Dam Passage Plan; (3) Adult Passage Plan; (4) Tributary Conservation Plan; (5) Hatchery Management Plans; and (6) Predator Control Program.

7.2.2.1 Passage Survival Plan

The HCP Passage Survival Plan is composed of two primary components including the implementation of a Juvenile Dam Passage Plan and an Adult Fish Passage Plan. The Juvenile Dam Passage Plan includes the operation of the juvenile fish bypass system and the conduct of the juvenile fish survival studies. Each of these measures includes opportunities for the unintended take of bull trout.

7.2.2.2 Wells Dam Juvenile Dam Passage Plan

The assessment of the effects of the Wells AFA/HCP survival juvenile plan addresses two actions: fish bypass operation (Action -1) and survival studies (Action -2).

Fish Bypass Operation (Action-1)

JBS spill at Wells Dam typically occurs between April and August comprising a percentage of the total project discharge divided between spillbays 2, 4, 6, 8, and 10 as a function of the operating turbines. JBS spill is dependent on project operations and total river flow and generally results in spills of 5-12% of the total project discharge. Spillbays 2 and 10 have top-spill gates, while the remaining bays have underflow gates.

During periods of operation, juvenile bypass facilities are likely to result in increased downstream passage survival of adult bull trout. Operation of associated juvenile sampling facilities may result in the entrainment and capture of adult and subadult bull trout. Evidence suggests a level of utility in relying on the JBS for the downstream passage of fish species. The efficiency of operations at juvenile bypass facilities, such as the Wells Juvenile Bypass System (JBS), is often reflected in their ability to guide fish around spillways and powerhouses, commonly referred to as a Fish Bypass Efficiency metric. Specifically, the Wells Fish Bypass Efficiency estimates have been consistently high for spring and summer juvenile migrating fish. The efficiency and effectiveness of the JBS are important factors in limiting the amount of spill, and therefore TDG, while maximizing fish passage and survival. For example, the Fish Bypass Efficiency estimates for spring migrants and summer migrants are 92% and 96.2%, respectively (Skalski *et al.* 1996). These estimates have been supported by similar information collected during concurrent fyke net evaluations (Bickford 1997). A juvenile Chinook balloon-tag study that was conducted in 1993 concluded that there was no measurable direct injury or mortality through the JBS (RMC Environmental Services 1993). Douglas PUD has conducted three years of juvenile survival studies at Wells Dam which have shown an average survival rate of 96.2 percent for yearling Chinook and steelhead (Bickford *et al.* 1999; Bickford *et al.* 2000; Bickford *et al.* 2001). This is the highest survival rate for any dam on the Columbia or Snake rivers. In 2010 Douglas County also conducted a study to confirm that survival through the Wells Project for yearling Chinook and steelhead remains equal to or above the 93% juvenile project survival standard (Bickford *et al.* 2011). This study demonstrated a 96.4% survival estimate for yearling Chinook which was not significantly different from the aforementioned 96.2% survival estimate. For the purposes of this analysis, we will assume a survival rate of 96.4% for juvenile and sub-adult bull trout, and that only 8% of all fish pass through the turbines (i.e., due to the high attraction flows, screens, and other mechanisms to direct juvenile and sub-adults away from the turbines and toward spillways or bypass structures). However, bull trout are very substrate-oriented fish and may not be as easily directed to the JBS as compared to salmon and steelhead. Therefore, the Service concludes that 8% is likely a minimum estimate.

It is reasonable to assume that the high survival rates shown for juvenile salmon and steelhead would be similar for subadult bull trout. The JBS at Wells Dam is widely considered to be the most efficient bypass system on the mainstem Columbia River. NMFS (2002) estimated that 98-99% of the juvenile salmon and steelhead utilizing the JBS should survive to the next downstream hydroelectric project.

Since most juvenile salmon and steelhead migrate near the surface, with the help of the JBS, they successfully pass Wells Dam and avoid the turbine intakes located deeper in the forebay. Because subadult bull trout are morphologically similar to some species of anadromous salmonids it is expected that a similarly high proportion of subadults, if present, would also utilize the JBS. The JBS is in operation annually from April through August. This operating period is consistent with the period of high bull trout and anadromous fish presence at the Wells Project.

Although designed primarily for the passage of juvenile fish species, further evidence suggests the JBS may offer downstream passage benefits for adult bull trout as well when compared to a surrogate species such as steelhead. For example, Wertheimer 2007 explains that providing surface flow passage routes through Bonneville Dam's surface bypass (i.e., B2 corner collector) may provide an efficient means of bolstering iteroparity rates by increasing the number of kelts that successfully navigate this dam during the spring. Results compiled in Wertheimer 2007 show that over 80% of kelts at "B2" were routed away from turbines via surface flow routes passing up to 5% of total discharge at each Bonneville powerhouse, indicating that relatively small amounts of surface flow are needed to pass kelts via nonturbine routes. These results appear to indicate that the Project's JBS may offer a similar level of benefit for adult bull trout passing downstream through the Project.

The adult survival standard from the Wells AFA/HCP ensures that survival will be at or above 98 percent survival. Adult PIT-tag studies indicate that adult survival has been consistently greater than 98 percent per project since 2004 when the Wells AFA/HCP was implemented. The majority of steelhead fallback takes place through the JBS where survival is high.

Steelhead kelts migrating downstream of the Wells Project would pass downstream in the same manner as juvenile downstream migrants. English *et al.* (2001) estimated a 34 to 69 percent kelting rate for the Mid-Columbia River steelhead stocks. Although direct survival information was not developed during this study, it is reasonable to assume that adult survival during fallback and kelt (post-spawning steelhead) passage is higher passing through the JBS rather than through turbines. Most kelts likely use the surface-oriented JBS. Kelts are most likely to be passing downstream of the dam during late April through June when the JBS system is in full operation. Some mortality may occur through the turbines, but overall survival is expected to be high when non-turbine routes of passage are in operations including the JBS or spillways.
Survival rates of adult salmon and steelhead passing through the Mid-Columbia River have not been estimated due to the inability to differentiate tag loss, tag failure, and fish loss (NMFS 2002a). It is not presently possible to measure adult survival with existing technology. Although radio telemetry studies provide information on adult passage and apparent spawning distribution, uncertainties associated with the technology, and the inability to determine the ultimate fate or spawning success of radio-tagged fish, result in insufficient data to accurately estimate survival. In addition to the uncertainties related to the survival estimates developed through radio telemetry data, it is not possible to differentiate natural mortality from project-related mortality. However, PIT-tag studies have shown that minimum per-project survival rates exceed 98% per project, demonstrating that adult mortality rates are extremely low, irrespective of cause (Anchor and Douglas PUD 2009).

Even though the Wells JBS may demonstrate an adequate capacity to bypass sub-adult and adult bull trout around turbine and spillway facilities, its ability to minimize adverse effects and increase survival rates for bull trout in the project area for the term of a new 30-50 year license will be important. Adverse effects to bull trout resulting from JBS facility operations may include turbulence, physical injury, increased predation, entrainment of air, and increased turbidity.

As described in the Environmental Baseline (Section 5) and Appendix A, we have estimated at least 31 sub-adult bull trout may use the Wells Reservoir annually. The juvenile bypass should improve the survival of downstream migrant sub-adult bull trout to at least 98%, so we would expect no more than 1 of the 31 sub-adult bull trout will be killed if this standard is achieved. We acknowledge that this take estimate is likely low considering bull trout are more substrate-oriented than salmon and steelhead during downstream migration and bull trout migrate lower in the water column, thereby further exposing bull trout to effects of the Project's JBS. The effects of abrasions, scale loss, and other injury, in addition to potential water quality impacts including turbulence, entrainment of air, and erosion of the riverbed resulting in increased turbidity may impact all sub-adult bull trout. Increased turbulence and turbidity, which reduce sight distances, and concentrate fish into a small area may also increase their susceptibility to predation. However, these effects are expected to be minor; the Service estimates that approximately 6 individuals (or 20% of all sub-adult bull trout) will experience predation effects to such a degree that they result in injury.

It is uncertain whether or not adult bull trout use the JBS. For this analysis we estimate 76 adult bull trout, most likely from the Methow, Entiat, and Wenatchee core areas (see Appendix A), may be impacted by the JBS. Effects to adults are believed to be sub-lethal, and often take the form of scale loss or other minor injury. However, it may be possible for a sick, injured, or otherwise stressed bull trout to be killed as a result of the additive effect of injury from use of the JBS. As a result, 1 adult bull trout may be killed.

In summary, we estimate that, annually, 1 adult will be killed, 4 adults will be injured, no more than 1 sub-adult bull trout will be killed, and 6 will be injured. However, downstream fish passage through the JBS is expected to be safe and reliable with at least a 98% survival rate (NMFS 2002). In addition, the potential for injury and death of sub-adult bull trout is off-set to some degree by improved downstream passage provided by the JBS. The Service is unable to determine from which local populations these 31 sub-adult bull trout may originate, but presumably they would be from the Methow, Entiat, and Wenatchee core areas. Further, given the limited habitat in the Entiat compared to the Wenatchee and Methow, it is possible that the majority of the sub-adults in the action area are those from the Entiat. The adverse effects to sub-adult bull trout are considered relatively minor given they have naturally high mortality rates and relatively few are expected to be recruited into the breeding population (Downs *et al.* 2006). In addition, the three core areas impacted (i.e., the Methow, Entiat, and Wenatchee) range from low to moderate abundance. Overall, the adverse effects of the JBS are likely offset by the beneficial effects of increasing sub-adult bull trout passage.

Juvenile Survival Studies (Action-2)

The Wells AFA/HCP requires Douglas PUD to conduct survival studies for all five plan species covered by the Wells AFA/HCP. These large scale mark-recapture studies frequently require the in-river collection of large numbers of juvenile fish. The collection of juvenile salmon and steelhead for use in juvenile survival studies could result in the incidental capture of bull trout. Actions envisioned within this plan to collect wild or in-river migrating juvenile salmonids include beach seining, netting, and screw trap activities in the mainstem Columbia above Wells dam and in the Okanogan and Methow Tributaries. Study fish may also be collected from juvenile fish bypass systems at Wells, Rocky Reach and Rock Island dams as well as through the deployment of fyke nets, block nets, minnow traps and incline plane traps.

As is required by the Wells AFA/HCP, periodic evaluations of survival, behavior and lifehistory of juvenile salmonids and steelhead will be necessary to assess performance of hydro-operations and project effects on out-migrating smolts. Passive and active tags will be implanted in smolts exiting the project to meet these objectives. Netting and seining have to potential to encounter adult and subadult bull trout; however these collection efforts typically have a low rate of mortality (screw traps 3.5%; Rayton and Arterburn 2008). In addition beach seining mortality rates were less than 4% in the summer of 2011 when 17000 wild subyearling Chinook were collected in the Wells Project via seining (Douglas PUD and Biomark *in prep.*). During this sampling effort no bull trout were encountered.

Together, expected injury and mortality on bull trout as a result of capture methods for smolt survival and behavior studies is expected to be 2 adults and 2 sub-adult bull trout and non-lethal take on 5% or 4 of 76 fish in the action area. These estimates are based in part on Douglas PUD's characterization of take for the Project. In some cases a hatchery surrogate may be needed to meet these performance requirements and objectives. In this case take is not expected on bull trout, but some competition with subadult bull trout for resources is possible. The release of additional hatchery fish for survival studies has a net potential for beneficial effects to bull trout through anincrease in prey for adult bull trout.

7.2.2.3 Adult Dam Passage Plan

Continued, current operation of the adult fishway is likely to result in delays in the upstream movement of adult bull trout, impeded upstream passage of sub-adults, and injury or mortality of adults due to contact with structures within the fishway and to fallback. As described in the project description, the adult fishways are operated year round, 24 hours a day, to accommodate salmon and steelhead passage with the assumption that this operation also provides upstream passage to bull trout. The two fishways at Wells are also subject to maintenance activities and fish salvage activities, primarily December 1 through March 1, and may include power-washing and scrubbing to remove aquatic vegetation. During this maintenance period, bull trout upstream movement past the dam to use seasonal habitats will be limited to only one fish ladder, located on either the west bank or east bank. This impairment of normal behavior and movement patterns likely affects foraging opportunities, use of cover, and other key aspects of their life history.

Direct effects to bull trout may include physical injury from contact with fishway structures. A number of indirect effects may stem from temporary fatigue, which may be a function of the length of the ladder and water velocity. Temporary fatigue may increase susceptibility to predation, and decrease ability to compete for cover or forage. In addition, increased susceptibility to infection caused by scale loss or non-lethal wounds incurred during fishway negotiation may also result. The Service will conservatively estimate all fish using adult fishways may incur some sub-lethal injury. Although not documented at Wells Dam, it may be possible for a sick, injured, or otherwise stressed adult bull trout to be killed as a result of the additive effect of injury from ascending the fishways. We assume that fishways such as those at the Project have the potential to injure all fish which utilize these structures, but due to the long-term nature of the proposed new license term (i.e., 30-50 years) we conclude that 1 adult bull trout may be killed.

Douglas PUD plans to continue the implementation of its Adult Passage Plan, as contained within Section 4.4 and Appendix A of the Wells AFA/HCP, to ensure safe and rapid passage for adult Plan Species as they pass through the fish ladders at Wells Dam. The plan contains specific operating, dewatering and maintenance criteria for the two adult fish ladders and the two adult fish ladder traps, and provides details regarding the implementation of passage studies on adult Plan Species including studies related to passage success, timing and rates of fallback.

Migratory bull trout have been observed passing upstream through Wells Dam in the spring and summer with peak counts in late May and early June. There have never been any observations from past year-round monitoring of bull trout passing upstream during out of season months (i.e. winter). However, more recently, two adult-sized bull trout were salvaged alive from the east-bank fishway during routine annual winter maintenance. The majority of tagged fish move back into the Methow River by the end of June (BioAnalysts, Inc., 2004; LGL and Douglas PUD 2008). During the six years of study and eight years of telemetry monitoring from 2001 through 2008, a total of 93 upstream passage events were detected at Wells Dam (79 of which occurred within one year of release and used in take calculations). Out of all 93 upstream passage events recorded, zero bull trout mortality due to passage was observed at the Wells Project.

Current evidence suggests the importance of adult fishways for bull trout in the mainstem Columbia River. During the 2005 through 2008 study, 214 adult bull trout were counted passing upstream through Wells Dam. The proportion of the bull trout population at Wells Dam that was radio-tagged was 24 percent (52/214 = 0.24). The study found that Wells Project operations did not appear to influence the movements of adult bull trout. Instead, adult bull trout passage events appeared to be more closely associated with water temperature, photoperiod and time of year with rather predictable patterns of upstream and downstream movement.

Actively migrating bull trout may take additional time to pass through the Wells Dam, although no upstream or downstream passage problems were identified during the 2005 through 2008 study. Passage times upstream through the fishway appeared reasonable relative to the species migration and spawn timing. The Service also considered other data in its assessment of adult fishway operation effects at the Project.

Based upon an assessment of the tailrace residency metric used in evaluating upstream passage of bull trout at the Project, it is the Service's interpretation of data presented in BioAnalysts, Inc. 2004, 2006, 2007, 2008; and LGL and Douglas PUD 2008 that additional time was required for migrating bull trout to pass Wells Dam. Conversely, the use of the median passage metric appears to suggest the upstream passage of bull trout at the Project is relatively short in comparison to salmon and steelhead species (Table 7). On a comparative basis, observed median passage rates for adult Chinook and sockeye salmon have ranged between 31 and 60 hours at the Rocky Reach Project, between 15 and 39 hours for the Rocky Island Project, between 5 and 47 hours for the Wells Project, between 19 and 75 hours for the Priest Rapids Project. Median passage rates for steelhead ranged between 4 and 14 hours for the four hydroelectric projects.

It is not clear whether bull trout involved in previous telemetry studies required more time to find fishway entrances or whether these fish took advantage of potential foraging opportunities in the Project's tailrace. Benefits derived from increased foraging opportunities may be required to offset effects associated with bull trout upstream passage at the Project. It is not known whether passage delay results in late arrival at spawning locations and subsequently decreased spawning success, higher rates of egg superimposition, or increased adult mortality. Other factors such as natural tributary barriers may play a role in the timeframe in which bull trout arrive on tributary spawning grounds (Nelson and Nelle 2008). Regardless, upstream passage through the fishway at the Project likely represents an additive effect due to contact with associated structures, facilities, and operations associated with the fishway. However, the temporal distribution of bull trout spawning activity in the Wenatchee, Entiat, and Methow Rivers is within the ranges reported for other fluvial and adfluvial populations in the Columbia River Basin (Service 2002a; Pratt and Huston 1993; Fraley and Shepard 1989; Goetz 1989). In addition, the Project's fishway was designed for adult salmon and steelhead, so the overall effectiveness in passing bull trout to associated spawning grounds is uncertain. Bull trout use of the Wells adult fishway will likely remain prominent over the course of the new project license and as recovery actions are implemented.

In 2003, NMFS also concluded that small delays for listed steelhead and spring Chinook at Wells, Rocky Reach and Rock Island dams are compensated for by faster travel through the slower flowing reservoirs (NMFS 2003). In addition, NMFS also concluded that any delays that do occur are more likely to affect species that spawn soon after completing their migration. As a result, summer/fall-run Chinook salmon and sockeye salmon are more likely to be affected than those species that hold in the rivers or streams for considerable periods of time prior to spawning. Lastly, NMFS wrote "the effect of delays passing the fishway on Permit Species is likely non-existent for currently ESA-listed Permit Species and non-existent to very small for currently unlisted Permit Species. Thus the proposed action [continued operation of fishways] should have no effect, or a slight beneficial effect, on upstream migrating adults compared to the migration observed under unimpounded conditions." (NMFS 2003). According to NMFS, passage times for radio-tagged bull trout are comparable to those found for anadromous salmonids (Table 7) and similar effects for bull trout should be expected.

Table 11. Comparison of adult salmon, steelhead and bull trout median passage rates (hours) at Rock Island, Rocky Reach, Wells, Priest Rapids, and Wanapum hydroelectric projects.

	Rock Island	Rocky Reach	Wells	Priest Rapids	Wanapum
Bull trout	4-18	5-7	49	---	---
Spring Chinook	20-39	31-37	27-29	45-75	37-46
Steelhead	4	13	12	14	11
Summer Chinook	15	23-30	33-47	29	23
Fall Chinook	19	60	31-46	38	41
Sockeye	17	36	5-21	19	30

Sources: Stuehrenberg *et al.* 1995; BioAnalysts, Inc. 2004, 2006, 2007 and 2008; and LGL and Douglas PUD 2008.

While the Service considered NMFS' conclusion, it should be noted that the life history of the bull trout is quite different than salmon and steelhead. The frequency, timing, and routes of upstream and downstream passage by bull trout are not well understood. This is particularly true of downstream passage. For example, sub-adult downstream passage may occur at any time, and the routes available are dependent on the time of year (considering flow, habitat access, temperature, etc.). Based upon results of telemetry studies, adult bull trout are most likely to move downstream after spawning and re-enter the mainstem Columbia in mid to late fall (BioAnalysts, Inc. 2004, 2006, 2007 and 2008; and LGL and Douglas PUD 2008). Because Columbia River migratory bull trout are present in very low densities compared to other fish species, and they have relatively unpredictable migration behavior (especially sub-adults), effective study methods to evaluate downstream passage are in the preliminary stages of being developed. However, bull trout telemetry results such as those presented in BioAnalysts, Inc. 2004, 2006, 2007 and 2008; and LGL and Douglas PUD 2008 are adding to the collective understanding of this fish species' migratory behavior.

It is also likely that upstream movement of sub-adult bull trout within the mainstem of the Columbia River may be impeded or precluded by the operation and maintenance of the Project's dam. Since the construction of this dam, the only upstream passage avenue is the adult fishway which was designed for adult anadromous fish, and may be a velocity barrier for sub-adult bull trout. However, sub-adult bull trout (≤305 mm) have likely been observed passing through the Project's fishway during the period of April 14 – November 1. Telemetry results in BioAnalysts, Inc. (2004, 2006, 2007 and 2008; and LGL and Douglas PUD 2008) also demonstrate a sub-adult bull trout's ability to utilize the Project's fishway. The Service assumes that subadult bull trout are likely to be able to negotiate the fishways in a manner similar to anadromous salmonids because they are strong swimmers (Mesa *et al.* 2003). The sub-adult bull trout that ascend the adult fishways at the Project on an infrequent basis are likely to incur injury. Isolation of bull trout below the Project may result in altered growth and survival due to differences in the abundance and location of prey, altered flow patterns, warm water temperatures and degraded water quality, simplified habitat, and exposure to competition to predation. Life history traits may also be influenced by the lack of free movement throughout the system. Fish that may have exhibited a fluvial life history pattern could tend toward an adfluvial life history pattern due to changes in environmental factors.

Based on the best available information on typical bull trout movement patterns, the operation of the adult fishway (i.e., when the fishway is operating) coincides with 100% of the time migratory bull trout are anticipated to move within the mainstem Columbia and use FMO habitats. With both fishways operating during the key time period, when bull trout are moving into their spawning tributaries. This assumes most bull trout spend 3 to 5 months (i.e., typically between July to November) in spawning and rearing habitats and 6 to 9 months (i.e., typically November through July) in FMO habitats (based primarily on BioAnalysts, Inc. 2004, 2006, 2007 and 2008; Service 2006b; Appendix A).

The effects of the maintenance period on bull trout are not well understood. However, results presented in BioAnalysts, Inc. 2006, 2007 and 2008 contribute to this discussion of maintenance period effects and associated sporadic use of the Project's fishway by sub-adult bull trout within close proximity of the aforementioned maintenance time period. In accordance with the Service's 2004 Biological Opinion for the Project, Douglas PUD expanded its fishway video counts into the off-season period starting in 2004. Off-season or "winter" (November 16 to April 30) video monitoring of the Wells Dam fishways for adult and sub-adult bull trout was conducted during the winter of 2004 and 2005 as required by the BTMMP. Additional off-season counting took place during the winters of 2006 to 2010 and are expect to continue indefinitely. Past evidence has concluded no adult or sub-adult bull trout have been observed utilizing the fishways at Wells Dam during the winter count season (LGL and Douglas PUD 2008). However, more recently, two adult-sized bull trout were found alive during fish salvage operations and fishway dewatering operations in December 2011. Collection of these two individual fish amongst several hundred other fish during these types of fish salvage activities contributes additive stress and/or injury on bull trout which utilize the Project's fishway.

Fishways at the Project are inspected daily to ensure debris accumulations are removed, automated fishway instruments are calibrated properly and lights in the fishway are functioning. Both upstream fishway facilities (located on the west and east shores) are operational year around with maintenance occurring on each fishway at different times during the winter to ensure that one upstream fishway is always operational. Maintenance activities on Wells fishways typically occur during the winter when bull trout have not been observed passing Wells Dam (Douglas PUD 2008). As discussed previously, the maintenance period of December 2011 presented an exception to this conclusion.

Overall, this type of maintenance activity likely alters normal bull trout behavior patterns for the few fish present by limiting foraging opportunities, reducing habitat access, restricting use of refugia, and may ultimately reduce growth and survival. Other considerations include whether these fish spawn every year or alternate years, and the effects to other life history stages such as sub-adults.

Alternate-year spawning may be a function of energetics, and if growth and survival are generally reduced during the maintenance period because habitat access is reduced, then the proportion of fish expected to use this reproductive strategy may increase. Downs *et al.* (2006)

observed about 88 percent of bull trout spawned annually in an unobstructed adfluvial system, consistent with Baxter and Westover (1999), who found a 2:1 ratio. However, the Service (2006a) observed only 22% of bull trout spawned multiple times over a 2 to 3 year period, suggesting a higher rate of alternate-year spawning in the Wenatchee core area, a system characterized by numerous seasonal barriers including mainstem hydroelectric dams. Although this inference is speculative, it conforms to the energetics hypothesis that reduced growth and survival may increase the incidence of alternate-year spawning. Overall, these fish may be at increased risk of injury or death, or may contribute fewer progeny to a local population, if they cannot move normally and exploit mainstem Columbia habitats.

Use of the mainstem Columbia by sub-adult bull trout may result in similar reductions in growth and survival anticipated in adults, but predation may also increase. Decreased habitat access, especially to tributaries or other areas with relatively high amounts of cover, may result in decreased survival. In addition, non-native predators appear to exist in higher densities and have a competitive advantage in the mainstem Columbia versus tributary habitats. The access to and quality of nearshore habitats, which may be some of the best areas of habitat complexity and cover for sub-adult bull trout, are impacted by the fluctuation of river levels due to hydropower generation. These impacts are described in the Reservoir Operation Project element (Section 7.2.1.3) and will not be analyzed here.

Adult fishways are also subject to maintenance activities, and may include power-washing, and hand scrubbing to remove aquatic vegetation. Prior to maintenance, the fishways must be dewatered. Dewatering occurs gradually to encourage fish to move out of the fishways. However, the potential for stranding remains. Fish salvage occurs to remove fish that are stranded and place them back into the river as soon as possible. Once dewatered, maintenance effects to water quality are likely to be minor.

Based on the 2005, 2006, and 2007 telemetry data an average of approximately 100% (26 total tagged bull trout/26 upstream passage events) of the total tagged fish ascended the adult fishway (LGL and Douglas PUD 2008). Using this information, the Service estimates approximately 76 adult bull trout will be injured annually through the use of the Project fishway; if 12% of these fish are alternate-year spawners (Downs *et al.* 2006, Appendix A), then 9 of these 76 bull trout will spend an extended amount of time in these FMO habitats and may be impacted to a greater degree. The primary mechanism of effect is the delay in passage and water quality effects to adult bull trout. As previously described, at least one entrance to the upstream fishway is open for upstream passage 100% of the time adult bull trout are in the mainstem Columbia, allowing full access to use seasonal habitats, move between core areas, and effectively forage throughout the Project. A small proportion of sub-adult bull trout may also attempt to ascend the adult fishways and may incur injury such as abrasions, scale loss, secondary infections, all of which can reduce growth and survival. Specifically, 31 sub-adult bull trout are expected to use the Project (Appendix A). Based on this number, we expect 31 sub-adult bull trout to be subject to these effects annually. These sub-adults may be at increased risk of predation from the adult fish using these fishways; we estimate 3 of these 31 fish may die from predation.

Fishway operations are anticipated to impact adult bull trout from all core areas in the action area. Overall, impacts to bull trout from the Methow, Entiat, and Wenatchee core areas are likely to be moderate, based primarily on the population trends and number of individuals anticipated to be affected. Although most of the impacts of this Project element are non-lethal, reductions in growth and survival during the maintenance period may be putting selective pressures on reproductive strategies and increasing the frequency of alternate-year spawning. This strategy produces fewer progeny than annually spawning fish, and may be one factor in the low numbers in the Methow core area. However, current restoration activities in the action area are expected to continue, as well as restoration actions associated with the proposed action, potentially increasing overall bull trout abundance. The Project monitoring proposed within the ASA would greatly enhance our understanding of the effects of this project element, especially deriving a genetic baseline and additional radio-telemetry tracking.

7.2.2.4 Tributary Conservation Plan and Committee

Because the exact nature, magnitude, duration, and other site-specific information of these restoration projects inherent to the *Tributary Conservation Plan* are unknown over the period of this license, only program-level effects of this Project Element are analyzed in this Biological Opinion. The following analysis assumes that some short-term adverse effects may occur, but long-term benefits are anticipated and will outweigh the negative impacts. Based on the wide range of restoration activities that has occurred so far in the Methow, Entiat, and Wenatchee Rivers, we anticipate most actions to occur outside of bull trout spawning and rearing areas and will likely emphasize culvert replacements (of passage barriers), side channel reconnection, and habitat enhancements. Most tributary conservation projects are proposed for salmon and steelhead, but should have secondary benefits to bull trout and their habitat.

Some direct and indirect effects on bull trout are likely to occur resulting from implementation of actions funded under the proposed action's *Tributary Conservation Plan*. The premise of the plan is the protection of existing productive habitat and restoration of high priority habitat by restoring, when practical, natural processes that, over time, will create and maintain suitable habitat conditions without human intervention. The plan will fund third party conservation efforts in the Methow and Okanogan river basins. Tributary conservation projects and plans to purchase conservation easement or land in fee will be submitted to the Wells Tributary Committee. Examples of projects to be funded by the plan may include, but are not limited to: 1) providing access to currently blocked stream sections or oxbows; 2) removing dams or other passage barriers on tributary streams; 3) improving or increasing the hiding and resting cover habitat that is essential for anadromous species during their relatively long adult holding period; 4) improving in-stream flow conditions by addressing water diversion or withdrawal structures; or 5) purchasing (or leasing on a long-term basis) conservation easements to protect or restore important aquatic habitat and shoreline areas.

The Wells Tributary Committee, of which the Service is a member, will decide if the projects meet criteria for funding. Projects will have to be reviewed by state and federal agencies to receive permits for construction. Habitat restoration projects will likely benefit bull trout through the protection of important habitat found within Mid-Columbia River bull trout core areas (USFWS 2002a). Projects that may increase in-stream flow volume and lead to decreased temperatures in the Methow River Basins will benefit all life stages of bull trout by improving access through migration corridors, pool depth, in-stream cover, and preferred water temperatures.

Habitat restoration projects are likely to require a period of construction that may result in short term disturbances such as noise, increased turbidity, and disturbance associated with increased human presence. Many of these activities may require dewatering of a stream reach to facilitate construction, involving fish removal and salvage, and can result in the injury or death of bull trout. Overall, these projects are expected to result in net positive benefits for bull trout if additional aquatic habitat is created by the project or if upstream migration barriers are removed allowing bull trout access back into historically utilized watersheds. However, passage barrier removal could potentially introduce non-native brook trout to isolated stream reaches where currently only resident bull trout exist. Any passage barrier which controls the upstream distribution of migratory bull trout, salmon or steelhead would likely act as a barrier to brook trout.

Based on the number and distribution of funded projects so far, relatively few projects are anticipated to occur in any subbasin each year. The Service acknowledges that this is a coarse estimate, and that it is conceivable that the number of projects conducted in a subbasin may vary based on a number of factors and objectives. However, the Service believes that effects of these actions will be moderated by review of the potential projects by the Wells Tributary Sub-Committee, in which the Service has representation. By selecting projects that provide some benefit to the bull trout, the conservation needs of the species are likely to be met to some degree. *Tributary Conservation Plan* projects are expected to benefit the bull trout in the long-term, in spite of any short-term adverse effects that occur and with the realization that most of these projects are anticipated for the benefit of salmon and steelhead. Although these actions are reasonably certain to occur and may result in the injury or death of bull trout, there is insufficient information to evaluate the site-specific location, nature, magnitude, timing, frequency, or duration of potential adverse effects. The effects of individual projects that utilize construction activities will require separate consultation in order to evaluate the potential for, and amount and extent, of incidental take.

7.2.2.5 Hatchery Management Plans

The following section addresses several elements representing hatchery activity and management. The section is organized by four specific action areas that include: (Action-1) hatchery management; (Action-2) operation of the Twisp Weir; (Action-3) hatchery genetic management program implementation; and (Action-4) release of juvenile salmonids.

Hatchery Management (Action-1)

It is anticipated that effects to bull trout associated with water quality and the use of fish traps (i.e., Methow Hatchery) will be the primary effect resulting from the continued operation and maintenance of hatcheries associated with the Wells AFA/HCP, specifically the Wells Hatchery and the Methow Hatchery. Water withdrawal for hatcheries located within the spawning and/or rearing areas can diminish stream flow from points of intake to outflow and, if great enough, can impede migration and affect spawning behavior. Hatchery facilities operating to carry out the proposed programs rely largely on ground water withdrawal. Hatchery operators are required to comply with water right permits administered by Washington Department of Ecology established for each hatchery site. This is intended to prevent over-appropriation of surface water needed for natural fish production and migration. Hatchery facilities are also required to maintain all screens associated with water intakes in surface water areas to NOAA-Fisheries screening criteria.

Hatchery effluent may transport pathogens (disease) out of the hatchery and infect bull trout. Hatcheries and fish rearing facilities supporting the Wells AFA/HCP *Hatchery Compensation Plan* are all operated in accordance with state and federal water pollution regulations. Each facility operates under a NPDES permit which specifies discharge requirements, in accordance with finfish culture specifications. The U.S. EPA has delegated responsibility to administer the NPDES permit program to the state of Washington on the basis of RCW 90.48, which defines the Department of Ecology's authority and obligations in administering the discharge permit program. Washington has issued a general state NPDES permit, renewed in April, 2000, that sets wastewater limits and sampling requirements for use of fish treatment drugs and chemicals. The Service finds that adherence to water right limits, water quality NPDES permits, and NMFS intake screening criteria are sufficient measures to protect bull trout within the action area from these effects. Long-term monitoring of water quality is important to assessing effects to bull trout at these facilities.

The Methow Hatchery's broodstock trap would also be another source of effects to bull trout associated with the hatchery supplementation program. As previously discussed in the project description, one bull trout was incidentally-captured at the Methow Hatchery in 2011. Effects to bull trout would be derived from physical contact with the structure and devices associated with the fish trap at the hatchery. Although we anticipate that most bull trout captured at this facility would be released back to the Methow River with no apparent injury, these fish likely experience effects associated with degraded water quality in the outflow channel of the hatchery and migratory delay once captured in the fish trap. Conversely, bull trout may also experience positive effects associated with the Methow Hatchery and Wells Hatchery since releases salmon and steelhead from these facilities likely provides an additional forage resource for bull trout in the vicinity.

Based on the information described in the Environmental Baseline (Section 5) and Appendix A, the Service estimates 76 adults and 31sub-adult bull trout will use the Wells Reservoir and may be harassed by the Wells Hatchery; at the Methow Hatchery, we expect approximately 324 adult and 50 sub-adults to be present (Appendix A). Based on the long-term nature of the proposed action for the Project (i.e., 30-50 years) and the increased likelihood of encounters with bull trout associated with this project element during that timeframe, lethal take of 2 adult bull trout and 5 subadult bull trout may occur during the implementation of this project element. These estimates are also based in part on Douglas PUD's characterization of bull trout take for this project element.Adult and sub-adult bull trout will likely experience some effect as a result of increased forage base from release of smolts and increased competition for prey. The effects on these adult and sub-adult bull trout depends in part on the resiliency of the local population(s) impacted annually and over the 30-50 year license term of the Project.

Operation of the Twisp Weir (Action-2)

Douglas PUD proposes the continued collection of anadromous salmonid broodstock from the Twisp Weir collection facility located on the Twisp River. As described in the project description, these facilities are owned by Douglas PUD and operated by the Washington Department of Fish and Wildlife and associated tribal entities. The proposed action includes the trapping facilities (i.e., fish boxes) and the weir structure itself in this analysis.

Data has shown that bull trout spawn and rear in the upper Methow River and the Twisp River, tributaries of the Columbia River located outside of the FERC-designated project area. Broodstock collection activities for anadromous salmonids are conducted at Twisp Weir by the Washington Department of Fish and Wildlife typically from April through August. In many instances the weir and associated broodstock fish traps were likely not operational during the entire trapping period due to high river flows and accumulation of debris. Bull trout migrate upstream through Wells Dam and into the Methow and Twisp rivers past the Twisp Weir by ascending the weir once it is in the lowered position or through the fish collection boxes during the broodstock collection timeframe. In general, the weir's fish trap boxes allow upstream passage of fish species during non-broodstock collection hours. The weir does experience short periods of time during the broodstock collection period when maintenance activities need to be completed. Once the broodstock collection timeframe has ended, the fish trap boxes are removed from the Twisp Weir and volitional upstream fish passage resumes past the weir. Bull trout typically migrate past the Twisp Weir during the months of June, July, and August. For example, 87 and 33 adult bull trout migrated upstream past the Twisp Weir during these months in 2010 and 2011, respectively. A total of 62 sub-adult bull trout were also PIT-tagged at Douglas PUD's off-site smolt collection facility on the Twisp River. This timeframe typically overlaps with the migration of bull trout in the Wenatchee River. The Twisp Weir and associated acclimation pond are located downstream of important spawning and rearing grounds for bull trout. Because of the Twisp Weir's proximity to spawning habitat, this is the only location within the Action Area where juvenile bull trout (<150mm) are anticipated to be exposed to Project effects. Bull trout have been found to successfully pass upstream of the weir, however, the specific route of downstream passage for bull trout through the weir is not well-known. Downstream migrating adults, subadults, and juveniles have the option passing upstream over the picketed-lead structure of the dam or through the facility's fish trap boxes during broodstock collection activities. Twisp Weir trapping operations for anadromous salmonids are closely monitored. Douglas PUD concludes that no verified effects (injury and mortality) on bull trout have been currently substantiated indicating minimal potential for incidental take. Douglas PUD also concludes the weir does not appear to have a direct impact on spawning habitat for bull trout.

Nonetheless, adult and sub-adult bull trout are likely to encounter effects resulting from the utilization of the Twisp Weir's fish trapping facilities and the weir's hydraulically-operated picketed lead structure. Since a significant portion of anadromous salmonid runs are sampled for broodstock at this facility, migratory delay effects resulting from the holding and processing of target species are likely. Adult bull trout passing upstream through the fish trap boxes at the Twisp Weir may exert increased levels of energy. The potential also exists for adult bull trout migrating upstream through the fish trap boxes to experience contact with structural features of the weir (vertical slots of the weir itself and the fish trap boxes, in addition to crowding within the fish trap boxes) and potential injury. Specifically, the facility's fish trap boxes are checked daily during collection activities, however, some fish (including bull trout) could be held in the facility's holding well for up to 24 hours. These types of conditions likely create additive physiological stress on adult bull trout during upstream passage through past the weir and associated broodstock facility due to elevated temperature regimes, injury, and even death. For this reason, the Service believes 1 adult bull trout may be killed annually at the Twisp Weir.

Based on the information described in the Environmental Baseline (Section 5) and Appendix A, the Service estimates 118 adult bull trout, 31 sub-adults, and 19 juvenile bull trout at the Twisp Weir may be impacted by broodstock collection activities. Adult and juvenile/sub-adult bull trout will likely experience some direct effects associated with upstream passage, handling, and water quality. Both adult and juvenile/subadult bull trout are susceptible to sublethal effects from passage and handling as a result of these factors. Based on the Twisp Weir passage data the Service estimates that 118 adult bull trout, 31 sub-adult bull trout, and 19 bull trout originating from the Methow Core Area, will be affected.

Using this information, the Service estimates approximately 118 adult bull trout, 31 sub-adult bull trout, and 19 juvenile bull trout at the Twisp Weir will be injured annually through the use of the associated broodstock collection facility and upstream passage at these structures; if 12% of the adult fish are alternate-year spawners (Downs *et al.* 2006, Appendix A), then 14 of these 118 adults at the Twisp Weir will spend an extended amount of time in FMO habitats and may be impacted to a greater degree. The primary mechanism of effect is the delay in passage, handling, and contact with facility structures.

As previously described, the broodstock collection facilities are operated approximately 80% (7 days a week and up to 24 hours a day) of the time adult and juvenile/sub-adult bull trout are in the mainstem Methow River, impacting their ability to use seasonal habitats and move between local populations which can result in reduced growth and survival. Nearly all adults and a small proportion of juvenile/sub-adult bull trout may also attempt to ascend the fishways and may incur injury such as abrasions, scale loss, and secondary infections, all of which can reduce growth and survival. Specifically, 31 subadult and 19 juveniles at the Twisp Weir were assumed to be present as described in Appendix A. The Service expects adverse effects primarily to the the adult and sub-adult life history stages.

These broodstock collection facilities are anticipated to impact adult bull trout from the Methow core area. Overall, impacts to bull trout from the Methow core area are likely to be moderate based primarily on the population trends and number of individuals anticipated to be affected. Although most of the impacts of this Project element are non-lethal, reductions in growth and survival may be putting selective pressures on reproductive strategies and increasing the frequency of alternate-year spawning. However, current restoration activities in the action area are expected to continue, as well as restoration actions associated with the proposed action, potentially increasing overall bull trout abundance. Project monitoring would greatly enhance our understanding of the effects of this project element, especially deriving a genetic baseline and additional radio-telemetry tracking.

As a result, the Service believes that 118 adults, 31 subadults, and 19 juvenile bull trout at the Twisp Weir may be harmed and harassed by the broodstock collection facilities at this site. Approximately 14 of these 118 adults at the Twisp Weir will spend an extended amount of time in FMO habitats and may be impacted to a greater degree. We estimate 1 of these 31 sub-adults at the Twisp Weir may die from effects of the weir. The effects of these adult and juvenile/sub-adult bull trout being harmed or harassed depends in part on the resiliency of the local population(s) impacted annually and over the 30-50 year term of the Project.

Hatchery Genetic Management Plan Implementation (Action-3)

In 2010, new HGMPs were developed and approved by the Wells AFA/HCP Hatchery Committee for UCR spring Chinook salmon and UCR steelhead. Once approved by NMFS and the FERC, these new HGMPs will require modification to programs previously authorized at the Methow and Wells Fish hatcheries.

Numerous effects to the bull trout may result from the implementation of Douglas PUD's HGMPs. These may be associated with broodstock collection, stock assessment and research, juvenile rearing, transfers, and releases, ecological effects such as predation, competition, behavioral effects, and disease transmission, in addition to activities associated with juvenile fish monitoring. Bull trout may be incidentally removed from the natural environment during broodstock collection, therefore resulting in adverse effects due to trapping and handling. Stock assessment and research related to salmon and steelhead may also result in adverse effects of bull trout due to trapping and handling of bull trout. Factors associated with hatchery supplementation of salmon and steelhead smolts may also lead to incidental take of bull trout through competition for forage resources, predation, disease transmission, and behavioral modification. Based on the long-term nature of the proposed action for the Project (i.e., 30-50 years) and the increased likelihood of encounters with bull trout associated with this project element during that timeframe, the Service estimates 2 adult bull trout and sub-adult bull trout may be hooked and die; 76 adult and 31 juveniles/sub-adults will be harmed or harassed. These estimates are based on previous estimates from the Service's consultation on the issuance of the Wells AFA/HCP and Douglas PUD's estimation of take associated with this project element.

Juvenile Salmonid Release (Action-4)

In accordance with section 8 of the Wells AFA/HCP, Douglas PUD's *Hatchery Compensation Plan* entails numerous programs for the release of juvenile salmon and steelhead into the mainstem Columbia River and its associated tributaries. Many of these programs originate from the Wells Hatchery and Methow Hatchery, but in the future fish will also originate from the Chief Joseph Hatchery. Species specific hatchery program objectives developed by the fishery agencies may include contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest. Release of these juvenile salmon and steelhead likely has both beneficial and negative effects on bull trout. For bull trout that are large enough to consume these juvenile salmon and steelhead, these annual releases likely represent a prey bonanza that contributes to a rapid accumulation of energy reserves. These reserves may promote increased growth and gamete production and increased survivorship. Juvenile salmon and steelhead move downstream relatively rapidly, however, limiting the time that this prey resource is available. For smaller bull trout, especially those that are about the same body size or smaller than juvenile salmon and steelhead, release of the juvenile salmon and steelhead introduces a large number of fairly homogeneous competitors for food and space into the Methow River and the mainstem Columbia River. For these bull trout, rapid downstream movement by this swarm of competitors helps to minimize the duration of competitive interactions. Downstream migration of salmon and steelhead may deplete some prey resources, such as some macroinvertebrates, and rebuilding of this macroinvertebrate prey base may not occur for a prolonged period after the juvenile salmon and steelhead have emigrated. Small bull trout confronted with depleted prey resources may move away from familiar territories in search of food. These movements may expose bull trout to increased predation risk. The potential for bull trout in all life stages to contract diseases from hatchery juvenile salmon and steelhead is unknown. We also anticipate positive and negative effects to adult bull trout, however, there is inadequate information to substantiate these positive and negative effects to these fish exposed as a result of this project element.

Although these actions are reasonably certain to occur and may result in the injury or death of bull trout, there is insufficient information to evaluate the site-specific location, nature, magnitude, timing, frequency, or duration of potential adverse effects. Based upon the location of these juvenile salmon and steelhead releases and Appendix A, we anticipate 629 adult bull trout, 113 sub-adult bull trout, and 13 juveniles to be exposed to these forage resource and competition effects discussed above.

7.2.2.6 Predator Control Program

Section 4.3.3 of the Wells AFA/HCP requires Douglas PUD to implement a targeted northern pikeminnow, piscivorous bird and piscivorous mammal harassment and control program with the goal of reducing the level of predation upon salmonids migrating through the Wells Project. However, the pikeminnow removal program may also result in the harassment, incidental capture and potential mortality of bull trout.

Northern pikeminnow are native predators of juvenile and subadult bull trout. The *Northern Pikeminnow Removal Program* (NPRP) included a northern pikeminnow bounty program, participation in fishing derbies and tournaments, hook and line fishing by experienced anglers and the use of longline fishing equipment. Currently longline fishing is the most effective method utilized in the Project; however, Douglas PUD may also utilize other methods to be developed during the course of the new license term.

There is a potential for individual bull trout to be caught during northern pikeminnow longline angling. From inception in 1995 through 2007 Douglas PUD's NPRP has captured over 154,000 northern pikeminnow. During that time no bull trout have been incidentally captured during longline fishing.

From 1995-1999, the NPRP implemented by Douglas PUD consisted mainly of experienced anglers using hook and line techniques to remove northern pikeminnow from Wells Project waters. Traditionally, hook and line angling has lacked the ability to target species specifically. Incidental captures of steelhead, cutthroat, walleye and bass were documented during these activities. No bull trout were captured but the potential for capture appeared to be too high. As such, Douglas PUD currently does not use rod and reel angling for the removal or predator pikeminnow in the Wells Project.

More recently (2000-present), the NPRP has shifted to a longline fishing system. This new system has proven to be more cost efficient and effective at targeting northern pikeminnow. Longline fishing gear has a low probability of catching bull trout by fishing deeper in the water column using small hooks typically baited with dead crickets. Lines are checked daily in order to release any species other than northern pikeminnow. To date the incidental catch rate of bull trout by longline fishing has been zero.

The NPRP is a required Wells AFA/HCP action implemented to benefit listed Columbia River salmonids. The operation of the program is likely to benefit bull trout by increasing juvenile salmonids in the mainstem Columbia, a forage base for bull trout. Increased survival of salmonids will increase the distribution of ocean nutrients into the upper reaches and tributaries of the Columbia River when these fish return from the ocean to spawn and die. The removal of northern pikeminnow is also likely to reduce predation on subadult adfluvial bull trout entering the mainstem Columbia as they migrate out of their natal tributaries. Pikeminnow removal is also expected to benefit bull trout rearing in the reservoir by reducing competition for prey.

Other threats to bull trout include predation by piscivorous birds and mammals. The focus of managing these species is not removal but hazing and access deterrents. Hazing includes propane cannons, pyrotechnics and the physical presence of hazing staff. Access deterrents include steel wires across the hatchery ponds and tailrace, fencing and covers for hatchery ponds, and electric fencing. When hazing and access deterrents fail, options for removal are also implemented by the US Department of Agriculture (USDA) Animal Control staff hired to conduct the hazing programs. The minor increase in human activity as a result of the avian and mammal predator control measures is unlikely to adversely affect bull trout. Similar to pikeminnow removal, the reduction in predation on salmonids will likely increase the prey base for foraging bull trout.

In Section 4.5.1 of the ASA, Douglas PUD states that if incidental take from the Predator Control Program exceeds allowable levels, Douglas PUD will develop a new plan with the Wells AFA/HCP Coordinating Committee and the Aquatic SWG. This plan will address factors contributing to the exceedance and seek a resolution.

Based on the information described in the Environmental Baseline (Section 4) and Appendix A, the Service estimates 76 adults and 31 sub-adult bull trout will use the Wells Reservoir and may be impacted by the pikeminnow predator control program. Sub-adult bull trout will likely experience a beneficial effect as pikeminnows are removed and their mortality rate presumably decreases. However, it is possible that a sub-adult bull trout may be injured or killed as a result of this angling targeting pikeminnows. As a result, 1 sub-adult may be killed as a result of this Project element.

Adult bull trout may be incidentally hooked and can be injured or killed. Based on the long-term nature of the proposed action for the Project (i.e., 30-50 years) and the increased likelihood of encounters with bull trout associated with this project element during that timeframe, the Service estimates 2 adult bull trout and 1 sub-adult bull trout may be hooked and die. This number is based on previous estimates from the Service's consultation on the issuance of the Wells AFA/HCP and Douglas PUD's estimation of take associated with this project element. The effect of 2 adult bull trout and 1 sub-adult bull trout dying depends in part on the resiliency of the local population(s) impacted annually and over the 30-50 year term of the Project.

7.2.3 *Aquatic Settlement Agreement*

A number of post-relicensing management plans, which have been fully designed, are part of the proposed action (Douglas PUD 2010 and FERC 2011). They include a variety of activities, including fish surveys for multiple species and associated aquatic resources, habitat monitoring and assessment, and implementation monitoring. These activities may occur throughout the action area with variable amounts of intensity. Many of these activities may involve capture, handling, marking (e.g., pit-tagging, wire tags, radio tags, etc.), or sampling (e.g., fin clips for genetic sampling), which can result in the injury or death of bull trout. Some of these methodologies can be substantial in their impact, involving gill nets or physical features that may temporarily impair or preclude fish passage. Habitat assessment and monitoring can vary in their effects to bull trout, ranging from negligible to severe impacts depending on the activity. Accordingly, we will discuss the effects associated with each of these management plans.

7.2.3.1 Water Quality Management Plan

The *Water Quality Management Plan* entails several actions, some of which could potentially affect bull trout. The focus of this plan is to protect and improve mainstem water quality and to operate in accordance with a *Spill Prevention Control and Countermeasure* (SPCC) *Plan*, implementing applicable portions of the Columbia-Snake River Spill Response Initiative (CSR-SRI).

Temperature monitoring and SPCC/CSR-SRI implementation are expected to have beneficial effects on bull trout. These types of monitoring will enable Douglas PUD to maintain compliance with designated water temperature criteria for the Project's forebay, fishways, and tailrace areas. The SPCC/CSR-SRI implementation will also assist in minimizing the exposure of bull trout to chemical contaminants originating from the Project.

TDG management actions have the potential to affect bull trout as well. Actions to manage and control TDG will include measures to reduce the frequency and volume of spill (minimize fish passage spill, spill due to maintenance, and spill past unloaded units) and measures to reduce the amount of TDG introduced into the river during spill (fish passage spill management, alternative spillway gate operations). These actions are expected to benefit bull trout survival and reduce their exposure to TDG. These measures are subject to review and approval by the Wells AFA/HCP Coordinating Committee. For example, the measure to minimize fish passage spill is subject to a determination by the Wells AFA/HCP Coordinating Committee that juvenile survival standards will still be achieved. Any modifications to spill management, including alternative spillway gate operations, will be analyzed prior to implementation. The desired result is achieving the survival standards stated in the Wells AFA/HCP. Based on the long-term nature of the proposed action for the Project (i.e., 30-50 years) and the increased likelihood of encounters with bull trout associated with this project element during that timeframe, harassment of 76 adult bull trout and 31 subadult bull trout, and lethal take of 1 adult bull trout and 2 subadult bull trout may occur during the implementation of this Project element. These estimates are also based in part on Douglas PUD's characterization of bull trout take for this project element.

7.2.3.2 Bull Trout Management Plan

The *Bull Trout Management Plan* includes operating the adult fishway and downstream fish bypass systems in accordance with criteria established in the Wells AFA/HCP for anadromous salmonids, monitoring adult bull trout passage, and monitoring sub-adult bull trout passage (when feasible). In certain cases, Douglas PUD may modify the upstream fishway, downstream bypass system, or project operations to reduce impacts to bull trout.

It is anticipated that the monitoring of effects on bull trout habitat is not expected to significantly affect bull trout. However, physical handling of bull trout during monitoring studies conducted during the implementation of this plan may result in injury and/or mortality. The Service's 2004 Biological Opinion contained measures to monitor bull trout movements through the Project, specifically, the handling and tagging of bull trout. As described in the project description for the Project, numerous bull trout were tagged from 2001-2007 in accordance with past studies. As a result, these types of tagging procedures expose bull trout to handling, surgical procedures, and exposure to low levels of chemicals such as those contained in sunscreens. However, the scope and nature of these measures in Douglas PUD's proposed *Bull Trout Management Plan* would occur at 10-year intervals over the course of the new 30-50 year license, or as determined by the Service in coordination with Douglas PUD and associated fishery resource agencies. As a consequence this level of injury and/or mortality is likely to continue over the course of the new license term. Based on the long-term nature of the proposed action for the Project (i.e., 30-50 years), the increased likelihood of encounters with bull trout associated with this project element during that timeframe, and the average number of bull trout that Douglas PUD has radiotagged during previous studies, the Service estimates that the periodic sampling of bull trout for research purposes could result in up to 9 bull trout being harmed or harassed and as many as 2 being killed. This take estimate would also apply to any research studies implemented under this plan, including bull trout assessments of incidental take at the Twisp Weir. These estimates are also based in part on Douglas PUD's characterization of bull trout take for this project element.

Implementation of any physical modifications to the Project's fishways for bull trout will likely improve passage for this species; however, these same types of modifications may reduce the efficacy of the passage systems for salmon and steelhead. In this case, because the Wells AFA/HCP Coordinating Committee must approve any such modifications to ensure consistency with passage system criteria established in the Wells AFA/HCP for salmon and steelhead, it is likely that fishway modifications tailored for bull trout will be consistent with salmon and steelhead. In addition, any significant modifications to the adult fishway, downstream bypass system or project operations would require FERC approval and would require additional ESA consultation if the level of take anticipated for these project elements in this biological opinion is expected to be exceeded.

7.2.3.3 Pacific Lamprey Management Plan

The *Pacific Lamprey Management Plan* includes studies of Pacific lamprey upstream passage success, operation of the adult fish and downstream fish bypass system in accordance with criteria established in the Wells AFA/HCP for anadromous salmonids, monitoring of juvenile lamprey habitat, determination of Project impacts to juvenile lamprey downstream passage, and reservoir sampling for juvenile lamprey. In certain cases, Douglas PUD may modify the adult fishway to improve conditions for Pacific lamprey passage.

Studies and monitoring for effects on Pacific lamprey are not expected to cause significant effects to habitat components for bull trout. However, implementation of any physical modifications to passage systems could cause temporary adverse effects if such modifications were to create obstructions that interfered with attraction or passage conditions for bull trout. Any proposed modifications (i.e., reduction of fishway flows) will be analyzed prior to implementation and modified, as needed, to minimize the potential for impacts to the Columbia River migratory corridor for bull trout. Post implementation monitoring of salmonid passage will detect and result in correction of any unforeseen effects. Approval by the Wells AFA/HCP Coordinating Committee of any modifications to the fishway for Pacific lamprey passage will require that the modifications maintain criteria established for salmon and steelhead in the Wells AFA/HCP. Any significant modifications to the adult fishway, downstream bypass system, or project operations would require FERC approval and would also require additional ESA consultation if the level of take anticipated for these project elements in this biological opinion is expected to be exceeded.

During the term of the new license Douglas PUD may implement at adult passage or acoustic tag study, whereby adult fish may be trapped in fish ladders or collected via electro shocking or netting (block, dip, beach seine). In addition, juvenile distribution surveys in the reservoir and tributaries may be implemented in year three of the license. Similar capture methods would be used. Based on the long-term nature of the proposed action for the Project (i.e., 30-50 years) and the increased likelihood of encounters with bull trout associated with this project element during that timeframe, incidental capture and delay of 2 adult bull trout and up to 5 subadult bull trout, and lethal take of 1 adult bull trout and 1 subadult bull trout may occur during these sampling and field exercises. These estimates are also based in part on Douglas PUD's characterization of bull trout take for this project element.

7.2.3.4 White Sturgeon Management Plan

The *White Sturgeon Management Plan* will stock Wells Reservoir with hatchery origin sturgeon in an effort to increase the local population in the Wells Reservoir. Other segments of the Columbia River below Wells Dam will also experience increased populations of white sturgeon due to downstream emigration of a portion of the stocked fish. In addition, a monitoring program will include sturgeon sampling in the Wells Reservoir to monitor growth and survival of these fish.

Increasing the white sturgeon population in the Wells Reservoir entails broodstock planning and collection. Possible sources of broodstock are numerous but would include collection from the Wells, Priest Rapids, Wanapum, Rocky Reach, Rock Island, or McNary reservoirs. Broodstock could also be collected from below Bonneville Dam in the lower Columbia River. It is the intent of Douglas PUD to use the progeny of the initial source of brood stock, if feasible, in the future for the white sturgeon stocking program. Rearing and acclimation would occur at a hatchery within the Mid-Columbia Basin not designated at the time of this consultation. Rearing and acclimation of juvenile white sturgeon will likely have minimal impact on bull trout, however, the timing and capture of brood stock in the Wells Reservoir and associated reservoirs will likely overlap when adult and, to a lesser extent, subadult bull trout are present in the Mid-Columbia River on a seasonal basis. Broodstock capture techniques (i.e., hook and line sampling) intended to capture fecund white sturgeon or the collection of larval sturgeon will likely result in the incidental capture of adult and subadult bull trout. Increased physical harm and/or mortality to bull trout would result from this activity.

Within two years following issuance of the new license, Douglas PUD shall release up to 5,000 yearling white sturgeon into the Wells Reservoir and annually for four consecutive years (20,000 fish total). Additional years and numbers of juvenile sturgeon to be stocked during Phase I will be determined by the Aquatic SWG and will not exceed 15,000 juvenile sturgeon (total of 35,000 juvenile sturgeon during Phase I). The supplementation phase of the *White Sturgeon Management Plan* is likely to provide some benefit to bull trout populations by increasing densities of a historically important prey item (i.e., juvenile white sturgeon) in the Mid-Columbia River. Conversely, an increase in historically important prey items in tributaries and mainstem habitats will likely increase competition between bull trout and other fish species for these food resources.

In addition to the supplementation activities, a white sturgeon monitoring program will be implemented. Monitoring will include both an indexing program and assessments of emigration rates from the reservoir, habitat use, and spawning locations through tracking of active-tagged white sturgeon. Douglas PUD will also investigate other white sturgeon recovery programs that are collecting information regarding white sturgeon supplementation, and use the data to refine the implementation of the monitoring program. The result of this information will assist Douglas PUD to adjust future stocking rates. The monitoring components of this plan are not expected to significantly affect bull trout. However, the incidental physical handling and capture of bull trout during white sturgeon monitoring studies conducted during the implementation of this plan may result in injury and/or mortality. Activities with the potential to capture adult bull trout include the use of longline and rod and reel angling for juvenile and adult sturgeon tracking, index monitoring and brood stock collection, the use of hook and line, gill nets and beach seines for the collection of habitat utilization data. Mortality from this activity is not expected to exceed that anticipated for the predator control component. Based on the long-term nature of the proposed action for the Project (i.e., 30-50 years) and the increased likelihood of encounters with bull trout associated with this project element during that timeframe, the Service estimates 2 adult bull trout and 5 subadult bull trout may be incidentally collected and released during implementation of the monitoring component of the White *Sturgeon Management Plan.* Lethal take of no more than 1 adult and 1 subadult may occur during implementation of this plan. These estimates are based on previous estimates for predator control effects in the Service's consultation on the issuance of the Wells AFA/HCP. The effect of 1 adult bull trout and 1 subadult dying depends in part on the resiliency of the local population(s) impacted annually and over the 30-50 year term of the Project. These estimates are also based in part on Douglas PUD's characterization of bull trout take for this project element.

7.2.3.5 Resident Fish Management Plan

The *Resident Fish Management Plan* consists of habitat measures to protect native resident fish populations and habitat in the Wells Project during the term of the new license. The plan includes measures to minimize the effects of project operations on the spawning, rearing, and migration of resident fish in the project area. Douglas PUD will also continue the implementation of measures contained in the Wells ASA/HCP Predator Control Program and the Shoreline Management Plan to protect resident fish assemblages in the Wells Reservoir. The last component of the plan will include a resident fish assessment to determine the relative abundance of the various resident fish species found within the Wells Reservoir. The study will focus on (1) identifying whether there have been major shifts in the resident fish populations resulting from the implementation of the White Sturgeon, Bull Trout, Pacific Lamprey, and Aquatic Nuisance Species Management Plans and (2) collecting information on predatory fish populations found within the Wells Reservoir. The results of this study will be used to inform the implementation of the aquatic resource management plans and predator control activities.

Components of the management plan may have effects on bull trout. If these components result in reductions in the numbers of fishes that bull trout prey upon, the management plan will have a negative effect on bull trout. Conversely, a reduction in the numbers of fishes that potentially prey on bull trout will be beneficial in the sense of reducing "obstructions" in the Columbia River migratory corridor.

These activities are likely to involved seining, trapping, electrofishing and angling and thus should each have some take associated with them. These activities will occur in index areas of the Wells Project and like other collection activities are not expected to appreciably harm or encounter bull trout. However, resident fish indexing will occur during periods when bull trout may be moving from overwintering habitat to spawning grounds and as such, they may be encountered. Based on the long-term nature of the proposed action for the Project (i.e., 30-50 years) and the increased likelihood of encounters with bull trout associated with this project element during that timeframe, the Service expects 1 adult and 2 sub-adults to be injured and killed during resident fish management plan implementation. These estimates are also based in part on Douglas PUD's characterization of bull trout take for this project element.

7.2.3.6 Aquatic Nuisance Management Program

The *Aquatic Nuisance Species Management Plan* (ANSMP)(Douglas PUD 2010) is comprised of several actions to monitor the spread of nuisance species in the Wells Reservoir, some of which could potentially affect bull trout. The focus of this plan is to implement best management practices to prevent the spread of aquatic nuisance species such as Eurasian watermilfoil (*Myriophyllum spicatum*) and associated proliferation during in-water (i.e., construction, maintenance and recreation improvements) improvement activities in the Project.

Nonnative aquatic species may be released or "introduced" into an aquatic environment intentionally or unintentionally. Most often, such species are unable to adapt to their new environments and do not form self-sustaining populations (ANSC 2001). However, if such a species is able to adapt, become established and thrive, it has the potential to threaten the diversity or abundance of native species and aquatic habitats and may even affect economic resources and human health. Such species are considered aquatic nuisance species or ANS (ANSC 2001).

RCW 77.60.130 defines the term aquatic nuisance species as a "nonnative aquatic plant or animal species that threatens the diversity or abundance of native species, the ecological stability of infested waters, or commercial, agricultural, or recreational activities dependent on such waters (RCW, 2007)." Since few natural controls exist in their new habitat, ANS may spread rapidly, damaging recreational opportunities, lowering property values, clogging waterways, impacting irrigation and power generation, destroying native plant and animal habitat, and sometimes destroying or endangering native species (ANSC 2001).

Many of the actions inherent to the ANSMP will likely have some level of benefit to bull trout in that the plan will minimize the spread of nuisance species and provide ecological stability (i.e., maximizing invertebrate forage resources) for bull trout which use the project area. These actions include the deployment of substrate mats, benthic samplers, substrate samplers, snorkel transects, plankton tow sampling, netting, and crayfish monitoring. All of these actions entail the netting of aquatic nuisance species through the use of trapping, hand capturing, or netting when bull trout may be present. However, we anticipate the crayfish monitoring component of the ANSMP is likely the only action that will result in the take of bull trout. This is because crayfish monitoring may involve the use of minnow or crayfish traps, buoys, and bait which may harm, harass, or potentially kill bull trout.

Based on the long-term nature of the proposed action for the Project (i.e., 30-50 years) and the increased likelihood of encounters with bull trout associated with this project element during that timeframe, the Service expects 1 adult bull trout and 1 subadult to be lethally taken during the crayfish monitoring component of this project element. These estimates are also based in part on Douglas PUD's characterization of bull trout take for this project element.

7.2.4 Terrestrial Management Plans

The following section describes the potential interaction and resultant effects from implementing the FERC Terrestrial Management Plans to bull trout.

7.2.4.1 Wildlife and Botanical Management Plan

The Wildlife and Botanical Management Plan is a terrestrial-based measure designed to protect and enhance RTE wildlife species' habitat and native habitat on Wells Project lands and includes protecting RTE botanical species from land-disturbing activities and herbicide sprays;

conserving habitat for species protected by the federal ESA, Bald and Golden Eagle Protection Act, and Migratory Bird Treaty Act; maintaining productive wildlife habitat on the Cassimer Bar Wildlife Management Area; and controlling noxious weeds on project lands. These activities will have negligible if any impact to aquatic resources or bull trout. Actions that may have the potential to negatively impact bull trout or their critical habitat will require a separate ESA consultation with the Service prior to implementation.

7.2.4.2 Avian Protection Plan

The Avian Protection Plan is a terrestrial-based measure to ensure that Project features and general terrestrial maintenance are appropriately conducted to protect surrounding avian resources. Specific measures identify tree-clearing practices, installation and maintenance of flight diverters, and record keeping of observed mortalities. These activities will have negligible if any impact to aquatic resources and only work to not impact existing avian resources. These activities do not enhance existing bird populations and would likely not pose any increase in possible aviation predation on bull trout. No impact to bull trout or their critical habitat is anticipated during the implementation of the APP.

7.2.4.3 Recreation Resources Management Plan

As described in the Project description, the proposed action includes a number of recreation facilities associated with the Wells Reservoir. In general, the Wells Reservoir area and associated Project lands are open for use by the public for recreational purposes subject to the provisions of Douglas PUD's *Recreation Management Plan* (Douglas PUD 2011). These provisions include a roadmap for operating, maintaining, updating, and improving the existing recreation facilities and a process for meeting recreation needs as they change over time. These developments can have a wide range of effects to bull trout and its habitat, including shoreline development (which can accelerate erosion, impact riparian functions, etc.), use of fertilizers and herbicides that degrade water quality, hazard tree removal (which can impact large woody debris recruitment and function, etc.), and the potential for gas and oil contamination at boat launches, all of which can result in direct and indirect effects to bull trout.

Although these actions are reasonably certain to occur and may result in the injury or death of bull trout, there is insufficient information to evaluate the site-specific location, nature, magnitude, timing, frequency, or duration of potential adverse effects. Actions that have the potential to negatively impact bull trout or their critical habitat will require a separate ESA consultation with the Service prior to implementation.

7.2.4.4 Historic Properties Management Plan

Compliance with the Douglas PUD Land Use Policy ensures the compatibility of public and commercial occupancy of Project land (public land) with project operations, compliance with FERC license articles, and federal and state laws. Significant cultural resource sites on Project lands are subject to protection under Articles 41 and 44 of the Wells FERC License and section 106 of the *National Historic Preservation Association (*NHPA).

Under the NHPA, Douglas PUD is required to address potential impacts to cultural resources that may be affected by Project-related activities conducted in compliance with the FERC license. Procedures for addressing cultural resource issues are defined in Douglas PUD's proposed *Historic Properties Management Plan* (HPMP). Douglas PUD will follow the guidelines of the HPMP prior to issuing any land use permits. If a permit is issued, the proponent will be required to pay for any additional archaeological work related to the proposed land use activity.

Federal law prevents Douglas PUD from disclosing the location of archaeological and cultural sites. Permits for these locations will either not be issued, or will include special conditions to ensure protection of the cultural resource site.

The continued preservation of these sites can have a wide range of effects to bull trout and its habitat, including shoreline development (which can accelerate erosion, impact riparian functions, etc.), use of fertilizers and herbicides that degrade water quality, hazard tree removal (which can impact large woody debris recruitment and function, etc.), and the potential for gas and oil contamination at boat launches, all of which can result in direct and indirect effects to bull trout. The type and level of effects on bull trout can vary widely, depending on the setting, size, and visibility of the resource, as well as whether there is public knowledge about the location of a particular cultural resource.

Although these actions are reasonably certain to occur and may result in the injury or death of bull trout, there is insufficient information to evaluate the site-specific location, nature, magnitude, timing, frequency, or duration of potential adverse effects. Actions that have the potential to negatively impact bull trout or their critical habitat will require a separate ESA consultation with the Service prior to implementation.

7.2.4.5 Land Use Policy

The Douglas PUD Land Use Policy does not have any associated direct actions within the Project. The Policy is a decision making process for issuing any land use permit for commercial and private use of Wells Project land and waters. The Policy protects against any external activity that might go against the goals, objectives, and protective measures established within the Wells AFA/HCP, ASA, and FERC license.

7.3 Summary of the Effects of the Proposed Action

To assist the Service in determining the effects of the Wells relicensing on bull trout, the Service utilized a draft *Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale* (Matrix or MPI). This tool uses 24 indicators to analyze impacts to bull trout and bull trout habitat at multiple scales. The Matrix also enables the Service to uniformly and consistently determine the impacts resulting from a variety of projects. We used the pathways and indicators set forth in the Matrix to assess the existing condition of the action area and associated Project impacts resulting from the proposed relicensing of the Wells Hydroelectric Project. This allows a direct comparison of the existing conditions and the effects to aquatic resources, specifically bull trout.

Due to a lack of historical information for comparison, many of the baseline conditions and impacts from the Project must be qualitatively compared. For this analysis, the Service used the following pathways (comprised of one or more indicators) in its examination of bull trout within the context of the continued operation and maintenance of the Project: 1) population characteristics; 2) water quality; 3) habitat access; 4) habitat elements; 5) channel condition and dynamics; 6) flow/hydrology; and 7) watershed conditions (Table 8). More detailed discussion related to the degree and magnitude of effects for the proposed action in relation to the Matrix can be found later under Significance of the Effects (Section 7.4).

Table 12. Summary of the Wells relicensing and primary effects to bull trout and habitats by MPI (excluding project operations). An "(-) indicates a negative effect while a (+) indicates that a net positive effect occurs to the MPI from some aspect of the Project Element.

MPI	Operations			HCP Measures												ASA						Terrestrial Management Plans				
	Turbine Operation (A-1)	Spillway Operation (A-2)	Reservoir Operation (A-3)	Passage Survival Plan	Wells Dam Juvenile Dam Passage Plan	*-Fish Bypass Operation (A-1)*	*-Juvenile Survival Study (A-2)*	Wells Dam Adult Dam Passage Plan	Tributary Conservation Plan and Committee	Hatchery Management Plans	*-Hatchery Management (A-1)*	*-Operation of the Twisp Weir (A-2)*	*-HGMP Implementation (A-3)*	*-Juvenile Salmonid Release (A-4)*	Predator Control Program	Water Quality Management Plan	Bull Trout Management Plan	Pacific Lamprey Management Plan	White Sturgeon Management Plan	Resident Fish Management Plan	Aquatic Nuisance Management Plan	Wildlife and Botanical Management Plan	Line Avian Protection Plan	Recreation Resources Management Plan	Historic Properties Management Plan	Land Use Policy
Population Characteristics	–	–	–	+	+	+	–	+	+	+/-	-	–	–	+/-	+	+	+/-		+/–	+/-	+	+/-		–	–	+
Temperature	–	–	–					–	+/-	–	–										+			–		
Sediment	–								+/-																–	
Chemical Contamination/ Nutrients	–	–				–		–		–	–	-									+			–		
Physical Barriers	–	–				+/–		+/–	+/-	–		–														
Substrate Embeddedness	–	–	–						+/-	–	–															
Large Woody Debris			–						+/-															–		
Pool Frequency and Quality			–						+/-																	
Large Pools			–						+/-																	
Off-Channel Habitat			–						+/-															–		
Refugia			–						+/-			–	–	–	+						+					
Average Width/ Depth Ratio			–						+/-	–	-	-														
Streambank Condition			–			–			+/-	-	-	–												–	–	

Table 8. (Continued)

MPI	Operations			HCP Measures												ASA						Terrestrial Management Plans				
	Turbine Operation (A-1)	Spillway Operation (A-2)	Reservoir Operation (A-3)	Passage Survival Plan	Wells Dam Juvenile Dam Passage Plan	*-Fish Bypass Operation (A-1)*	*-Juvenile Survival Study (A-2)*	Wells Dam Adult Dam Passage Plan	Tributary Conservation Plan and Committee	Hatchery and Genetic Management Plans	*-Hatchery Management (A-1)*	*-Operation of the Twisp Weir (A-2)*	*-HGMP Implementation (A-3)*	*-Juvenile Salmonid Release (A-4)*	Predator Control Program	Water Quality Management Plan	Bull Trout Management Plan	Pacific Lamprey Management Plan	White Sturgeon Management Plan	Resident Fish Management Plan	Aquatic Nuisance Management Plan	Wildlife and Botanical Management Plan	Line Avian Protection Plan	Recreation Resources Management Plan	Historic Properties Management Plan	Land Use Policy
Floodplain Connectivity		+/-	+/-			-			+		-	-												-		
Change in Peak/ Base Flows	+/-	+	+/-			+/-			+/-	−	−															
Drainage Network Increase																										
Road Density and Location			-						+/−		-	-														+/-
Disturbance History	-	−	−			+		+/-	+/−	+/-	+/-	−		+/-										−		+
Riparian Areas			−						+/-	-	-	−												−	−	
Disturbance Regime	−	−	−						+/−	−	−	−									+			-		+

7.4 Significance of the Effects of the Action on Bull Trout

The analysis of Project effects on the bull trout using the Matrix is summarized in Table 8. Note that the Matrix was developed before the draft *Bull Trout Recovery Plan*, and so the Matrix uses the term "subpopulation." For the purpose of using the Matrix in this consultation, the Service considers the term "subpopulation" to be analogous with "local population".

As summarized in Table 8, some Matrix pathways are impacted to a greater degree than others by the Project elements. In particular, the population characteristics pathway (e.g., population size, growth and survival, life history diversity and isolation, and persistence and genetic integrity) are impacted by all project elements and the water quality pathway (e.g., temperature, sediment, and chemical contaminants and nutrients) are impacted by nearly all project elements. The habitat access pathway (e.g., physical barriers) is moderately impacted, with 7 of 12 Project elements affecting fish passage to some degree. The reservoir operation project element is one of the few Project elements that effects all Matrix pathways. The following summarizes the effects of the action grouped by Matrix pathways.

7.4.1 *Effects on Bull Trout Populations*

The following summarizes the population-based effects described in sections 7.1 and 7.2. Overall, the effects of the action are anticipated to kill 26 adults, and 26 subadult/juvenile bull trout, and injure most of the adults and sub-adult bull trout or juveniles, annually. Adult and subadult bull trout will be affected by all project elements, and juvenile bull trout will be affected by the operation of the Twisp Weir.

In summary, we expect annual lethal and sublethal take from each of the Project elements in the following categories below:

- Turbine Operations: 4 adults and 1 sub-adult are expected to be killed or lethally taken and 31 adults and 30 sub-adults are expected to be harassed or sublethally taken from turbine operations; 4 of the 31 are also expected to fall back and be subjected again to additional impacts of having to pass through the turbines again.

- Fish Bypass Operation: 1 adult killed and 1 sub-adults killed, and 4 adults and 6 sub-adults are expected to be harassed.

- Juvenile Survival Studies: 2 adults killed and 2 sub-adults killed, and 4 adults 6 adults expected to be harassed.

- Wells Dam Adult Passage Plan: 1 adult killed and 3 sub-adults killed, and 76 adults and 31 juvenile/sub-adults are expected to be harassed; 9 of the 76 fish could be alternate year spawners and spend additional time migrating and may be subjected to additional effects of residing in the FMO habitat and having to migrate back and forth through the dams.

- Spillway Operation: 2 adults killed and 1 juvenile/sub-adult killed, and 76 adults and 31 juvenile/sub-adults are expected to be harassed; additionally 1 of the 31 sub-adults may be injured due to GBD.

- Reservoir Operation: 1 adult killed and 2 juvenile/sub-adults killed, and 8 adults and 3 juvenile/sub-adults are expected to be harassed;

- Predator Control Program: 2 adults killed and 1 juvenile/sub-adult killed, and 76 adults and 31 juvenile/sub-adults are expected to be harassed;

For all Hatchery Management Plan elements, other than the release of juvenile salmonids, specific estimates of lethal and nonlethal take for juvenile/sub-adult bull trout are quantified as follows:

- Hatchery Management (Wells and Methow Hatcheries): 2 adults and 5 juveniles/sub-adults killed; 629 adults, 113 sub-adults, and 19 juveniles are expected to be harassed;

- Operation of the Twisp Weir: - a total of 118 adults,31 sub-adults, and 19 juveniles are expected to be harassed at Twisp Weir; 14 of the adults are expected to be alternate year spawners and may be impacted to a greater degree while using the FMO habitat and trying to migrate back and forth. 1 adult and 1 sub-adults may be killed.

- HGMP Implementation: 2 adults and 2 juveniles/subadults killed; 76 adults and 31 juvenile/sub-adults are expected to be harassed.

- Juvenile Salmonid Release: 629 adults and 132 juvenile/subadults are expected to be harassed.

Aquatic Management Plans are implemented with multiple activities; the following are those where effects are expected:

- Water Quality Management Plan: We estimate that a total of 76 adult bull trout and 31 sub-adult bull trout will be harmed or harassed and 1 adult and 2 sub-adult bull trout will be killed (based on the number of bull trout typically radio-tagged, including a low incidence of mortality).

- Bull Trout Management Plan: We estimate that a total of 76 adult bull trout, 31 subadult, and 19 juveniles will be harmed or harassed and 2 adults will be killed.

- Pacific Lamprey Management Plan: We estimate that a total of 2 adult bull trout and 5 sub-adult bull trout will be harmed or harassed and 1 adult and 1 sub-adult will be killed (based on the number of bull trout typically radio-tagged, including a low incidence of mortality).

- White Sturgeon Management Plan: We estimate that a total of 2 adult bull trout and 5 sub-adult bull trout will be harmed or harassed and 1 adult bull trout and 1 sub-adult bull trout will be killed (based on the number of bull trout typically radio-tagged, including a low incidence of mortality).

- Aquatic Nuisance Species Management Plan: We estimate that a total of 76 adult bull trout and 31 sub-adult bull trout will be harmed or harassed and 1 adult and 1 sub-adult bull trout will be killed (based on the number of bull trout typically radio-tagged, including a low incidence of mortality).

- Resident Fish Management Plan: We estimate that a total of 76 adult bull trout and 31 sub-adult bull trout will be harmed or harassed and 1 adult and 2 sub-adult bull trout will be killed (based on the number of bull trout typically radio-tagged, including a low incidence of mortality).

For the *Tributary Conservation Plan*, *Recreational Management Plan*, *Historic Properties Management Plan*, and *Land Use Policy* (shoreline management) Project elements, the Service identified effects but did not authorize take because there is not enough information to effectively describe the individual activities and projects associated with these Project elements are unknown at this point. Effects from these activities are typically short term negative effects and long term beneficial effects as previously described in the effects section above.

Affected fish experience sublethal effects in multiple pathways and by multiple Project elements. Effects are additive and may occur to the same individuals. Obviously, the lethal take only occurs once and effectively removes individuals from populations. Project impacts are anticipated to affect fish predominantly from the Methow core area, in addition to the Entiat and Wenatchee core areas; the significance of these effects depends in part on the resiliency of the local population(s) impacted annually and over the 30-50 year term of the Project. Impacts to bull trout from the Methow and Wenatchee core areas are likely to be relatively minor to moderate depending on the project element affecting the populations and primarily on the population trends and number of individuals anticipated to be affected. Impacts to bull trout from the Entiat core areas is of concern. The status and trend of bull trout from the Entiat core area suggests neither an increasing nor decreasing population, but rather stability at low abundance. Project effects are likely to contribute to maintaining the Entiat core area in a depressed condition, which may result in an increased risk of extirpation due to stochastic events. So while we acknowledge Yakima core area bull trout are capable of migrating long distances (approximating the distance between the Yakima River and the Wells action area), we do not currently have enough information to suggest adverse effects are reasonably certain to occur. This is due to a number of factors, including degraded habitat conditions in the lower Yakima, reduced population sizes, reduced expression of the migratory life history form, and a lack of specific monitoring to detect this event if it is occurring. As a result, we do not believe the available information supports the notion that Yakima core area bull trout will be adversely affected by the effects of the proposed action.

7.4.2 *Water Quality*

The primary mechanism of the effects to the water quality pathway are related to temperature increases due to impounding water and reducing velocity; increased sediment due to fluctuating river levels and bank erosion (which is also related to higher temperatures); and gas supersaturation due to spillway operations. These impacts were analyzed in detail in sections 7.1 and 7.2 as they relate to population effects. The effects to temperature will be additive to those described in the Environmental Baseline (Section 5) as a result of global climate change. Other water quality degradation may occur due to cultural and recreational facilities, shoreline erosion sites, hatchery supplementation, and the Project tributary conservation plan. In addition, turbine operations, the juvenile fish bypass, and adult fishways may also degrade the temperature, substrate embeddedness, and chemical contaminant/nutrient indicators, mainly through increasing erosion and turbidity, and periodic maintenance activities.

The overall effect of the action is likely to maintain degraded water quality in the mainstem Columbia River. This is based primarily on the overall risk rating of the baseline function of this pathway being at high risk of not functioning (i.e., functioning at unacceptable risk). In the tributaries, the overall effect of the action (i.e., the hatchery management plans, aquatic resource management plans, and tributary conservation plan Project elements) is the potential for low to moderate degradation of water quality at the Project scale, but is likely to maintain a degraded water quality. However, some *Tributary Conservation Plan* activities may improve water quality to some degree at a localized scale. This is based primarily on the overall risk rating of the baseline function of this pathway being at high risk of not functioning (i.e., functioning at unacceptable risk) in the Methow FMO, Entiat core area and FMO, Wenatchee core area and FMO, and being at moderate risk (i.e., functioning at risk) in the Methow core area.

7.4.3 *Habitat Access*

The primary physical barrier to normal movement and behavior patterns of adult bull trout is the seasonal closure of at least one Wells adult upstream fishway at a time for maintenance activities, which can isolate them from upstream habitats or alter their migratory behavior when attempting to reach these upstream habitats. Sub-adult bull trout are also expected to be impacted at Wells Dam, but at least some have demonstrated an ability to ascend the fishways. It is possible smaller individuals may not have the swimming ability to ascend the fishways and may be isolated between dams, exposing them to a variety of habitat, competitive, and predatory threats. The effects to adult bull trout by fishway operations were previously described in sections 7.2.2.3. Reservoir operation (i.e., fluctuating water levels imposed through reservoir operations) may also create temporary reductions in habitat availability, foraging opportunities, and other effects by dewatering access to nearshore and off-channel habitats. Because the Project is a run-of-river hydroelectric project (minimal storage and daily outflow generally equals daily inflow), it has relatively stable water surface elevations and remains mostly full throughout the year. From 2001through 2005, the daily fluctuation frequency of the reservoir was less than three ft 93.3 percent of the time and minimum elevations fell below 777 ft MSL only 3.8 percent of the time (DTA 2006). Infrequent reservoir operations resulting in fluctuations over four ft in a 24-hour period occurred only 1.1 percent of the time. Degraded water quality, especially high water temperatures and supersaturated gases, may create temporary thermal or chemical barriers, at least in some areas of the mainstem Columbia River. The hatchery management plans may create substantial barriers (e.g., concrete weirs) depending on the design and placement of future hatchery, acclimation, and other facilities. Examples of these types of effects would occur at the Twisp Weir facility. Monitoring and the aquatic resource management plans can also result in temporary barriers, such as gill nets used for research efforts. The overall effect of the action is to maintain a degraded condition for habitat access.

The overall effect of the action is likely to maintain degraded habitat access. This is based primarily on the overall risk rating of the baseline function of this pathway being at high risk of not functioning (i.e., functioning at unacceptable risk). In the tributaries, the overall effect of the action (i.e., the hatchery supplementation plans, monitoring, and tributary conservation plan Project elements) is likely to maintain degraded habitat access. However, some *Tributary Conservation Plan* activities may improve habitat access at a localized scale. This is based primarily on the overall risk rating of the baseline function of this pathway being at moderate risk (i.e., functioning at risk) in the Methow core area and FMO, Entiat core area and FMO, and Wenatchee core area and FMO.

7.4.4 *Habitat Elements*

A number of habitat elements are impacted by hydrographic variation and the impoundment of the Columbia River. Increased levels of sediment from fluctuating river levels and bank erosion have increased substrate embeddedness. Large woody debris has been decreased due to the fluctuations in river levels, altering riparian vegetation composition, vigor, and mortality. In addition, what large woody debris is mobilized is typically captured at log booms or trash racks and removed from the river as part of Project maintenance. Pool frequency and quality, especially primary pools, have also been inundated by the Project and maintained by hydrographic variation. Off-channel habitat has also been reduced in quality and access due to fluctuating river levels and overall channel simplification. Refugia have likely been eliminated or degraded in most cases, although the increased depth of the Columbia River may have created thermal refuge in cases where cold water sources are present (e.g., upwelling, large groundwater influences). Future *Tributary Conservation Plan* projects may also affect habitat elements, but little information regarding the scope and magnitude of these projects was provided to assess these effects. The *Recreational Resources Management Plan* will also likely result in a continued level of moderate degradation within riparian zones located adjacent to recreation facilities.

The overall effect of the action is likely to maintain degraded habitat elements in the mainstem Columbia River. This is based primarily on the overall risk rating of the baseline function of this pathway being at moderate risk of not functioning (i.e., functioning at risk). In the tributaries, the overall effect of the action (i.e., the hatchery management plans, including the Twisp Weir facility, monitoring, and tributary conservation plan Project elements) is the potential for low to moderate degradation of habitat elements at the project scale, but is likely to maintain a degraded condition. However, some *Tributary Conservation Plan* activities may improve habitat elements to some degree at a localized scale. This is based primarily on the overall risk rating of the baseline function of this pathway being at high risk of not functioning (i.e., functioning at unacceptable risk) in the Methow FMO, Entiat core area and FMO, Wenatchee core area and FMO, and being at moderate risk (i.e., functioning at risk) in the Methow core area.

7.4.5 *Channel Condition/Dynamics*

Hydrographic variation has resulted in an overall change in wetted width/maximum depth ratio, increasing this ratio and overall water depth (especially in the mainstem Columbia River and the confluence and lower portions of tributaries). While increased water depth is generally beneficial to the bull trout in this case, it is also accompanied with slower water, warmer temperatures, simplified habitat conditions, and other habitat degradation. Streambank condition is also impacted, primarily by the fluctuations in pool/river level. Effects can stem from direct bank erosion, but also impacts to the condition and extent of riparian vegetation, which, if degraded, can lead to additional stream bank instability. Floodplain connectivity is also impacted by hydrographic variation, reducing hydrologic connectivity between off-channel habitat, wetlands, and riparian areas. In addition, the extent of wetlands has likely been reduced and riparian vegetation and succession have been altered significantly. However, because the Project is a run of river hydroelectric project (minimal storage and daily outflow generally equals daily inflow), it has relatively stable water surface elevations and remains mostly full throughout the year. From 2001through 2005, the daily fluctuation frequency of the reservoir was less than three ft 93.3 percent of the time and minimum elevations fell below 777 ft MSL only 3.8 percent of the time (DTA 2006). Infrequent reservoir operations resulting in fluctuations over four ft in a 24-hour period occurred only 1.1 percent of the time. Little information was provided to evaluate the effects of the *Resources Management Plan*, but presumably streambank condition and floodplain connectivity have been degraded through the development and maintenance of nearshore and in-stream structures. Future *Tributary Conservation Plan* projects may also affect channel condition/dynamics, but little information regarding the scope and magnitude of these projects was provided to assess these effects. Hatchery supplementation facilities, specifically the Twisp Weir, will continue to have effects associated with channel condition and dynamics.

The overall effect of the action is likely to maintain degraded channel conditions and dynamics in the mainstem Columbia River. This is based primarily on the overall risk rating of the baseline function of this pathway being at high risk of not functioning (i.e., functioning at unacceptable risk). In the tributaries, the overall effect of the action (i.e., the hatchery supplementation plans, including the Twisp Weir facility, monitoring, and tributary conservation plan Project elements) is the potential for low to moderate degradation of channel conditions and dynamics at the project scale, but is likely to maintain a degraded condition. However, some *Tributary Conservation Plan* activities may improve channel conditions and dynamics to some degree at a localized scale. This is based primarily on the overall risk rating of the baseline function of this pathway being at high risk of not functioning (i.e., functioning at unacceptable risk) in the Methow core area and FMO, Entiat core area and FMO, Wenatchee FMO, and being at moderate risk (i.e., functioning at risk) in the Wenatchee core area.

7.4.6 *Flow/Hydrology*

Hydrographic variation has resulted in a moderation of the amplitude of hydrographic change, a function of regulating the mainstem Columbia River for hydropower generation. While this has resulted in lower proportional change in peak flows, higher base flows have resulted from water impoundment. A natural hydrograph would have the ability to support bull trout populations by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation. As a result of the proposed action, a highly modified hydrograph with altered peak and base flows will be continued. These alterations will be additive to those anticipated as a result of global climate change discussed in the Status of the Species (Section 3). This impairs a number of natural ecosystem processes, including sediment, large woody debris, and other key functions. However, because the Project is a run of river hydroelectric project (minimal storage and daily outflow generally equals daily inflow), it has relatively stable water surface elevations and remains mostly full throughout the year. From 2001through 2005, the daily fluctuation frequency of the reservoir was less than three ft 93.3 percent of the time and minimum elevations fell below 777 ft MSL only 3.8 percent of the time (DTA 2006). Infrequent reservoir operations resulting in fluctuations over four ft in a 24-hour period occurred only 1.1 percent of the time. Future tributary conservation plan projects may also affect flow/hydrology, but little information regarding the scope and magnitude of these projects was provided to assess these effects. A low level of hydrographic variation effects will likely result from water withdrawls associated with the hatchery supplementation facilities and recreation facilities.

The overall effect of the action is to likely maintain degraded flow and hydrology conditions in the mainstem Columbia River. This is based primarily on the overall risk rating of the baseline function of this pathway being at high risk of not functioning (i.e., functioning at unacceptable risk). In the tributaries, the overall effect of the action (i.e., the hatchery supplementation plans, monitoring, and tributary conservation plan Project elements) is the potential for low to moderate degradation of flow and hydrology conditions at the project scale, but is likely to maintain a degraded condition. However, some tributary conservation plan activities may improve flow and hydrology conditions to some degree at a localized scale. This is based primarily on the overall risk rating of the baseline function of this pathway being at high risk of not functioning (i.e., functioning at unacceptable risk) in the Methow core area and FMO, Entiat core area and FMO, Wenatchee FMO, and being at moderate risk (i.e., functioning at risk) in the Wenatchee core area.

7.4.7 *Watershed Conditions*

Reservoir operation has resulted in substantial effects to the condition of the watershed condition pathway. The disturbance history in the action area has been altered by substantial changes to the hydrograph due to hydropower generation, degraded riparian areas, and nearly a century of fire suppression. This has led to the impairment of a number of ecosystem processes that support habitats used by bull trout. Analysis of the riparian conservation area indicator in particular suggests a condition that fragmented, poorly connected, and provides limited protection to aquatic species. In addition, the natural disturbance regime in terms of floods and fires has departed substantially from its historic properly functioning condition. This likely translates to an overall watershed condition of poor quality, little resiliency, and limited ability to provide habitat for the bull trout in the long term. However, because the Project is a run-of-river hydroelectric project (minimal storage and daily outflow generally equals daily inflow), it has relatively stable water surface elevations and remains mostly full throughout the year. From 2001through 2005, the daily fluctuation frequency of the reservoir was less than three ft 93.3 percent of the time and minimum elevations fell below 777 ft MSL only 3.8 percent of the time

(DTA 2006). Infrequent reservoir operations resulting in fluctuations over four ft in a 24-hour period occurred only 1.1 percent of the time. Little information was provided to evaluate the effects of the Recreation Management Plan, but riparian areas have been degraded especially when roads have been constructed. Future Tributary Conservation Plan projects and the supplementation plan activities (i.e., Twisp Weir) may also impact watershed condition, but little information was provided to assess these effects.

The overall effect of the action is likely to maintain degraded watershed conditions in the mainstem Columbia River. This is based primarily on the overall risk rating of the baseline function of this pathway being at moderate risk of not functioning (i.e., functioning at risk). In the tributaries, the overall effect of the action (i.e., the hatchery supplementation plans, and monitoring plan Project elements) is the potential for moderate degradation of watershed conditions at the Project scale, but is likely to maintain, rather than increase, the current degraded condition. However, some Tributary *Conservation Plan* activities may improve watershed conditions to some degree at a localized scale. This is based primarily on the overall risk rating of the baseline function of this pathway being at high risk of not functioning (i.e., functioning at unacceptable risk) in the Methow core area and FMO, Entiat core area and FMO, and Wenatchee core area and FMO.

7.4.8 *Integration*

The last step of the Matrix analysis is integration, which is a summary of the effects of the Action. Overall, bull trout are anticipated to originate from all four core areas and be exposed to the effects of one or more Project element. The significance of the effects depends in part on the resiliency of the local populations within the four core areas impacted annually and over the 30-50 year term of the Project. While impacts to bull trout from the Methow Core Area is likely to be relatively moderate, based primarily on the population trends and number of individuals anticipated to be affected, impacts to bull trout from the Entiat Core Area is of concern. The status and trend of bull trout from the Entiat core area suggests neither an increasing nor decreasing population, but rather stability at low abundance. Project effects are likely to contribute to maintaining the Entiat core area in a depressed condition, which may result in an increased risk of extirpation due to stochastic events.

Anticipated habitat effect in the mainstem Columbia FMO is the maintenance of a degraded condition, with the most severe effects expected to occur to water quality, habitat access, and multiple habitat indicators associated with hydrographic variation. In the tributaries, the overall effect of the Action (i.e., the hatchery supplementation plans (Twisp Weir facilities), monitoring, and tributary conservation plan Project elements) is the potential for moderate degradation of the condition of habitat indicators at the Project scale, but is likely to maintain a degraded condition. However, a variety of *Tributary Conservation Plan* activities may improve the conditions of some indicators to some degree at a localized scale, but are unlikely to change the overall ranking of a pathway at the core area scale.

Table 9 summarizes the effects of the action by Matrix Pathway, as described above, but includes the Magnitude Codes used in the bull trout Consulted-Upon Database (COED). The following describes the codes displayed in Table 9:

Code	Type of Effect
N2	No significant disruption of normal behavior patterns when considered alone; effects to the physical environment (habitat) could aggregate
N3	Significant disruption of normal behavior patterns, not resulting in actual injury or death; no measureable population level effects
N4	Significant disruption of normal behavior patterns, resulting in actual injury but not death; no measureable local population effects
N5	Significant disruption of normal behavior patterns resulting in death; no measureable local population effects
B2	Improve conditions necessary for normal behavior; no beneficial local population effects

Table 13. Overall Effect of Project Effects to Bull Trout by Selected Pathways of the Matrix and Magnitude Codes.

	Project Element	Matrix Pathways						
		Subpopulation Characteristics	Water Quality	Habitat Access	Habitat Elements	Channel Condition/ Dynamics	Flow/ Hydrology	Watershed Conditions
Operations	**Turbine Operation (A-1)**	N5	N2					
Operations	**Spillway Operation (A-2)**	N5	N5					
Operations	**Reservoir Operation (A-3)**	N5	N4	N4	N4	N4	N4	N4
HCP	**Passage Survival Plan**							
HCP	**Wells Dam Juvenile Passage Plan**							
HCP	*-Fish Bypass Operation (A-1)*	N4/B2	N2					
HCP	*-Juvenile Survival Study (A-2)*	N2						
HCP	**Wells Dam Adult Passage Plan**	N4	N2	N3				
HCP	**Tributary Conservation Plan and Committee**	N5/B2	B2	B2	B2	B2	B2	B2
HCP	**Hatchery and Genetic Management Plans**							
HCP	*-Hatchery Management (A-1)*	N4	N3	N3	N4	N3	N3	N3
HCP	*-Operation of the Twisp Weir (A-2)*	N4		N4	N4	N3	N2	
HCP	*-HGMP Implementation (A-3)*	N4						
HCP	*-Juvenile Salmonid Release (A-4)*	N4/B2						
HCP	**Predator Control Program**	B2						
ASA	**Water Quality Management Plan**	N5		N3	N3			
ASA	**Bull Trout Management Plan**	N5		N3	N3			
ASA	**Pacific Lamprey Management Plan**	N4		N3	N3			
ASA	**White Sturgeon Management Plan**	N5		N3	N3			
ASA	**Resident Fish Management Plan**	N5		N3	N3			
ASA	**Aquatic Nuisance Management Plan**	N5/B2		N3	N3			
TERRESTRIAL	**Wildlife and Botanical Management Plan**		N2					
TERRESTRIAL	**Line Avian Protection Plan**							
TERRESTRIAL	**Recreation Resources Management Plan**	N4	N3		N4	N4		N2
TERRESTRIAL	**Historic Properties Management Plan**	N4	N3					N2
TERRESTRIAL	**Land Use Policy**				B2			

8.0 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 biological 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 ESA.

As the human population in the State of Washington continues to grow, residential growth and demand for dispersed and developed recreation is likely to occur. This trend is likely to result in increasing habitat degradation from riparian road construction, levee building, bank armoring, and campsite development on private lands. These activities tend to remove riparian vegetation, disconnect rivers from their floodplains, interrupt groundwater-surface water interactions, reduce stream shade (and increase stream temperature), reduce off-channel rearing habitat, and reduce the opportunity for large woody debris recruitment. Each subsequent action by itself may have only a small incremental effect, but taken together they may have a substantive effect that would further degrade the watershed's condition and resiliency, and undermine efforts to improve the 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 and recreation on salmonid habitats and by presenting ways in which a growing human population and healthy fish populations can co-exist. For this description of cumulative effects, the Service assumes that future non-Federal activities in the area of the proposed action will continue into the immediate future at present or increased intensities. Accordingly, these actions will contribute to maintenance of at risk and non-functioning habitat indicators in the action area.

Cumulative effects from a variety of activities are likely to adversely affect the bull trout and their habitat. These actions include, but are not limited to, industrial and residential development, road construction and maintenance, mining, forest activities, fish management activities, agriculture and grazing, and fire management.

9.0 CONCLUSION

After reviewing the current status of the bull trout, the environmental baseline for the action area, the effects of the proposed relicensing action, and the cumulative effects, it is the Service's biological opinion that the relicensing action, as proposed, is not likely to jeopardize the continued existence of the bull trout and will not destroy or adversely modify its designated critical habitat. We reached this conclusion for the following reasons:

No Jeopardy

1. The environmental baseline for the action area indicates that although bull trout are widely distributed, abundance is generally low and productivity highly variable. The overall status and trend in the Methow and Wenatchee core areas show a slight increase in population size, the Entiat core area is unstable and has a low abundance. Habitat conditions are highly variable across the action area, but generally increase in quality when moving upstream into the tributaries. The mainstem Columbia River is highly altered yet provides key FMO habitats.

2. The effect of the action will result in the injury and death of adult and juvenile or sub-adult bull trout across 3 core areas with the largest proportion of these individuals originating from the Methow Core Area. This includes direct mortality from turbine and spillway operations, delays in migratory behavior, and a variety of habitat-based effects related to hydrologic variation. Beneficial effects, however, include a juvenile fish bypass system, predator control, and the *Bull Trout Management Plan* and *Tributary Conservation Plan*. Overall, the proposed action provides limited but adequate connectivity between core areas, the key conservation role of the mainstem Columbia River.

3. Cumulative effects are anticipated to degrade or maintain degraded conditions across the action area. Key issues include floodplain development and function, water quality and quantity, fish passage (connectivity), and habitat fragmentation.

4. Overall, the relicensing of the Wells Hydroelectric Project will not diminish the numbers, distribution, or reproduction of bull trout to a degree that will appreciably reduce the likelihood of survival and recovery of bull trout in the Columbia River interim recovery unit.

No Destruction/Adverse Modification

1. The status of habitat conditions and the PCEs of designated critical habitat in the action area are marginal. The PCEs are either "functioning at risk" or "functioning at an unacceptable risk" (USFWS 1999). The degradation of PCEs is influenced by the presence of hydroelectric production on the mid-Columbia River and multiple Clean Water Act section 303(d) listed impairments (temperature, dissolved oxygen, instream flow, pH, PCBs, fecal coliform, and ammonia-N). Impacts associated with the upstream and downstream passage of bull trout through turbines, spillways, and fishway structures at hydroelectric facilities such as those contemplated at the Project have influenced the migratory behavior of bull trout.

2. The proposed Project is likely to affect the PCEs of designated critical habitat for the bull trout. Water storage at the Project is influenced by hydroelectric production and results in fluctuations ranging within the upper four feet of the reservoir over 95% of the operational record. Although Project related hatchery facilities do not significantly divert or alter the quantity of water, the quality of this water is influenced once it is returned to the aquatic environment. Bull trout have been documented to pass upstream and downstream of the Project through its turbines, spillways, and fishways, however, the resulting injury and mortality likely to be associated with these structures likely influences the PCEs for bull trout. The Project does provide some level intermittent shoreline vegetation and submerged aquatic macrophytes, but this condition has been altered from its original riverine state due to the Project. Overall, the proposed action degrades the functional suitability of the PCEs in CHU's 10 and 22, but not to the extent that we would expect a categorical downgrade (i.e., from a qualitative ranking of "functioning at risk" to "functioning at unacceptable risk") relative to the baseline condition.

3. As discussed previously above, significant cumulative effects are anticipated to occur during the term of the proposed Project.

4. This aggregate effect is consistent with the conservation role of critical habitat range-wide to support viable core area populations. On that basis, implementation of the proposed Project is not likely to destroy or adversely modify bull trout critical habitat at the range-wide scale.

Incidental take of bull trout may occur, given that bull trout are known to occupy the action area. Incidental take may occur as a result of turbine operations, spillway operation, reservoir operation, Wells Dam Juvenile Survival Plan, Wells Dam Adult Survival Plan, hatchery and genetics management plans, predator control program, Water Quality Management Plan, Bull Trout Management Plan, Pacific Lamprey Management Plan, White Sturgeon Management Plan, and the Resident Fish Management Plan. Based on the information provided, there is insufficient information to evaluate the site-specific nature and magnitude of the potential effects of the remaining Project elements. So, while these Project elements were considered in this section 7(a) (2) analysis, the Service cannot issue incidental take for those Project elements at this time.

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 attempt to engage in any such conduct. Harm is further defined by Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include but are not limited to, breeding, feeding or sheltering. 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 FERC 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. FERC has a continuing duty to regulate the activity covered by this incidental take statement. If FERC fails to assume and implement 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) will lapse. In order to monitor the impact of incidental take, FERC must report the progress of the action and its impact on the species to the Service as specified in this Incidental Take Statement [(50 CFR §402.14(i)(3)].

Anticipated Amount or Extent of Take of the Bull Trout

Based on the preceding "Effects of the Action" analysis, the amount and types of take described in Table 9.1-1 (below) are anticipated with implementation of the proposed action over the life of the Project.

Effects of the Take

In the accompanying Biological Opinion, the Service determined that this level of anticipated take is not likely to jeopardize the continued existence of the bull trout. Table 14 summarizes the type of take authorized by Project element. Note that not all Project elements are included in the table. In some cases, site-specific detail is not yet available, so the Service has analyzed a Project element at a programmatic level to ensure it is not likely to jeopardize listed species or destroy or adversely modify their critical habitat. In such cases, additional consultation may be required in the future as specific projects obtain federal approvals. Other Project elements are not included in the table because the Service does not anticipate the injury or death of individuals from that element.

Table 14. Annual incidental take estimates for the project elements.

	Project Element	Program/Action	Type of Take	Lethal Take		Non-lethal Take	
				Adult	Sub-adult	Adult	Sub-adult
Operations	**Turbine Operation (A-1)**	**Turbine operations and maintenance**	Harm or Harass	4	1	31	30
	Spillway Operation (A-2)	**Spillway operations and maintenance**	Harm or Harass	2	1	76	31
	Reservoir Operation (A-3)	**Reservoir elevation changes**	Harm or Harass	1	2	8	3
AFA/HCP	**Passage Survival Plan**						
	Wells Dam Juvenile Passage Plan						
	-Fish Bypass Operation (A-1)	**Operation of the juvenile fish bypass system**	Harm or Harass	1	1	4	6
	-Juvenile Survival Study (A-2)	**Purse & beach seine, dip & cast nets, screw trap, collection at Rocky Reach JBS. Route specific, balloon tagging and fyke netting.**	Harm or Harass	2	2	4	6
	Wells Dam Adult Passage Plan	**Adult ladder traps, angling, bypass collection, ladder maintenance**	Harm or Harass	1	3	76	31
	Tributary Conservation Plan and Committee	**Insufficient information for consultation**	Harm or Harass	-	-	-	-
	Hatchery Management Plans						
	-Hatchery Management (A-1)	**Operation of the hatchery include brood stock collection and adult management**	Harm or Harass	2	5	76	31
	-Operation of the Twisp Weir (A-2)	**Collect, anesthetize, sample, tag or mark and release**	Harm or Harass	1	1	118	50*
	-HGMP Implementation (A-3)	**Collect, anesthetize, sample, tag or mark and release via screw trap, e-fishing, angling, weirs, redd surveys, snorkel surveys, seining, dip & block nets, PIT and sonic tagging, carcass sample, Redd cap, drift net, snerding**	Harm or Harass	2	2	76	31

	-Juvenile Salmonid Release (A-4)	**acclimation and release of juvenile fish**	Harm or Harass	-	-	629	132*
	Predator Control Program	**Set lines; angling; traps; seine, gill, cast, and trammel nets; spear**	Harm or Harass	2	1	76	31
ASA	**Water Quality Management Plan**	**GBT monitoring at Rocky Reach JBS, Wells reservoir beach seines, Wells adult ladder, temperature monitoring, TDG monitoring**	Harm or Harass	1	2	76	31
ASA	**Bull Trout Management Plan**	**Ladder trap at Wells, Twisp weir collection, stranding surveys using nets, PIT tag sub-adults in M&E screw traps**	Harm or Harass	2	-	76	31
ASA	**Pacific Lamprey Management Plan**	**change in fish ladder operations/ configuration, changes in bypass system ops, substrate grab samples, ladder traps at Columbia river hydroprojects**	Harm or Harass	1	1	2	5
ASA	**White Sturgeon Management Plan**	**Longline, angling, seine, egg mats, D-rings, gill net, plankton tow nets,**	Harm or Harass	1	1	2	5
ASA	**Resident Fish Management Plan**	**Beach & purse seine, angling, fyke & trap net, spear, longline, snorkel, acoustics**	Harm or Harass	1	2	76	31
ASA	**Aquatic Nuisance Management Plan**	**substrate mats, benthic and substrate samplers, plankton tows, trapping, hand capture and netting**	Harm or Harass	1	1	76	31
TERRESTRIAL	**Wildlife and Botanical Management Plan**	**Insufficient information for consultation**	Harm or Harass	-	-	-	-
TERRESTRIAL	**Line Avian Protection Plan**	**Protection of terrestrial avian nest sites**	Harm or Harass	no effect	no effect	no effect	no effect
TERRESTRIAL	**Recreation Resources Management Plan**	**Insufficient information for consultation**	Harm or Harass	-	-	-	-
TERRESTRIAL	**Historic Properties Management Plan**	**Insufficient information for consultation**	Harm or Harass	-	-	-	-
TERRESTRIAL	**Land Use Policy**	**Protection of reservoir habitat**	Harm or Harass	no effect	no effect	no effect	no effect

*These totals include 19 juveniles.

Reasonable and Prudent Measures

Reasonable and prudent measures (RPMs) are non-discretionary measures designed to minimize impacts on specific individuals or habitats affected by the proposed action, and require only minor changes to the project. The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of the bull trout.

Reasonable and prudent measures (RPMs) are non-discretionary measures designed to minimize impacts on specific individuals or habitats affected by the proposed action, and require only minor changes to the project. The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of the bull trout.

RPM 1. FERC shall require Douglas PUD, in coordination with the Service, to provide adequate year-round passage conditions for all life stages of bull trout at all Project facilities.

RPM 2. FERC shall require Douglas PUD, in coordination with the Service, to minimize the effects of spillway operations and hydrographic variation to all life stages of bull trout at all Project facilities.

RPM 3. FERC shall require Douglas PUD, in coordination with the Service, to minimize the effects of the Hatchery Supplementation Program to all life stages of bull trout.

RPM 4. FERC shall require Douglas PUD, in coordination with the Service, to minimize the effects of the Aquatic Resource Management Plans (white sturgeon, Pacific lamprey, resident fish, aquatic nuisance species, and water quality) and the Predator Control Program to all life stages of bull trout.

RPM 5. FERC shall require Douglas PUD, in coordination with the Service, to design and implement a bull trout monitoring program that will adequately detect and quantify Wells Hydroelectric Project impacts, including those associated with the Wells Dam, Twisp Weir trapping facilities, and hatchery facilities. This information will allow the Service to determine whether authorized take levels are exceeded.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the action agency must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and also outline required reporting and monitoring requirements. *These terms and conditions are non-discretionary.* All plans called for in these terms and conditions shall be provided to the Service upon completion.

To implement RPM 1: FERC shall require Douglas PUD, in coordination with the Service, to provide adequate year-round passage conditions for bull trout at all Project facilities.

1. Upstream and Downstream Passage for Adult and Sub-Adult Bull Trout (*BTMP Section 4.1.1*): FERC shall require Douglas PUD, in coordination with the Service, to provide upstream passage for bull trout through the existing upstream fishways and downstream passage for bull trout through the existing downstream bypass system consistent with the AFA/HCP and Aquatic SA. Both upstream fishway facilities (located on the west and east shores) shall be operational year round with maintenance occurring on each fishway at different times during the winter to ensure that one upstream fishway is always operational. Operation of the downstream passage facilities for bull trout shall be consistent with bypass operations for Plan Species identified in the Wells AFA/HCP.

2. Bull Trout Passage Performance Standard: FERC shall require Douglas PUD, in coordination with the Service, to implement the upstream and downstream measures contained in the Wells Hydroelectric Project BTMP to provide safe, timely, and effective upstream and downstream passage for adult and sub-adult bull trout at the Wells Hydroelectric Project. "Safe, timely and effective" passage shall be achieved when Douglas PUD has demonstrated that the survival and passage success rates for adult marked fish are greater than 95% and greater than or equal to 90%, respectively, and when passage studies demonstrate that the fishway facilities at Wells Dam do not impede the passage of bull trout. To ensure that safe, timely and effective passage at Wells Dam is maintained during the term of the new license, Douglas PUD shall implement the bull trout upstream and downstream measures consistent with the BTMP.

3. Upstream Fishway Operations Criteria (*BTMP Section 4.1.3*): FERC shall require Douglas PUD, in coordination with the Service, to operate the upstream fishway at Wells Dam in accordance with criteria outlined in the Wells AFA/HCP.

4. Bypass Operations Criteria (*BTMP Section 4.1.4*): FERC shall require Douglas PUD, in coordination with the Service, to operate the bypass system at Wells Dam in accordance with criteria outlined in the Wells AFA/HCP.

5. Implement Reasonable and Appropriate Measures to Modify the Upstream Fishway and Downstream Bypass if Adverse Impacts on Bull Trout are Identified (*BTMP Section 4.3*): FERC shall require Douglas PUD, in coordination with the Service, to identify, design, implement, and evaluate reasonable and feasible measures to modify the upstream fishway, downstream bypass, or operations to reduce the identified incidental take of bull trout if monitoring (Term and Condition #10) identifies upstream or downstream passage problems for bull trout, in consultation with the Service, WCC and the Aquatic SWG. Study protocols and radio-telemetry assessment methodologies prescribed above in Term and Condition #10 and #11, shall be used to evaluate the effectiveness of any additional measures implemented to reduce the incidental take of bull trout. Upon completion of the evaluation, the Service and the National Marine Fisheries Service (NMFS), in consultation with the Aquatic SWG, and the WCC, will determine whether the proposed measure should be made permanent, removed, or modified.

To implement RPM 2: FERC shall require Douglas PUD, in coordination with the Service, to minimize the effects of hydrographic variation to all life stages of bull trout at all Project facilities.

6. Investigate Entrapment or Stranding of Bull Trout during Periods of Low Reservoir Elevation (*BTMP Section 4.4*): FERC shall require Douglas PUD, in coordination with the Service, to continue to investigate potential entrapment or stranding areas for bull trout through periodic monitoring when periods of low reservoir elevation expose identified sites. During the first five years of the new license, Douglas will implement up to five bull trout entrapment/stranding assessments during periods of low reservoir elevation (below 773' MSL). If no incidences of bull trout stranding are observed during the first five years of study, additional assessment will take place every fifth year during the remainder of the license term, unless waived by the Aquatic SWG. If bull trout entrapment and stranding result in take in exceedance of the authorized incidental take level, then reasonable and appropriate measures will be implemented by Douglas, in consultation with the Aquatic SWG, to address the impact.

To implement RPM 3: FERC shall require Douglas PUD, in coordination with the Service, to minimize the effects of the Hatchery Supplementation Program to all life stages of bull trout.

7. Bull Trout Monitoring During Hatchery Activities (*BTMP 4.6.1*): FERC shall require Douglas PUD, in coordination with the Service, to monitor hatchery actions (e.g., salmon trapping, sturgeon brood stocking and capture activities) that may encounter adult and sub-adult bull trout resulting from incidental capture and take. Actions to be monitored shall be associated with the Wells Hatchery, the Methow Hatchery, and any future facilities directly funded by Douglas. If the incidental take of bull trout is exceeded due to Douglas's hatchery actions then Douglas will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to the exceedance of the allowable level of incidental take.

To implement RPM 4: FERC shall require Douglas PUD, in coordination with the Service, to minimize the effects of implementing the Aquatic Resource Management Plans (white sturgeon, Pacific lamprey, resident fish, aquatic nuisance species, and water quality) and the Predator Control Program to all life stages of bull trout.

8. Monitoring Other Aquatic Resource Management Plan Activities and Predator Control Program for Incidental Capture and Take of Bull Trout (*BTMP Section 4.5.1*): FERC shall require Douglas PUD, in coordination with the Service, to monitor activities associated with the implementation of other Aquatic Resource Management Plans for white sturgeon, Pacific lamprey, resident fish, aquatic nuisance species, and water quality and Predator Control Program that may result in the incidental capture and take of bull trout. If the incidental take of bull trout is exceeded due to the implementation of other Aquatic Resource Management Plan activities, then Douglas PUD will develop a plan, in consultation with the Aquatic SWG, to address the identified factors contributing to the exceedance of the allowable level of incidental take. If the incidental take of bull trout is exceeded due to the implementation of the Predator Control Program, then Douglas will develop a plan, in consultation with the

HCP Coordinating Committee and the Aquatic SWG, to address the identified factors contributing to the exceedance of the allowable level of incidental take.

To implement RPM 5: FERC shall require Douglas PUD, in coordination with the Service, to design and implement a bull trout monitoring program that will adequately detect and quantify Wells Hydroelectric Project impacts, including those associated with the Wells Dam, Twisp Weir trapping facilities, and hatchery facilities. This information will allow the Service to determine whether authorized take levels are exceeded.

9. Upstream Fishway Counts (*BTMP Section 4.1.2*): FERC shall require Douglas PUD, in coordination with the Service, to conduct video monitoring in the Wells Dam fishways from May 1st through November 15th to count and provide information on the population size of upstream moving bull trout.

10. Adult Bull Trout Upstream and Downstream Passage Evaluation (*BTMP Section 4.2.1*): FERC shall require Douglas PUD, in coordination with the Service, to periodically monitor incidental take of bull trout through Wells Dam and in the Wells Reservoir through the implementation of a radio-telemetry study. Specifically, in years 5 and 10 of the new license, and continuing every ten years thereafter during the new license term, Douglas PUD shall conduct a 1 year monitoring study to verify continued compliance with the bull trout passage performance standard (Term and Condition #2). These monitoring studies shall employ the same study protocols and radio-telemetry assessment methodologies used at Wells Dam in 2006 and 2007. If the monitoring results demonstrate continued compliance with the bull trout passage performance standard (Term and Condition #2), then no additional actions are needed. If the monitoring results demonstrate that Douglas PUD is no longer in compliance with the bull trout passage performance standard (Term and Condition #2), then the monitoring study will be replicated to confirm the results. If the results after two years of monitoring demonstrate that Douglas PUD is no longer in compliance with the bull trout passage performance standard (Term and Condition #2), then Douglas PUD shall, pursuant to Term and Condition #5, develop and implement additional measures to improve bull trout passage until compliance with the bull trout passage performance standard (Term and Condition #2) is achieved. If the bull trout counts at Wells Dam increase more than twice the existing 5-year average or if there is a significant change in the operation of the fish ladders, bypass, or hydrocombine, then Douglas PUD shall, in consultation with the Service, the Aquatic SWG, and the Wells HCP Coordinating Committee (WCC), shall conduct a 1 year, follow-up monitoring study to verify continued compliance with the bull trout performance standard (Term and Condition #2). Although the BTMP specifies to Douglas PUD to utilize radio-telemetry as the recommended monitoring method, the Service concludes that future monitoring technologies may be utilized in the implementation of this term and condition.

11. Adult Bull Trout Passage Evaluation at Off-Project Collection Facilities (*BTMP Section (4.2.2)*: FERC shall require Douglas PUD, in coordination with the Service, beginning in year one of the new license, to conduct a one-year radio-telemetry evaluation to assess incidental take of adult bull trout at the adult salmon and steelhead brood stock collection facilities associated with the Wells AFA/HCP, including but not limited to, the Twisp weir adult collection facility. Douglas PUD shall capture and tag up to 10 adult, migratory bull

trout (>400mm) per assessment per year and use fixed receiver stations upstream and downstream of the collection facilities. Assessments shall employ the same study protocols and radio-telemetry assessment methodologies used at Wells Dam in 2006 and 2007. If the evaluation demonstrates that Douglas PUD is not in compliance with the bull trout passage performance standard (Term and Condition #2), then the evaluation will be replicated to confirm the results. If the results after two years of evaluation demonstrate that Douglas PUD is not in compliance with the bull trout passage performance standard (Term and Condition #2), then Douglas PUD shall develop, implement, and evaluate additional measures, in consultation with the Service, WCC and the Aquatic SWG, until the Service determines that the bull trout passage performance standard has been achieved. At such time as the Service determines the bull trout passage performance standard has been achieved, the implementation of this measure shall be integrated into the 1 year telemetry monitoring program that is to be conducted every ten years (beginning in year 10 of the new license) at Wells Dam as identified in Term and Condition #10 above. Although the BTMP specifies to Douglas PUD to utilize radio-telemetry as the recommended monitoring method, the Service concludes that future monitoring technologies may be utilized in the implementation of this term and condition.

12. <u>Sub-Adult Bull Trout Monitoring</u> <u>*(BTMP Section 4.2.3)*</u>: FERC shall require Douglas PUD, if at any time during the new license term, sub-adult bull trout are observed passing Wells Dam in significant numbers (>10 per calendar year), in consultation with the Service, and the Wells Aquatic SWG, implement reasonable and appropriate methods for monitoring sub-adult bull trout. Although the BTMP states that >10 sub-adults per calendar year as the threshold, new information leads the Service to conclude that 31 sub-adults per calendar year is a more appropriate threshold. Specifically, Douglas PUD may modify counting activities, and shall continue to provide PIT tags and equipment, and facilitate training to enable fish sampling entities to PIT tag sub-adult bull trout when these fish are collected incidentally during certain fish sampling operations. This activity shall occur the following year of first observation of sub-adult bull trout (>10 per calendar year), in consultation with the Service and the Aquatic SWG.

13. <u>Funding Collection of Tissue Samples and Genetic Analysis</u> <u>*(BTMP Section 4.5.2)*</u>: FERC shall require Douglas PUD, in coordination with the Service, to collect up to 10 adult bull trout tissue samples in the Wells Dam fishway facilities over a period of one year and fund their genetic analysis. Genetic tissue collection will take place concurrent with the implementation of the bull trout radio-telemetry monitoring study. Any sub-adult bull trout collected during these activities will also be incorporated into the bull trout genetic analysis. Beginning in year 1 of the new license, Douglas will collect up to 10 adult bull trout tissue samples from the Twisp River brood stock collection facility over a period of one year and will fund their genetic analysis. Genetic tissue collection will take place concurrent with the implementation of the off-Project bull trout radio-telemetry monitoring study. This term and condition is consistent with other section 10(a)(1)(a) permits that involve handling of bull trout. The analysis will provide valuable information on the conservation status and genetic relationships between bull trout populations in the Columbia basin. This information will be used to determine the local populations impacted by Project operations, and when used in conjunction with other data such as movement data and redd counts, the resiliency of local

populations impacted by the proposed action may be determined. Samples will be submitted to the Service (Central Washington Field Office in Wenatchee, Washington).

Reporting Requirements

In order to monitor the impacts of incidental take, Douglas PUD shall prepare an annual report describing the progress of implementing the proposed relicensing and its impact on the bull trout. The report, which shall be submitted to the Service (Central Washington Field Office) annually on or before April 15th, shall list and describe the work that was completed and the number of bull trout, if any, observed and/or incidentally taken (i.e., injured or killed) during the course of implementing the Project.

Upon locating a dead, injured, or sick endangered or threatened species specimen, initial notification must be immediately made to the nearest Service Law Enforcement Office (Redmond, Washington; telephone 425-883-8122) and reported to the Service's Central Washington Field Office (509-665-3508). Care should be taken in handling sick or injured specimens to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species and preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Service Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

The RPMs, 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, the level of incidental take described above is exceeded, such additional take represents new information requiring reinitiation of consultation (assuming the Commission retains discretion or control over the action) and review of the RPMs provided. Douglas PUD must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the RPMs.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act 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. For this consultation, the Service has the following recommendations for the Commission and Douglas PUD to consider:

1. Implement recovery actions and restoration opportunities identified in the Service's draft *Bull Trout Recovery Plan* (Service 2002a) where the Wells Project activities involve or intersect recovery actions.

2. Coordinate with, and contribute to, bull trout monitoring efforts in the Columbia River Basin. Sharing expertise, workload, and funding of monitoring can better distribute the effort across agencies, land and water managers.

3. Design and implement an environmental education plan for bull trout. Similar to current public education efforts for salmon and steelhead, this environmental education plan will increase the public's understanding of bull trout use, project effects within the action area, and what Douglas PUD is doing to conserve bull trout. Douglas will make available an informational and educational display at the Wells Dam Visitor Center to promote the conservation and recovery of bull trout in the Upper Columbia River and associated tributary streams.

4. Participate in information exchanges with other entities conducting bull trout research and regional efforts to explore availability of new monitoring methods and coordination of radio-tag frequencies for bull trout monitoring studies in the Project.

RE-INITIATION NOTICE

This concludes formal consultation on the action outlined in the request. As provided in 50 CFR §402.16, reinitiating 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 reinitiating.

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APPENDICES

Appendix A

Bull Trout Population Estimate: Wells Dam Relicensing

Prepared by Jeff Krupka and Judy Neibauer, USFWS, Wenatchee, WA

3-5-2012

Executive Summary

We have reviewed the best available information in estimating the annual number of bull trout exposed to the effects of the proposed action. In the mainstem Columbia near Wells Dam (Wells Hatchery, and other mainstem structures and facilities), we estimate an average of 48 adult and 31 subadult bull trout may present any given year. Near the Twisp weir and acclimation pond, we estimate 228 adults, 31 sub-adults, and 19 juveniles. Near the Methow Hatchery, we estimate 324 adults and 50 subadults. Near the Chewuch acclimation pond, we estimate 1 adult and 1 subadult bull trout. The number and life history forms of bull trout likely to experience adverse effects is a small proportion of the total exposed.

Summary of Existing Information

Information Considered – fish counts, radio-telemetry, and other information in the Action Area as noted below. The focus of this analysis was to determine an estimate of the distribution, abundance, and movement patterns of bull trout in the mainstem Mid-Columbia (i.e., from Priest Rapids to Chief Joseph Dam).

Rock Island Dam (Chelan PUD, unpublished data, 1998-2011)

- Between 1998 and 2001, the number of bull trout passing upstream through Rock Island dam has ranged from 48 to 88. Between 55 and 70 percent of the fish that passed Rock Island Dam in those years did so in May and June.
- In 2002, a total of 87 bull trout passed through Rock Island Dam. About 75 percent of these fish passed in May and June.
- In 2003, a total of 77 bull trout passed Rock Island Dam between April 14 to September 3, about 71 percent (55 fish) during May and June.
- Between 2004 through 2006, a total of 114, 69, and 35 bull trout, respectively, passed Rock Island Dam, most in May through August (USFWS and USFS summarized data, 2007.
- Between 2007 and 2011, 36-60 fish passed Rock Island.
- The ten year average is 66 fish, or very close to the 61 fish average at Wells Dam.

Rocky Reach Dam (Chelan PUD, unpublished data, 1998-2011)

- In 1998, a total of 83 bull trout passed upstream through Rocky Reach Dam between May 3 and July 31.
- In 1999 from May 10 to November 14, 128 bull trout passed the project.
- In 2000, 2001, and 2002, counts of bull trout using the fish ladder from April 20 to November 14 were 216, 204, and 201, respectively. More than 80% of bull trout passage for these years occurred from May 1 to July 31.

- In 2003 (April 14 to September 3), 206 bull trout passed Rocky Reach Dam.
- In all years on record, the majority of the bull trout passed the Project in May and June (75 to 90 percent).
- Between 2004 through 2006, a total of 161, 155, and 132 bull trout, respectively, passed Rock Reach Dam, most in May through August (USFWS and USFS summarized data, 2007).
- Between 2007-2011, 77-168 bull trout have been observed ascending Rocky Reach fish ladders.
- The ten year mean for number of bull trout ascending Rocky Reach is 150, or more than twice Rock Island, and Wells Dam. This is likely attributed to the proximity of Rocky Reach to the Entiat River, which has a highly fluvial migratory population of bull trout, which almost solely use the mainstem Columbia River given the poor overwintering habitat quality in the Entiat. And further, PIT tag data suggests that Entiat River bull trout move downstream more often than upstream.
- In all years on record, the majority of the bull trout passed the Project in May and June (75 to 90 percent).

<u>Wells Dam (Douglas PUD, unpublished data, 1998-2008)</u>

- Data summarized by the USFWS and USFS suggests total bull trout counts from 1998 to 2008 range from 17 to 108 (mean = 64), with most passing upstream through Wells dam in May and June.

<u>Wells Dam: Bull Trout Management Plan 2009 Annual Report (Le and DPUD 2010).</u>

- Stranding and entrapment surveys indicate that infrequent Project operations that result in lowering of the reservoir have not impacted adult or sub-adult bull trout in the Wells Project.
- Off-season fishway monitoring continues to support that adult and sub-adult bull trout are not passing Wells Dam during the winter months.
- To date, no sub-adult bull trout have been observed in Wells Dam fishways.
- Data collected from Methow River basin smolt collection operations indicate that sub-adult bull trout are present outside of the Wells Project. During these operations, a total of 41 sub-adult bull trout were captured and biological information recorded. Forty (98%) of these fish were PIT-tagged. Six additional sub-adult bull trout were captured in the Methow River basin via hook and line sampling with 1 of these fish being PIT tagged. Tag codes for all PIT tagged fish were uploaded to the PTAGIS database. Queries of the PTAGIS database show that none of these PIT tagged bull trout have since been detected, either at Wells Dam or any other location where monitoring takes place throughout the Columbia Basin.
- In 2009, genetic samples were taken from 15 fish during the implementation of off-site smolt collection activities and provided to the USFWS for future genetic analysis.

<u>Wells Dam: Bull Trout Management Plan 2010 Annual Report (Douglas PUD 2011).</u>

- Adult bull trout fishway counts at the Wells Project were 43, 43 and 44 respectively for the past three years.

- Off-season fishway monitoring continues to indicate that bull trout are not passing Wells Dam during the winter months.
- During the 2010 season 82% of all bull trout fishway observations were in the May-June period, with the last observation in late October 2010. This timing is consistent with past years, and indicates bull trout passage at the dam is a seasonal trend independent of Project operations.

Wells Dam (Douglas PUD, unpublished data, 1998-2011)

- Data summarized by the USFWS and USFS suggests total bull trout counts from 1998 to 2011 range from 17 to 108, with most (90%) passing upstream through Wells dam in May and June
- A 10 year mean of 63 fish are counted ascending Wells Dam Fish ladders annually (2001-2011). To date, no fish have been counted in fish ladders from January to April.
- 99% of bull trout ladder use occurs between the months of May and August. The 13 year average of bull trout at Wells dam is slightly smaller at 61 fish (1998-2011).
- In December 2012 two adult bull trout (>33cm) were collected in the east fish ladder during annual fish ladder maintenance activities (East ladder).
- Off season ladder counts have been conducted since 2000 at Wells Dam.

Counts of Bull Trout ascending Wells Dam Fish ladders 1998-2011 (available through FPC.org).

Year	Total Annual	May-June observations	% May-June	%Jan-April
1998	17			
1999	49			
2000	93	85	91	0
2001	108	102	94	0
2002	76	70	92	0
2003	53	47	89	0
2004	47	45	96	0
2005	49	47	96	0
2006	100	88	88	0
2007	65	58	89	0
2008	43	37	86	0
2009	43	34	79	0
2010	44	36	82	0
2011	66	64	97	0
Total	**787**	**713**		
Mean	**61**	**59**	**90**	0

Summary of the GPUD 1999 Fish Inventory

- In 1999, a fish inventory was conducted in a 58-mile stretch of the Columbia River between river miles 395 and 453 (FERC 2003). Set lines, gill nets, beach seines, minnow traps, and electrofishing gear were used to collect over 58,000 individual fish from 38 species in tributary, forebay, reservoir, backwater, and tailrace habitats.

- Sampling occurred primarily in July through November, during both day and night hours. Although 93% of the fish collected were juvenile Cyprinids from beach seining, salmonids were collected at an intermediate rate and consisted mainly of juvenile Chinook.
- Federally-listed species captured in reservoirs and tailraces included 261 spring Chinook, 28 steelhead, and 2 bull trout. Both bull trout were collected by boat electrofishing in November; one at RM 399 (2 miles upstream of Priest Rapids Dam), and one at RM 430 (midway between Whiskey Dick and Quilomene Creeks in the Wanapum pool).

Other Priest Rapids/Wanapum Dams Information (GPUD, unpublished data, 1997-2003, 2007-2011)

- During fish salvage within the gatewells during juvenile salmonid outmigration, only 3 bull trout were observed at Wanapum Dam during 1997 and 2003 (one each observed in 1998-2000). No bull trout were observed during similar activities at Priest Rapids Dam.
- During fish ladder maintenance, one bull trout (36 cm) was salvaged from the Priest Rapids Dam on December 8, 2000. Fish ladder maintenance at Wanapum Dam salvaged one bull trout (42 cm) on December 12, 2000
- One bull trout was observed using the Wanapum fish ladder on July 23, 2002
- Bull trout have been observed in both upstream fishway at Priest Rapids and Wanapum dam, respectively, as noted in Grant PUD 2011.
- Two bull trout were observed in 2010/2011 using the fish ladders which were previously PIT tagged in other studies, one PIT tagged in the Walla Walla R. and one PIT tagged in the Entiat R.

Lower Skagit Bull Trout – Age and Growth Information (WDFW Brief, 2003)

- Sampled fluvial and anadromous bull trout in 2001 and 2002
- 2001 anadromous: n=41, ages 3 to 7, size 430 to 680 mm total length (TL)
- 2001 fluvial: n=49, ages 2 to 8, size 195 to 570 mm TL
- 2002 anadromous: n=79, ages 3 to 10, size 350 to 780 mm TL
- 2002 fluvial: n=36, ages 2 to 8, size 230 to 700 mm TL
- Fluvial fish: 64/85 previously spawned, and 31 (48%) spawned at least twice
- Anadromous fish: 88/120 previously spawned, 52 (59%) spawned at least twice
- 2002 sampling: 17 fish spawned 4 or more times; 15/22 fish over 60cm spawned 4 or more times
- Estimated percent of population surviving to spawn 5 or more times given annual survival rates (agrees with Rieman, 2002 pers. com):

Annual survival from spawn to spawn	% of the population spawning 5+ times
10%	0.01
20%	0.14
30%	0.54
40%	2.50
50%	5.88
60%	11.47

70%	19.36
80%	24.70

Wells Dam Bull Trout – Age and Growth Information (Wells bull trout monitoring and management plan 2005 annual report)

- Bull trout migrating upstream through Wells Dam in 2001 were 5 year old (n=2, mean fork length=55.6cm) and 6 year old (n=6, mean fork length= 54.6cm) fish as determined by scales (LGL and Douglas PUD 2008)
- Bull trout migrating upstream through Wells Dam in 2006 were 4 year old (n=1, fork length=43.0cm), 5 year old (n=1, fork length=58.0cm), and 6 year old (n=3, mean fork length=60.0cm) fish as determined by scales.
- For 5 and 6 year old fish that reside in the Methow Basin, the mean fork lengths were 19.5 cm and 22.8 cm, respectively (Mullan et al. 1992).

Report to GPUD (BioAnalysts, Inc. 2003)

- A total of 39 adult migratory bull trout were radio-tagged at Wells, Rocky Reach, and Rock Island Dams in 2001. All fish were 4-7 years old.
- Detailed information on 19 BT; tributary use corresponds to 11 Entiat, 4 Wenatchee, 2 Methow, 1 multiple core areas, 1 dead.
- Other results reported in BioAnalysts 2004.

Report to CPUD (BioAnalysts, Inc. 2004)

- One of the single best reports available. However, they appeared to be somewhat reserved in their analysis. As a result, the Service tried to take a broader look at the great wealth of information they provided and made our own interpretation and assessment.
- A total of 79 adult migratory bull trout were radio-tagged at Wells, Rocky Reach, and Rock Island Dams in 2001 and 2002. All 79 radio-tagged fish were all 4-7 years old; bull trout can live 12 to 20 years.
- Fish made extensive upstream and downstream movements into multiple tributaries, between and within years, including the Methow, Entiat, and Wenatchee Rivers. One fish entered the Okanogan River (detected at RK 9), but shortly thereafter moved downstream and entered the Methow River.
- Use of the mainstem Columbia was extensive and occurred year–round, but most adult bull trout moved into tributaries by July and reentered the Columbia in November. About 92% of bull trout leave the Columbia when temps >15 C, and 5% stayed in Columbia year-round.
- 14 of 79 (18%) radio tags were recovered (half from Twisp fish), with distances from tagging location to point of recovery ranging from 98 to 322 km. 5 other radio-tagged fish were stationary for months but not recovered.
- 10 of the 79 fish (12.7%) radio-tagged in the mainstem Columbia River moved into the Wanapum pool. Five fish used the upstream half of the pool (upstream of Tekison Creek), the other half used the entire pool, with one fish moving downstream of Priest Rapids. Fish moved as many as 140 km one-way. Table 1 of this report summarizes the movements of these fish.

- Tributaries used by the 75 of 79 radio-tagged fish (by core area) in 2001 and 2002: 18.7% Wenatchee (n=14), 45.3% Entiat (n=34), 36% Methow (n=27). Core areas were not "assigned" to 4 fish; 3 stayed in the Columbia, 1 died.
- Use of core areas by radio-tagged fish differed between years. Only 2 fish tagged in 2001 were tracked in 2002, but 50% used different core areas. 14 fish tagged in 2002 were tracked in 2003, and 8/14 used different areas; 3/8 used different areas within the same core area, but 5/8 used different core areas or the Columbia. (FMO vs. spawning/rearing?)
- Bull trout may use multiple core areas within and between years.
- In the Service's review of multi-year data, we suggest core area spawning occurred similar to single year spawning: 25% in the Wenatchee, 50% Entiat, 12.5% Methow, and 12.5% unknown/may have spawned in consecutive years (fish number 101 used the Mad and Peshastin during spawning season). This is a rough estimate due to a variety of uncertainties and assumptions, but is the best information available.
- Passage delays at dams (and movement to tributaries) varied: 2.3-5.9 days at Rock Island, 1.4-6 days to Wenatchee; 3.8-4.9 days at Rocky Reach, 7.2-16.5 days to the Entiat (shortest distance); 1.2-8.9 days at Wells; 0.4-2.8 days to Methow.
- The location of release of fish (upstream or downstream of the dams) after being radio-tagged did influence movement patterns, but Rock Island/Rocky Reach pattern differed from Wells.
- Upstream/downstream movements at dams detailed for 10 BT. Tracked for 3-22 months, individual BT, on average, made 1.8 (0-3) upstream and 2.3 (1-4) downstream passes through dams. These movement patterns suggest use of ladder counts (unadjusted) as a population estimate may over-estimate the actual population by 12 to 28%.

<u>CPUD Juvenile Bypass (2004 BO on the Mid-Columbia HCP)</u>

- Juvenile bypass operated 24/7, April 1- August 31. Downstream migrating fish are collected at the sampling facility five days each week (Monday – Friday) for 2 hours (0800 to 1000 hours) or until roughly 1,500 fish have been collected (whichever comes first). In addition, sampling conducted in the evenings (1400 to 1600 and 1900 to 2100 hours) once each week to assess how well the 0800 to 1000 hours sample represents the migration in general.
- Rocky Reach: The juvenile bypass collector observed 4 to 30 subadult bull trout between 1998 and 2002 (23, 30, 8, 4, and 5 fish, respectively); no subadult bull trout were observed in 2003.
- Rock Island: Numbers of bull trout captured in the Rock Island Bypass smolt trap facility ranged from 1 to 30 between 1997 through 2002 (2, 7, 30, 1, and 8, respectively). No juvenile bull trout were captured in 2003 (L. Praye, WDFW, pers. comm., 2003).
- From 2005-2011, 1-30 subadult bull trout have been encountered at the Rocky Reach Juvenile Bypass Facility (Lance Keller Pers Comm. 2011 Chelan PUD):

Subadult Bull Trout Counts @ RRJFB	
Year	Bull Trout Count

2005	1
2006	1
2007	1
2008	14
2009	30
2010	11
2011	9

BioAnalysts 2006 (2005 HCP Annual Report)

- Reports on the implementation of the RPMs and T&Cs of the HCP
- 2 sub-adult and 1 adult bull trout ascended the Rocky Reach fishways in the 2005 fall-off season period (November 15 to December 4)
- 1 subadult bull trout was observed on April 14, 2005, but originally misidentified as a lake trout, at the Rocky Reach juvenile bypass.
- 1 adult bull trout ascended Rock Island during the 2005 off-season period (Nov 15-Dec 31)
- Conclude no mortality (which they equate as incidental take) has occurred, fallback has not been observed, and mortality is not associated with the dams or operations.

BioAnalysts 2007 (2006 HCP Annual Report)

- Reports on the implementation of the RPMs and T&Cs of the HCP
- 15 juvenile (<305mm) and 117 adult bull trout ascended Rocky Reach during the normal counting period in 2006.
- 1 sub-adult and 1 adult ascended the Rocky Reach fishway in the early season following fishway maintenance (Feb 7, 2006) and 35 sub-adult and 1 adult ascended during the fall off-season (Nov 15-Dec 4, 2006); this total of 36 is the highest annual sub-adult use recorded at Rocky Reach and the Mid-Columbia.
- Tissue samples were collected from all 25 adults radio-tagged at Rocky Reach, and 4 from Rock Island
- Suggests that stranding/entrapment of adults is unlikely based on radio-telemetry data.
- One adult used the juvenile bypass in 2006
- Rock Island: In 2006, no juvenile bull trout were observed in the smolt bypass trap, and no bull trout were observed outside the normal counting period (April 15-November 15).
- 35 adult bull trout ascended the Rock Island fishway in 2006.
- Conclude no mortality (which they equate as incidental take) has occurred, fallback has not been observed, and mortality is not associated with the dams or operations.

Spawning demographics and Juvenile Dispersal (Downs *et al.* 2006)

- Annual repeat spawning was more common than alternate-year spawning (about 88%) over 4 years; this is consistent with Baxter and Westover (1999) that found a 2:1 ratio.
- Emigration of juveniles occurred in two pulses: one in the spring associated with spring runoff/increasing water temperatures, and a second in fall as stream temperatures drop/fall rains began.

- Based on otolith microchemistry, most of the sampled adults emigrated at age 3 or 4, and none had emigrated at age 0.
- Age structure of sampled fish was 6 to 11.

Juvenile/subadult bull trout dispersal (unpublished data2004-2011 (Columbia River Dart, www.cbr.washington.edu/cgi-bin/dart/makegraph/dart/makegraph/html-src/trap.config)
Chiwawa River Screw trap from 2007-2011 showed downstream movements of bull trout with larger pulses in the Spring and Fall;
Twisp River Screw trap from 2007-2011 showed downstream movements of bull trout with some years having pulses in Spring and Fall and other years a bigger pulse in the Spring than the Fall and some years there were pulses in August
Methow River Screw trap from 2007-2011 shows low numbers of downstream movements of bull trout observed between March and November-
Entiat River Screw traps from 2004-2011 showed downstream movements of bull trout with larger pulses in the Spring and Fall.

MCFRO 2005 Annual Permit Report (Kelly-Ringel [2006])

- Seasonal movements of bull trout in the Entiat River (Study #9)
- Movement, travel times and timing of bull trout movements
- Implicates log jams as a source of mortality/barriers

2006 Mad River Bull Trout Spawning Survey Report (Archibald and Johnson 2006)

- Summary of 7.5 mile index reach
- Log jam movement, restored access to historic spawning areas (but data incomplete)
- Observed a decline in redds and offered several hypotheses:
    1. relationship between Rocky Reach dam counts and number of redds
    2. sub-optimal habitat reduced survival in 1999-2003 age classes
    3. log jam effects (as a partial barrier)
    4. poaching and predation
    5. high flows delaying upstream migration
    6. delayed mortality from tagging/handling
    7. Non-repetitive spawning
- Recommends to maintain the total angling closure

MCFRO 2005 Methow Telemetry Progress Report (Nelson and Nelle [2007])

- Tracked 45 PUD fish tagged in Columbia, 8 used the Methow
- Have detailed information on 6/8 fish that used the Methow: 3 used the Twisp, 1 in WF Methow, 1 in Wolf Creek, 1 in Lost River
- Bull trout tagged in the Methow Core Area exhibited different movement patterns than bull trout tagged in the Columbia River. All 6 of the active Methow River tagged bull trout over-wintered in the Methow Core Area, while 11 of the 12 active Columbia River tagged bull trout returned to the Columbia River.

- 9 of 22 fish spawned in the Twisp, five of which were fish that were tagged a Mid-Columbia Dam
- Fish tagged in the Methow core area overwinter in the Methow River (n=6)
- Fish tagged at Mid Columbia Dam, that entered the Methow appear to overwinter in the Columbia River
- Migration Distances: 110-141 km for Wells-tagged fish, 174 km for RR tag fish

MCFRO 2006 Methow Telemetry Progress Report (Nelson et. al [2007])

- MCFRO tagged 13 bull trout in Methow, also tracked 17 fish tagged in Columbia
- Only 2/13 bull trout tagged in the Methow migrated into the Columbia, compared to ¾ tagged by DPUD and 8/8 tagged by CPUD.
- Post-spawning migration distances: 6-110 km (MCFRO), 45-169 km DPUD, 106-222 km (CPUD)
- High tag recovery rate of 33% (10/30 tagged fish); 54% (7/13 fish) MCFRO tags but 17% (3/17 fish) PUD tags. Literature ranges from 3-28% tag recovery rate.
- Weight/length plot different between Columbia vs. Methow tagged fish (Methow fish weighed less than Columbia fish at lengths over about 475mm)
- Upstream/downstream movements, but period of coverage incomplete
- Discussion of barriers, recruitment, stranding, etc. speculative

Adult Fluvial Bull Trout Passage of Tumwater Dam (Nelson [2007])

- Analysis of WDFW ladder counts (1998-2006) suggests the average timing of upstream movements peak on July 7, about 45 days after the peak of the hydrograph
- Mean number of fish ascending Tumwater (1998-2006) is 98 (range: 33-147)
- Including 2007 data (n=65), mean is 95
- Early data may not be reliable, appears more accurate in evaluation and reporting for the period 2000-2007; the mean this period is 110 but appears to be in decline

MCFRO - Icicle Creek radio-telemetry (Nelson et al. 2011)

Nelson, M.C, A. Johnsen, and R.D. Nelle. 2011. Seasonal movements of adult fluvial bull trout and redd surveys in Icicle Creek, 2009 Annual Report. U.S. Fish and Wildlife Service, Leavenworth WA.

- Fluvial bull trout tagged in Icicle creek overwinter in the Wenatchee River or Columbia River between Rocky Reach and Rock Island dam
- 4 of 7 radio tag bull trout appeared to use the Columbia River for FMO habitat, specifically between Rock Island and Rocky Reach, near the confluence of the Wenatchee and Columbia Rivers
- Downstream movements were 5.4-50.1 km, primarily at night
- Hybrid (brook x bull) radiotagged in Icicle, moved 69 km

Wells Dam: Bull Trout Monitoring and Management Plan 2005-2008 Final Report (LGL Limited and Douglas PUD 2008)

- Between 2005 and 2008, 26 adult bull trout were trapped at Wells Dam and radio-tagged. Concurrent with the Bull Trout Plan study, the USFWS and Public Utility District No. 1 of Chelan County (Chelan PUD) radio-tagged and released 136 adult bull trout at other mid-Columbia River basin locations including the Methow River, and Rock Island and Rocky Reach dams (50 USFWS tags 2006-2008, 86 Chelan PUD tags 2005-2007).

- From 2005 to 2007, 25 downstream passage events and 52 upstream passage events by 40 individual bull trout were recorded at Wells Dam. Of these, 17 downstream and 41 upstream passage events occurred within one year of release. No bull trout injury or mortality was observed at the Wells Project, as indicated by subsequent movement and detections.
- Only 2 of 52 upstream passage events were from fish that made two upstream passage movements at Wells dam in a given year. Therefore, 4% of counts at Wells dam ladder viewing windows are from fish counted twice in a given year.
- Video monitoring of the Wells Dam fishways during the off-season period (November 16 to April 30) detected no adult bull trout utilizing the fishways over the entire study period.
- From 2004 to 2008, 67 sub-adult bull trout were PIT tagged in the Methow River subbasin during standard tributary smolt trapping operations. Douglas PUD operated PIT tag detection systems year-round within the Wells Dam fishways during the study period (2005 to 2008) and no PIT tagged sub-adult bull trout were detected. Additionally, sub-adult bull trout were to be PIT tagged opportunistically when encountered at the Wells Project; however, no sub-adult bull trout were encountered during the study period. Off-season (November 16 to April 30) video monitoring of the Wells Dam fishways from 2004 to 2008 as required by the Bull Trout Plan. No sub-adult bull trout were observed utilizing the fishways.
- Data from radio-tagged bull trout tracked during the 2005 to 2008 study period were analyzed with the data from the 2001 to 2004 study. Bull trout that pass Wells Dam (either upstream or downstream) migrated into the Methow, Entiat, and Wenatchee rivers during the spawning period. Observed tributary entrances of bull trout detected at Wells Dam from 2005 to 2008 were 86% Methow River, 10% Entiat River and 2% Wenatchee River.
- Over 8 years of radio telemetry studies conducted by LGL and BioAnalysts, there were 27 downstream and 93 upstream total passage events at Wells Dam by radio-tagged bull trout, and 19 downstream and 79 upstream passage events at Wells Dam by radio-tagged bull trout within one year of release over the six years of tagging and eight years of monitoring. Radio-tagged bull trout passed downstream through the turbines or spillways as no downstream passage events were recorded via the fishways.

<u>Columbia River Data Access in Real Time [DART]:</u>
<u>(http://www.cbr.washington.edu/dart/dart.html)</u>

- Little correction or expansion factors are available for these data for bull trout. The Service assumes this represents the minimum number of bull trout moving into the mainstem Columbia annually.
- PIT tag releases and observations are increasing both within the mainstem Columbia River and subbasins (i.e., Wenatchee, Methow, Entiat, Walla Walla, Touchet, etc.)

<u>Twisp River weir adult bull trout Encounters (WDFW Charlie Snow Personal Communication)</u>

- Adult bull trout >400 mm are encountered in June through August at the Twisp River Weir Brood collection location

- Yearly comparison are challenged by inconsistent annual operation as a result of variable flows
- Average encounters between 2010-2011 is about 64 fish
- 5-6% fallback has been observed from 2010-2011

Year	Count	Description
2010	91	Encountered
2010	87	Tagged
2010	4	Existing tags (all recaps that year)
2011	36	Encountered
2011	26	Tagged
2011	3	Existing tags (all recaps that year)
2011	7	Existing tags (from the previous year-2010)

Fish Passage Center (www.fpc.org)

- Comprehensive source of bull trout information, including data not on DART
- Rock Island Smolt Monitoring reports 7 bull trout in 1998, 14 juvenile and 7 adults in 1999, 1 adult and 1 juvenile in 2000, 8 bull trout in 2001, 8 bull trout in 2002, 2 bull trout in 2003, 3 bull trout in 2004, 3 juvenile and 2 bull trout in 2006, and 2 bull trout in 2007.
- Bull trout counts by date through the Rocky Reach surface collector/bypass (1998-2002): 13 in 1998, 30 in 1999, 8 in 2000, 4 in 2001, 5 in 2002.

PTAGIS (http://www.ptagis.org/ptagis/index.jsp)

- Since August 2004, 1,123 PIT tags have been implanted in bull trout in the upper Columbia Recovery unit. Almost 570 of those have been implanted in Methow and Twisp River bull trout. An additional 402 have been implanted in Entiat River bull trout.
- 2 Twisp River fish and 1 Methow River PIT tagged fish have since been detected at Wells adult fishways, suggesting that only and 1-2% of the Methow fish appear to use adult fish ladders in the mid-Columbia.
- However, 31 of 402 Entiat River tagged fish, or 7.7% have been detected at Rock Island, Rocky Reach or Wells Dam, suggesting Entiat River fish are more likely to use the Columbia River and adult fish ladders. Only one of 31 has been detected at Wells (the other 30 have been detected at either Rock Island or Rocky Reach). Therefore, Entiat fish appear to use the lower Projects preferentially compared to moving upstream to use the Wells Project.
- PIT tag results suggest that Entiat River fish may have a higher propensity to be use the Columbia River mainstem compared to fish hatched in Methow River tributaries. PIT tagged bull trout sizes were an average of 261 mm and represent all life histories more effectively than current studies of radio tagged fish.

	# PIT Tagged in Basin	Unique BT detected on any PIT array post release	Detection Probabilities of tagged fish (2004-2011)	# fish detected at Mid-C dams	Percent migratory (low estimate)*	Percent migratory (high estimate)~

Yakima	4	0				
Entiat	402	95	24%	31	7.7%	32.6%
Mad River	13	5	38%	2	15.4%	40.0%
Wenatchee	127	33	26%	1	0.8%	3.0%
Methow	**298**	**66**	**22%**	**1**	**0.3%**	1.5%
Twisp	**268**	**111**	**41%**	**2**	**0.7%**	1.8%
Wells	9	5	56%	0	0	0
Rocky Reach JBS	2	0				
Total PIT tagged since 2004	1123	316				

* estimates percentage migratory assuming all PIT tagged fish survived. ~ estimates percentage migratory using only those fish detected on an array post release. In this case, an highly migratory fish is define by a fish that not only enters the Columbia River but uses an adult fish ladder at either Rock Island Rocky Reach, Wells, Priest Rapids, or Wanapum (however only Grant County Projects were not used by any of the 1123 fish). Note: Of the five fish that were tagged at Wells and recaptured 4 were detected in the Twisp River and one in Gold Creek.

Wenatchee River Radio-telemetry (Kelly-Ringel and De La Vergne, 2006 draft)

- 43 of the 51 radio-tagged fish were grouped by similar movement patterns: Lake Wenatchee, Upper Wenatchee/Columbia, and Mid-Wenatchee/Columbia.
- 9 of 43 radio-tagged fish (all of the Upper Wenatchee/Columbia and Mid-Wenatchee/Columbia fishes) made large movements of up to 170 km one-way into the Columbia River; Lake Wenatchee fishes remained in the lake or upper tributaries. Only the Upper Wenatchee/Columbia fishes moved between all groups.
- Alternate-year spawning: use of known spawning areas suggests 22 percent of fish radio-tagged fish spawned multiple times over a 2 to 3 year period; about 88 percent of fishes radio-tagged tracked for only 1 year spawned.
- Key FMO habitats were used about 8 (Icicle Creek), 9 (mainstem Columbia River), or 12 (Wenatchee River) months of the year.

Demography of recovery of an overexploited bull trout population (Johnston *et al.* 2007)

- Observed a 28-fold increase over a 10-year period following zero-harvest regulations
- Abundance grew and equalized in about 2 generations, despite being suppressed to <5% of the unfished density.
- No depensatory processes observed; suggests the population was growth overfished, not recruitment overfished.
- Aging using length-frequency analysis vs. boney structures were not significantly different; age designation based on length provides a reasonable estimate.
- Estimated that the annual natural adult mortality is about 27%.
- Long-lived and late-maturing species are often unable to support high levels of mortality (Hilborn *et al.* 2003), and harvesting fish prior to maturity substantially increases the probability of population collapse (Myers and Mertz 1998).

Bull trout population responses to angling restrictions (Parker *et al.* 2007)

- Increase in abundance at isolated Harrison following regulation changes, but growth rates declined
- Change in age structure: elimination of older age classes (age 13-27), may have been a result of reduced prey abundance and size.
- No change was observed at Osprey Lake, which is road-accessible and connected to tributaries
- Illegal harvest and migration between tributaries may have limited abundance response
- Estimated survival rates in 1997: 65% for fish 200-300mm fork length (FL), 92% for fish >300mm FL (ages 5-8)

Migratory Patterns of Anadromous Bull Trout in the Hoh River (Brenkman *et al.* 2007)

- Sampled 105 bull trout killed in a legal gill-net fishery in the lower Hoh River (Jan-June 2002 fishery for Chinook/steelhead, 10 to 20 cm mesh size)
- Adult age structure derived from otolith chemistry: 11.4% (12) were age 3, 68.6% (72) were age 4, 19% (20) age were 5, 1% (1) were age 7
- 20 of 40 radio-tagged juveniles emigrated to the ocean, 20 remained in the river (Hoh, SF Hoh, and Kalaloch Creek)

Okanogan Basin Monitoring and Evaluation Program (OBMEP) - 2007

- Underwater video monitoring at Zosel Dam by Colville Tribes
- Observed 1 adult bull trout on November 10, 2007. Expert panel confirmed BT
- Water temp at Oroville ≥15°C for 81 days in 2007 (may be a thermal barrier for BT).
- Water temperatures at Oroville ≥19°C for 64 days in 2007 (may be lethal to BT). Max temp of 26.4 °C on July 28, 2007.
- http://www.colvilletribes.com/media/files/2007VideoReport_Final_20081002.pdf

Okanogan Basin Monitoring and Evaluation Program (OBMEP) - 2008

- Continuation of 2007 monitoring at Zosel Dam by Colville Tribes, observed 1 adult BT
- Water temp at Oroville suggest ≥15°C from May 25-Oct 12. Max temp of 26.2 °C on August 18, 2008.
- http://www.colvilletribes.com/media/files/2008VideoReport_Final12October2009.pdf

Temporal and Spatial Variability in the Migration Patterns of Juvenile and Subadult Bull Trout in Northeast Oregon (Homel and Budy 2008)

- Evaluated the movement patterns of juvenile and subadult BT (120-300mm)
- Movements occurred throughout the year, peaking in August, most (94%) at night
- Observed mostly downstream movements, but some upstream (~10%) did occur
- Found movements of up to 45 km, compared to the typical 2 km movements of "resident" fish (Jakober 1995, Chandler et al 2001)
- Temperature explained only 23-35% of the variation in timing. The highest ranked model was related to temperature and stream discharge

Relationships between water temperatures and upstream migration, cold water refuge use, and spawning of adult bull trout from the Lostine River, Oregon (Howell et al 2009)

- Archival tags, radio tags, and thermographs

- Moved out of FMO to spawning when temps were 16-18 °C (7DADM) and spawning occurred at 7-14 °C (7DADM)
- Temperatures appeared to be at or above the upper range of suitability

Kootenai River Fisheries Investigations (Paragamian et al. 2010)

- Idaho Fish and Game: bull trout radio-telemetry 1998-2006 in Idaho, Montana, and British Columbia
- Highly fragmented system with both dams and falls
- Longest single movement was 228 rkm (from Kootenay Lake, BC, to Kootenai Falls, MT)
- Largest distance moved by one fish over the course of approximately one year (home range estimate) was 270.6 rkm.
- Estimated age distribution of out-migrating BT: age 1 -13%, age 2 – 73%, age 3 – 7%, and age 4 – 7%
- Annual spawning was found to be 50%

Monitoring the Use of the Mainstem Columbia River by Bull Trout from the Walla Walla Basin (Anglin et al. 2010)

- PIT tag detections, with the variation in PDE (physical detection efficiency), yielded 120 migratory BT in 2007-2008 and 192 migratory BT over the period of the study (Nov 2007-Dec 2009)
- Large upstream (130 km) and downstream (162 km) movements of subadult BT (<300mm) were observed (from the WW to mainstem Columbia dams). One subadult (155mm) tagged at the Dayton Pond was detected at John Day juvenile bypass after 18 days; one subadult (249mm) tagged at the Little Walla Walla Diversion was detected at the McNary Dam juvenile bypass after 259 days; one subadult (269mm) was tagged at Nursery Bridge was detected at McNary Dam adult ladder after 240 days; one subadult (272mm) tagged at Pierce's RV park was detected at Priest Rapids ladder after 158 days.
- Migration timing (from the Walla Walla to the Columbia) varied from year to year, but generally occurred between October and May. Migration timing seemed to be influence more by streamflow than temperature

Diet Overlap: Bull Trout and Lake Trout in Swan Lake (Guy et al. 2011)

- Diets were similar, comprised of invertebrates as juveniles and shifting to fish as adults
- Diet shift occurred when fish grew to similar sizes (506mm for BT, 496 for LT)
- Contrasts sharply with earlier studies (Shepard et al. 1984, Boag 1987, Goetz 1989, Donald and Alger 1993) that found bull trout prey on fish when they are small. Bull trout that are 4.3 inches long or longer commonly have fish in their diet (Shepard et al. 1984), and bull trout of all sizes have been found to eat fish half their length (Beauchamp and Van Tassell 2001).

Impacts of River Regulation (Muhlfeld et al 2011)

- Flow manipulations can impact the amount of usable habitat (especially low-velocity shoreline areas)

- Sporadic streamflow fluctuations are detrimental, "natural" flow fluctuations improve the chances of protecting key habitats

Subadult bull trout ascending adult fishways (unpublished data from CPUD, 2004-2011)

- Information provided by Steve Hemstrom, CPUD. Subadults were described as BT<305mm
- For 2004-2011, a mean of 18 (range 4-43) subadult BT ascending the fishway at Rocky Reach
- For 2004-2011, a mean of 6 (range 1-11) subadult BT ascending the fishway at Rock Island
- It is likely that total bull trout reported as ascending the ladders at each dam are a combination of both adults and a smaller proportion of subadults

Wells Dam (Unpublished Data, 2012; Email and Pers. Com. Andrew Gingerich, DPUD)

- Fish counted at Wells Dam in the fish ladder were not sized
- Andrew looked at 2011 videos and found that they were notifying him of sizes less than and greater than 12" (300mm). They had not identified any subadults (<300mm) moving in the ladder.
- One PIT tagged fish tagged by WDFW in Twisp R did descend Wells Dam and was picked up at Rocky Reach Dam (see below USGS/WDFW PIT tag data)

USGS/WDFW Methow and Twisp PIT tag data (unpublished, 2012; Email and Pers Com, Kyle Marten USGS and Bob Jateff, WDFW)

- Two juvenile/subadult (163 and 174 mm) bull trout tagged by WDFW in the Twisp R went to the Columbia and one was located at Rocky Reach Dam antennas ~7 mos. later and one located at Wells Dam antennas and ~14 mos. later .
- The fish picked up at Rocky Reach (#3D9.1C2D60B879) was not located at Wells Dam antennas
- One adult (480 mm) tagged in the Twisp R by WDFW went to Columbia R and was located by Wells Dam antenna ~15 mos. later.
- One adult (367 mm) tagged in the Methow R by USGS went to Columbia R and was located at Wells Dam antenna~7.5 mos. later.
- The accuracy of PIT tag antennas varies depending on flow and species. They are generally good for larger fish that tend to move along the bottom. They are highly variable for juvenile fish at high flows. Small tributary readers tend to detect just about everything. The Twisp and Chewuch do pretty good (>30%) at normal flows for juvenile detections but lose efficiency as the flows go up. The mainstem Columbia adult readers tend to just about every fish.

WDFW Screw Trap data (unpublished, 2005-2011; Email and Pers Com. Charlie Snow)

Life History Stages handled at Twisp Screw Trap

Year Trapped	Juvenile (<150mm)	Subadult (150-330mm)	Adult (>330mm)	Total
2005	19	31		50
2006	2	18		20

2007	1	9		10
2008	8	20		28
2009	7	14		21
2010	9	19		28
2011	2	18	1 (556mm)	21

- 2005 - 19/50 (38%) were juveniles <150mm; 31/50 (62%) were subadults.
- 2006 - 2/20 (10%) were juveniles <150mm; 18/20 (90%).were subadults.
- 2007 - 1/10 (10%) were juveniles <150mm; 9/10 (90%) were subadults.
- 2008 - 8/28 (29%) were juveniles <150mm; 12/28 (71%) were subadults.
- 2009 – 7/21 (33%) were juveniles <150mm; 14/21(67%).were subadults
- 2010 – 9/28 (32%) were juveniles <150mm; 19/28 (68%) were subadults.
- 2011 – 2/21 (10%) were juveniles <150mm; 18/21(85%) were subadults; and 1 was an adult (5%).

Summary Findings

- 10 year average of Adult fishway data suggests 66 fish passing Rock Island Dam annually, 150 at Rocky Reach Dam, and 63 at Wells Dam (FPC.org).
- Although fish counts at adult fishways only cover about 5 to 8 months each year at all Mid-Columbia dams, most fish are believed to move through the dams in May and July.
- All 79 radio-tagged fish were all 4-7 years old; bull trout can live 12 to 20+ years. Recent literature suggests adult age structures of 6-11 (Downs *et al.* 2006; sample size n=47) and 4-12 (Parker *et al.* 2007; sample size varied through time but ranged from n=20 to 84 at Harrison Lake).
- Although the aging methods used by BioAnalysts (2004) are the least accurate, given the inherent difficulties of aging coldwater fish, their sample size of n=79 should have been large enough to detect age class 8+ bull trout (if present?), based on other findings in the literature.
- About 13 to 21% of radio-tagged sampled bull trout make large movements (up to 140 to 170 km); for the purpose of this analysis, we estimate 17% (the mean of 13 and 21%) of bull trout may make these large movements. Movements can exceed 200 km. However, PIT tag data for suggests that only 1-2% of the Methow River Core Area bull trout make large migrations past Wells dam. These differences may reflect tagging location and the proportion of migratory bull trout sampled (i.e., the likelihood of tagging a migratory fish is greater in the mainstem Columbia, whereas fish tagged in spawning tributaries may not be migratory).
- Detailed movement patterns of 10 of the 79 tagged bull trout show multiple upstream and downstream movements through the dams (BioAnalysts 2004). Using raw ladder counts may overestimate the actual number of bull trout ascending dam ladders by about 12 to 28 percent (about 20% overall).
- Location of capture (mainstem Columbia vs. tributaries) may influence movement patterns. Kelly-Ringel and DeLaVergne (2006) and Nelson et. al (2007) both observed less migratory behavior in tributary captured fish than mainstem Columbia captured fish.
- Spawning frequency is variable: Downs *et al.* (2006) found annual repeat spawning was more common that alternate-year spawning (about 88%) over 4 years; this is consistent

with Baxter and Westover (1999) that found a 2:1 ratio. However, Kelly-Ringel and DeLaVergne (2006) suggest 22 percent of fish radio-tagged may have spawned multiple times over a 2 to 3 year period; about 88% of fishes radio-tagged tracked for only 1 year spawned.

- Core area use varied within and between years, but on average (Service interpretation of BioAnalysts 2004); spawning of mainstem tagged fish occurred as follows: 25% Wenatchee, 50% Entiat, 12.5% Methow, and 12.5% unknown (due to insufficient information). This accounts for the difference in single vs. multi-year monitoring and consecutive vs. alternate-year spawning. Note that this generalized movement pattern is more appropriate near Rock Island and Rocky Reach Dams, due to their juxtaposition to the Wenatchee and Entiat Core Areas and may not be appropriate near Wells Dam. The Wells distribution is approximately 86-88 % Methow, 10-12% Entiat and only 0-4% Wenatchee (see LGL and DCPUD 2008). For the purposes of the proposed action, we will use the high end of the respective ranges for the Wells distribution.
- Ladder counts at Tumwater Dam suggest peak movement occurs about 45 days after the peak of the hydrograph and averages about 110 fish; however, the trend appears to be in decline, similar to that observed at the mainstem Columbia Dams.
- Harvest (illegal, commercial, and sportfishing) can exert substantial pressure on population abundance and demography.
- Few bull trout have been incidentally observed in the operation and maintenance of Priest Rapids and Wanapum Dams.
- A lack of understanding of the manner and limitations of data collected for juvenile bull trout in the Mid-Columbia confounds the use of this information.
- The high number of juvenile bull trout observed at the Chiwawa screw trap but low numbers observed at the Wenatchee River trap at Monitor, may suggest:
    1. that juveniles from the Chiwawa remain in Lake Wenatchee or the upper tributaries rather than move downstream (similar to the adult use patterns found by Kelly-Ringel and DeLaVergne 2006)
    2. they experience high mortality
    3. contribute few individuals to the mainstem Columbia
- Juvenile bypass data suggests few juvenile bull trout use the mainstem Columbia; a total of 1 to 30 and 4 to 36 sub-adults have been observed at Rock Island and Rocky Reach Dams, respectively.
- Juvenile outmigration varies between core areas. Screw Traps in Wentachee, Entiat, and Methow show peaks of migration in Spring and Fall with some movement in summer. However, screw trap efficiencies vary significantly.
- Bull trout sizes are not recorded by fish counters at Wells Dam fish ladder video, interpretations made by Andrew Gingerich for this BO, No subadults counted in 2011. Video not available to determine previous years.
- USGS/WDFW PIT tag data showed four bull trout moved to the Columbia River from the Methow and Twisp Rivers. Efficiencies vary with size of stream and stream flow.
- There is a large percentage of juveniles and subadults within area of the WDFW screw trap located downstream of the Twisp Weir. In 2005 90% of the bull trout handled at the screw trap were juvenile bull trout (<200mm) however, 19 or 38% were <150mm. The largest % of juveniles observed in this reach of the Twisp R;' also, indicates that all life history stages are located in the vicinity of the Weir.

Population Estimates

Population estimates for adult, subadult, and juvenile bull trout need to be developed to determine the degree of exposure of bull trout to the effects of the proposed action. Specific areas include the mainstem Columbia (i.e., to assess Wells Dam, hatchery, and other structures and facilities), the Okanogan (i.e., acclimation pond), the mainstem Methow (i.e., Methow hatchery), and Twisp River (i.e., Twisp weir and trap, acclimation pond). For the mainstem Columbia, ladder counts (adjusted for multiple upstream/downstream movements) may provide an easily obtainable estimate. Tributary estimates are derived from radio-telemetry data, screw trap data, and other information. All estimates are annual and estimate potential exposure to effects of the proposed action, not the number of individuals adversely affected.

1. **Adult Population Estimate**

Mainstem Columbia

Ladder counts (adjusted for multiple upstream/downstream movements) may provide an easily obtainable estimate. Data from DPUD and BioAnalysts (2004) suggests ladder counts at Wells Dam average about 64 (range 17-108) from 1998-2008. The Service believes the first year (1998, when only 17 bull trout were reported) may be an underestimate as many early data were not systematically collected. If the 1998 data are not considered, the average raw ladder counts at Wells Dam are 68 (range 43-108) adult bull trout. Adjusting for the multiple upstream and downstream movements of individual bull trout (which may overestimate the actual number of bull trout by 20%), the mean population estimate for the mainstem Columbia near Wells Dam is about 55 adult bull trout. The highest number of BT recorded, adjusted for multiple upstream and downstream movements, is 86. Given the information provided by Steve Hemstrom (Chelan PUD), that suggests about 12% of all bull trout counted as using adult fishways are actually subadults, the adjusted mean is 48 adults and the highest number is 76.

Okanogan River

Available radio-telemetry suggests periodic use of bull trout in the Okanogan River. BioAnalysts (2004) detected bull trout in the Okanogan up to rkm 9. Underwater video provided by the Colville Tribe (OBMEP 2007 and 2008) documented bull trout use at Zosel Dam. One adult bull trout was observed each year in 2007 and 2008. Currently there are very few observations of bull trout in the Okanogan River, but they are present at least seasonally. Historically, they may have been more abundant, with older accounts of fishing (i.e., newspaper articles) that targeted bull trout. The typical warm water summer temperatures (above 15 °C) likely prevent year-round use, and no spawning is known to occur in the Okanogan. The movement patterns observed appear to be exploratory or seasonal in nature, and are typical of bull trout in the Columbia basin. The limited amount of information prevents us from providing a precise quantitative estimate, so we assume the highest number of adult and subadult bull trout detected any given year (n=1) is our annual estimate.

Mainstem Methow River

The mainstem Methow is important FMO habitat for bull trout. Nelson et al. (2007) described the movement patterns of 13 USFWS radio-tagged and 17 PUD radio-tagged bull trout in the

Methow Core Area. The mainstem Methow was used extensively as a migratory corridor to spawning habitats by multiple local populations, and as FMO habitat (particularly around the towns of Winthrop and Methow). Detailed movement patterns observed by Nelson et al. (2007) showed habitat use in 6 of 10 local population areas despite their limited sample size. Considering the metapopulation theory used to characterize bull trout populations in the draft recovery plan (USFWS 2002a) and that the migration distances between local populations in the Methow Core Area are well within their capabilities (see Nelson et al. 2007), we assume all local populations in the core area use the mainstem Methow River. So while movement patterns displayed substantial use of the mainstem Methow, it is difficult to quantify this use. Since listing in 1998, redd counts have varied from 117 to 174, averaging 152. This estimate was derived from 7 years of comparable data from 7 of 10 local populations. Assuming 2 bull trout per redd as an estimate, about 304 bull trout use the mainstem Methow.

To account for bull trout that may have migrated from other core areas, we can make inferences from radio-telemetry. LGL and DCPUD (2008) reported that BT radio-tagged at Wells entered core areas as follows (high end of distributions): Methow – 88%, Entiat – 12%, Wenatchee – 4%. BioAnalysts (2004) reported fish radio-tagged throughout the Columbia entered core areas as follows: 25% Wenatchee, 50% Entiat, 12.5% Methow, and 12.5% unknown. Where it is available, detailed movement patterns show that bull trout readily move between core areas, but with low frequency. Previously, we estimated that long-range migrations are made by 13-21% of a given local population (BioAnalysts 2004). If we use the Wells distribution as an estimate (LGL and DPUD 2008), then 11 BT from the Entiat and 9 BT from the Wenatchee may also use the Methow core area (i.e., calculated from the total estimated number of adult migratory fish). This raises our estimate to 324 adult bull trout (304+20) may use the Mainstem Methow.

<u>Twisp River</u>

Existing information suggests that the Twisp River upstream of the confluence with Little Bridge Creek is important spawning and rearing habitat for bull trout, and that spawning mainly occurs in the upper Twisp, and Buttermilk, North, and Reynolds Creeks. Based on annual redd surveys of index reaches in the Twisp for the 10 years since listing (1998-2007), the Twisp has averaged about 93 redds. Assuming 2 bull trout per redd as an estimate, about 186 bull trout may use the Twisp. However, the Twisp River appears to be an important FMO habitat for bull trout and may be used by multiple local populations from the Methow core area (based on radio-telemetry and other information), and conforms to our understanding of the general life history requirements and habitat use patterns of bull trout. Anecdotal information (provided by DPUD) suggests the total number of bull trout in the vicinity of the Twisp Weir, at least seasonally, may be 350-400 adults.

While we acknowledge substantial numbers of bull trout can use certain areas as important FMO habitat, this range (350-400 adult bull trout) is greater than the estimate of total migratory adults for the Methow Core Area. Even considering the alternate-year spawning frequency (Downs et al. [2006] and Kelly-Ringel and DeLaVergne [2006] found 88% of bull trout spawned annually), and bull trout from other core areas that may migrate to the Twisp, it is unlikely that our estimate is off by a factor of two. To account for alternate-year spawning, if 88% of bull trout spawn annually, then 2.24 bull trout per redd is a better estimate of the true spawning migratory adult population. This suggests the population size of migratory adult bull trout in the Twisp is 208 (mean annual redd count of 93 x 2.24). Using the same methodology as above (to describe immigrates from the Entiat and Wenatchee), and assuming all these bull trout use the Twisp at least for some portion of the time they are in the Methow, our population estimate is 228 (208+20).

What is critical to understand is the number of bull trout adversely affected. To that end, information provided by WDFW (Charlie Snow, pers. comm.) suggests an average of 64 (range 36-91) bull trout are trapped and the Twisp Weir each year, although annual operations are variable and are influenced by streamflow. As a result, we will use 91 as our estimate of the number of bull trout trapped, reflecting the highest number encountered. We further assume that these 91 bull trout may also experience adverse effects due to delay in migration.

<u>Characterization of Core Area Populations</u>

Characterization of the status and trend of the local populations by Core Area provides valuable context to the significance of the effect of the action to these local populations. A highly resilient local population (e.g., high population numbers and good habitat conditions) impacted by the proposed action is anticipated to be at lower risk of extirpation than a local population of low resiliency (e.g., low population numbers and poor habitat conditions).

1. *Methow Core Area*: overall, the Methow is unstable (high variability between years) but indicates a slight increasing trend, and is influenced by a single large local population in the Twisp River. Since listing in 1998, redd counts have varied from 117 to 174, averaging 152. This estimate was derived from 7 years of comparable data from 7 of 10 local populations. The core area is considered to have low resiliency due to low numbers and population isolation. At 2 fish per redd, our core area estimate is 304 adult migratory bull trout.

2. *Entiat Core Area*: overall, the Entiat is unstable, and is low in numbers with no distinguishable trend. Since listing in 1998, redd counts have varied from 33 to 53, averaging 45. This estimate was derived from 7 years of comparable data from 2 local populations. The core area is considered to have low resiliency due to low numbers and only two local populations. At 2 fish per redd, our core area estimate is 90 adult migratory bull trout. In recent years the numbers of redds has fallen to less than 30. Thus, the trend for the last two years is downward.

3. *Wenatchee Core Area*: overall, the Wenatchee is unstable but indicates a slightly increasing trend, and is heavily influenced by a single large local population. Since listing in 1998, redd counts have varied from 242 to 706, averaging 452. This estimate was derived from 7 years of comparable data from 4 of 7 local populations. The core area is considered to have moderate resiliency due to moderate numbers and generally connected habitat. At 2 fish per redd, our core area estimate is 904 adult migratory bull trout.

4. *Yakima Core Area*: overall, the Yakima is unstable, and indicates a decreasing trend, and is influenced by three large local populations. Since listing in 1998, redd counts have varied from 455 to 687, averaging 534. This estimate was derived from 8 years of comparable data from 10 of 16 local populations. The core area is considered to have very low resiliency due to the high

degree of population isolation and low numbers in 13 of 16 local populations. At 2 fish per redd, our core area estimate is 1,068 adult migratory bull trout.

Although the distance between the Yakima and Methow Rivers is marginally within the range of documented adult bull trout migration distances (BioAnalysts 2004, Nelson et al. 2007, Paragamian et al. 2010), we have no radio-telemetry data showing bull trout tagged in the Yakima have moved into the mainstem Columbia (WDFW 2006). However, our radio-telemetry data are limited and may not have been robust enough to detect this occurrence if it is occurring. PIT tagging data is developing rapidly with bull trout increasingly being PIT tagged since 1998 according to the Columbia River DART website. There have been several subadult bull trout which were PIT tagged both downstream (Walla Walla River) and upstream (Entiat River) of the Yakima which were located in the Priest Rapids project area which is located just upstream of the Yakima River. It is likely that as more movements are detected we will see new patterns evolve.

Genetic data suggests that bull trout moved between the Yakima and adjacent core areas in the past. The Yakima is located at a major intersection in the Columbia basin, where the upper Columbia and Snake River evolutionary groups meet (see Spruell et al. 2003). Assessments of bull trout population genetic structure at the scale of the entire Columbia Basin indicated some apparent relationships among populations in the Yakima River, Upper Columbia River, and the Snake River (Spruell and Maxwell; 2002; P. Spruell, pers. comm. 2004; M. Small, WDFW Yakima Genetics baseline, 2009; Arden et al, 2011;). The 2011 draft genetics report "Analysis of Genetic Variation Within and Among Upper Columbia River Bull Trout Populations (Dehaan and Neibauer 2011) show similarities between fish in the Methow, Wenatchee, and Yakima core areas as well. The Yakima core area may be a "mixing zone" between these areas in terms of demographic and genetic exchange (USFS 2004, p. 6; Ardren at al 2010, p. 26). So while some degree of genetic exchange among the Yakima, Snake, and Upper Columbia must have occurred in the past, current data is limited and we are unable to establish what frequency (if any) inter-basin exchange occurs today. So while we acknowledge Yakima Core Area bull trout are capable of migrating long distances (approximating the distance between the Yakima and the Wells action area), and could move into the action area, we do not currently have enough information to suggest adverse effects are reasonably certain to occur. This is due to a number of factors, including degraded habitat conditions in the lower Yakima, reduced population sizes, reduced expression of the migratory life history form, and a lack of specific monitoring to detect this event if it is occurring. As a result, we do not believe the available information supports the notion that Yakima core area bull trout will be adversely affected by the effects of the proposed action.

2. Juvenile/Sub-adult Population Estimate

These population estimates are derived to determine the exposure of bull trout to impacts that occur as a result of the proposed actions. The majority of the available information is from screw traps (see the DART website), PIT tagging data, unpublished PUD data, and other local information. As described in the adult population estimate, characterization of the status and trend of the local populations provides valuable context for the significance of the effect of the action to these local populations. A highly resilient local population (e.g., high population numbers and good habitat conditions) impacted by the proposed action is anticipated to be at lower risk of extirpation than a local population of low resiliency (e.g., low population numbers and poor habitat conditions).

Bull trout have not been consistently accounted for or described in terms of their life history stage. They may have been counted or described as being juveniles, sub-adults, or adults during upstream passage events at the Project, other dams, traps, and weirs. Although there is variation across the range of the species, we make the following assumptions for the purposes of this BO: juveniles are typically associated with their natal streams and are <150mm (total length); subadults are larger, better swimmers, may make extensive movements (upstream and downstream) away from their natal stream, and are typically 150mm-330mm; and adults are >330mm. Anglin et al. (2010) described the movement patterns of PIT-tagged bull trout from the Walla Walla River. They observed 130 km upstream and 162 km downstream movements of subadult (155-272mm) bull trout (Anglin et al. 2010). PIT tag data also shows that a bull trout tagged in the Entiat was located at Priest Rapids Dam and a bull trout tagged in the Walla Walla was located at the Priest Rapids Dam suggesting that these subadults move both upstream and downstream and overlap upstream of the Yakima River. This suggests subadult bull trout may move between core areas if they are within their migration range.

Little comparable data exists to make inferences about the population size of juvenile and sub-adult bull trout in the mainstem Columbia. Screw trap data (Columbia River DART: www.crb.washington.edu/dart/dart.html) did not include trap efficiencies, expansion factors, or describe assumptions, but nonetheless appears to be one of the most complete sources of information. Screw trap and PIT tag antenna efficiencies can vary significantly. Most downstream screw traps in the Methow, Entiat, Wenatchee, and Yakima core areas, presumably the best indicator of the number of bull trout entering the mainstem Columbia, report up to 36 juveniles/sub-adults collected. Other weir, electroshocking, and hook and line sampling in the Yakima core area also reports low numbers, from 1 to 5 individuals, although some adults were also included in these totals. Similar patterns of reported use of the mainstem have been reported throughout the Columbia basin in the Snake, Grande Rhonde, and John Day Rivers (Fish Passage Center; http://www.fpc.org/). However, Anglin et al. (2010) calculated a population estimate of 192 subadult bull trout (<300mm) over the life of his study in the Walla Walla having corrected for detection efficiency.

As a result, the Service has very little information on which to base a population estimate for juvenile or sub-adult bull trout. For the purpose of this analysis, we will use the highest number reported to represent the minimum number of juvenile or sub-adults impacted. This low number may reflect the natural and anthropogenic high mortality rate of juvenile and sub-adult bull trout, as well as sampling bias, low detection probability, unknown proportion of fish that descend the dam through the turbine, bypass, or spill, and other factors.

Although this is a rough approximation and may be a substantial underestimate, it represents the best information available. Project monitoring would greatly enhance our understanding of the estimate of the actual number of juvenile or sub-adults impacted. There is not enough information available to suggest from which local populations these bull trout originated or the proportion of contribution from each core area. The Service will assume all core areas contribute individuals to some degree, the likelihood probably related to the distance from each core area, but we are unable to quantify the proportion.

Mainstem Columbia

The highest number of juvenile or sub-adults ever reported come from smolt monitoring efforts at Rock Island and Rocky Reach Dams (USFWS 2004a), although the data at Rock Island included some adults or did not consistently specify age or size classification. For these reasons, we will use the Rocky Reach data which does appear to be consistently collected; they report up to 36 subadult/juvenile bull trout have been present annually, but also report no observations some years. Near Wells Dam, the furthest downstream screw trap in the Methow is located near Pateros, and has averaged 1.6 bull trout (range 0-6) between 2004 and 2011. It is likely that these fish could move into the Columbia River for optimizing forage and overwintering opportunities. In addition, migratory sub-adult bull trout may move from other core areas into the action area. Anglin et al. (2010) described extensive sub-adult movement patterns: upstream (130 km) and downstream (162 km); most (75%) movements were downstream. The Entiat Core Area, known to have high proportions of local populations use the mainstem Columbia, is well within these potential migrations distances. Screw trap data from two traps in the Entiat suggests as many as 98 sub-adults may enter the mainstem Columbia. If Entiat subadults move in a similar fashion in the mainstem Columbia as the Walla Walla subadults studied by Anglin et al. (2010), we'd expect 25% of the Entiat Core Area sub-adults (about 25 individuals) to move upstream into the action area. Using the highest number of Methow screw trap data (n=6) and estimates of migrants from the Entiat Core Area (n=25), we estimate a total of 31 subadult bull trout for our mainstem Columbia River estimate.

Okanogan River

Very limited information is available. Most information is specific to migratory adult movement patterns (BioAnalysts 2004) or is limited to species identification (Zosel Dam) and did not allow for precise measurement of the individuals. For the purposes of this analysis, we will assume both bull trout observed at Zosel Dam were adults. So while we have no verified subadult use in the Okanogan, the Okanogan is within their migration distances as documented by Anglin et al. (2010). As a result, we estimate the numbers of subadult bull trout exposed to the effects of the proposed action to be similar to that of adults (n=1). Alternately, if we use the proportion of subadults moving upstream (25%) described by Anglin et al (2010), we would estimate 1.5 bull trout. For the purposes of this analysis, we will use n=1 due in part that spawning in the Okanogan is not known and subadult movements are likely foraging and exploratory in nature.

Mainstem Methow River

In the Methow River Core Area, sampling at screw traps on the Twisp River averaged 25 (range of 10-50) bull trout. On the Methow River near Carlton, in the lower portion of the Methow, only 2 bull trout have been documented at the screw trap or an average of 0.7 bull trout in the 3 years it has operated. The furthest downstream screw trap in the Methow is located near Pateros, and has averaged 1.6 bull trout (range 0-6) between 2004 and 2011. It is likely that these fish could move into the Columbia River for optimizing forage and overwintering opportunities. For the purposes of this analysis, we assume the highest number of bull trout detected (n=50) is our estimate for the mainstem Methow.

Twisp River

Screw trap data from the Twisp River (2005-2011) averages 25 (range of 10-50) bull trout (Columbia River DART: www.crb.washington.edu/dart/dart.html). For the purposes of this analysis, we base our estimate on the highest number of individuals captured (n=50). However, due to the close proximity of upstream spawning habitats, the likelihood of juvenile bull trout being present is elevated. We might assume movement patterns of juveniles in the Twisp are seasonal, similar to that described by Downs et al. (2006), but website specific data from the Twisp Weir with size classes that shows that on average 23% (range of 10-38%) are juveniles less than 150mm. For the purposes of this analysis, we estimate on the highest number of juveniles captured (19 out of 50) or 38%% of the individuals present are juveniles (n=19) and the remainder (n=31) are subadults.

Synthesis of Bull Trout Population Estimates

Adult Bull Trout

Adult population estimates in the mainstem Columbia are based primarily on ladder counts at major dams, adjusted for the multiple upstream and downstream movements made by individuals. Estimates in the Okanogan are very coarse, based on the limited information available. Estimates in the Methow and Twisp Rivers use a different approach, and make expansions from average redd count data. While these tributary estimates are likely underestimates, we believe this represents the best available information and is founded in regional trend data.

Sub-adult/juvenile Bull Trout

Sub-adult population estimates were derived from a combination of screw trap data, PIT tagged data, and observations at dams. Screw trap data are potentially severe underestimates of the true population, without trap efficiency rates and expansion factors, but they nonetheless represent the best available information. PIT tag data are good indicators but have some efficiency issues and there are not full antenna arrays to pick up actual movement patterns. However PIT tag data is beginning to show migration time and sizes of fish that begin to make longer movements (i.e. some WDFW PIT tagged bull trout from the Twisp River (>150mm) moved after 7 – 12 months and were found in the mainstem Columbia River). Observations at dams have similar issues, since we do not know the actual pathways of use (e.g., the proportion passing downstream through collection facilities versus turbines/spillways), do not have year-round monitoring, and other complications. Reporting of size classes is either not done consistently (e.g., at mainstem dams) or may simply not be easily available (e.g., screw traps). To avoid the crude lumping of the juvenile (<150mm) and sub-adult (>150-330mm) life history forms, we apply the following rule set:

- Juvenile bull trout are strongly associated with their natal stream. Movements out of their natal streams typically results from high-flow events when refugia is limited or not utilized (see Downs et al. 2006).
- Sub-adults make more volitional movements upstream and downstream, usually at age 3 or 4 (see Downs et al. 2006). Anglin et al. (2010) observed large upstream (130 km) and downstream (162 km) movements of subadult BT (<300mm), and these travel times can be extremely variable (weeks-year).

Given this, for the mainstem Columbia we assume only sub-adults are present. Our estimate of the number of individuals reflects Methow screw trap data (6 individuals) plus upstream migrants from the Entiat Core Area (25 individuals). For the Twisp, we assumed both juveniles and subadults were present, due to the close proximity of project facilities to spawning areas. Our estimate (50 individuals) reflects the highest number of individuals captured at the Twisp screw trap, and we estimate 38% are juveniles (19 of 50 individuals). Mainstem Methow estimates use the Twisp data (50 individuals) as a surrogate, but assume all individuals are sub-adults due to proximity to spawning areas.

Summary of Bull Trout Exposed to the Effects of the Proposed Action

Based on the discussion above, we summarize our best estimate of the bull trout likely to be exposed annually to the effects of the proposed action:

Waterbody	DPUD Facilities in Vicinity	Bull Trout Life History Stage Exposed		
		Adult	**Sub-adult**	**Juveniles**
Mainstem Columbia	Wells Dam Wells Hatchery	76	31	0
Okanogan River	Acclimation Site	1	1	0
Mainstem Twisp	Twisp Weir Acclimation Site	228	31	19
Mainstem Methow	Methow Hatchery	324	50	0
Totals		**629**	**113**	**19**

Exposure of Bull Trout and Adverse Effects Anticipated

Exposure of bull trout to project facilities does not directly equate to adverse effects. The mechanisms of effect are important considerations in this evaluation. For example, features such as spillways, turbines, fish ladders, traps, and weirs are unavoidable and are assumed to adversely affect all bull trout exposed, but exposure to acclimation ponds (e.g., water quality impacts) and hatchery intakes/broodstock collection may be avoidable and only a proportion of individuals may be adversely affected. Determining this proportion is largely a matter of professional judgment and evaluation of the specific mechanisms of effects. At the Twisp weir, the highest number of bull trout trapped (n=91) is used to reflect adverse effects to adults. Impacts of the operation of the Twisp weir are conservatively estimated to impact 20% of all adults not trapped (228-91=137 not trapped; 20% x 137=27). The mechanisms of adverse effects to 20% of the adults not trapped present include delay in upstream and downstream movements (see Kelly-Ringel and DeLaVergne 2006), and injury due to contact with structures. This increases the number of adult bull trout adversely affected by 27. Impacts of the operation of the Twisp weir are conservatively estimated to impact 20% of all subadults and juveniles exposed. The mechanisms of adverse effects to 20% of the subadult/juveniles present include delay in upstream and downstream movements, and injury due to contact with structures. At the Methow Hatchery, only 1 bull trout has ever been captured during broodstock collection since the bull trout has been listed, so the potential for adverse effects is very low despite the large number of individuals present. Exposure to acclimation ponds is primarily an evaluation of water quality impacts and prey base impacts upon release. Based on the available information, we believe these impacts are discountable or insignificant and adverse effects are not anticipated. The anticipated annual adverse effects are summarized as follows:

Waterbody	DPUD Facilities in Vicinity	Bull Trout Life History Adversely Affected		
		Adult	**Sub-adult**	**Juveniles**
Mainstem Columbia	Wells Dam Wells Hatchery	76	31	0
Okanogan River	Acclimation Site	0	0	0
Mainstem Twisp	Twisp Weir Acclimation Site	118	6	4
Mainstem Methow	Methow Hatchery	1	0	0
Totals		**195**	**37**	**4**

Appendix B

Maps

Figure B-1. As part of the Columbia River Distinct Population Segment the Draft Upper Columbia River Bull Trout Recovery Plan Unit is shown below (Service 2002a)

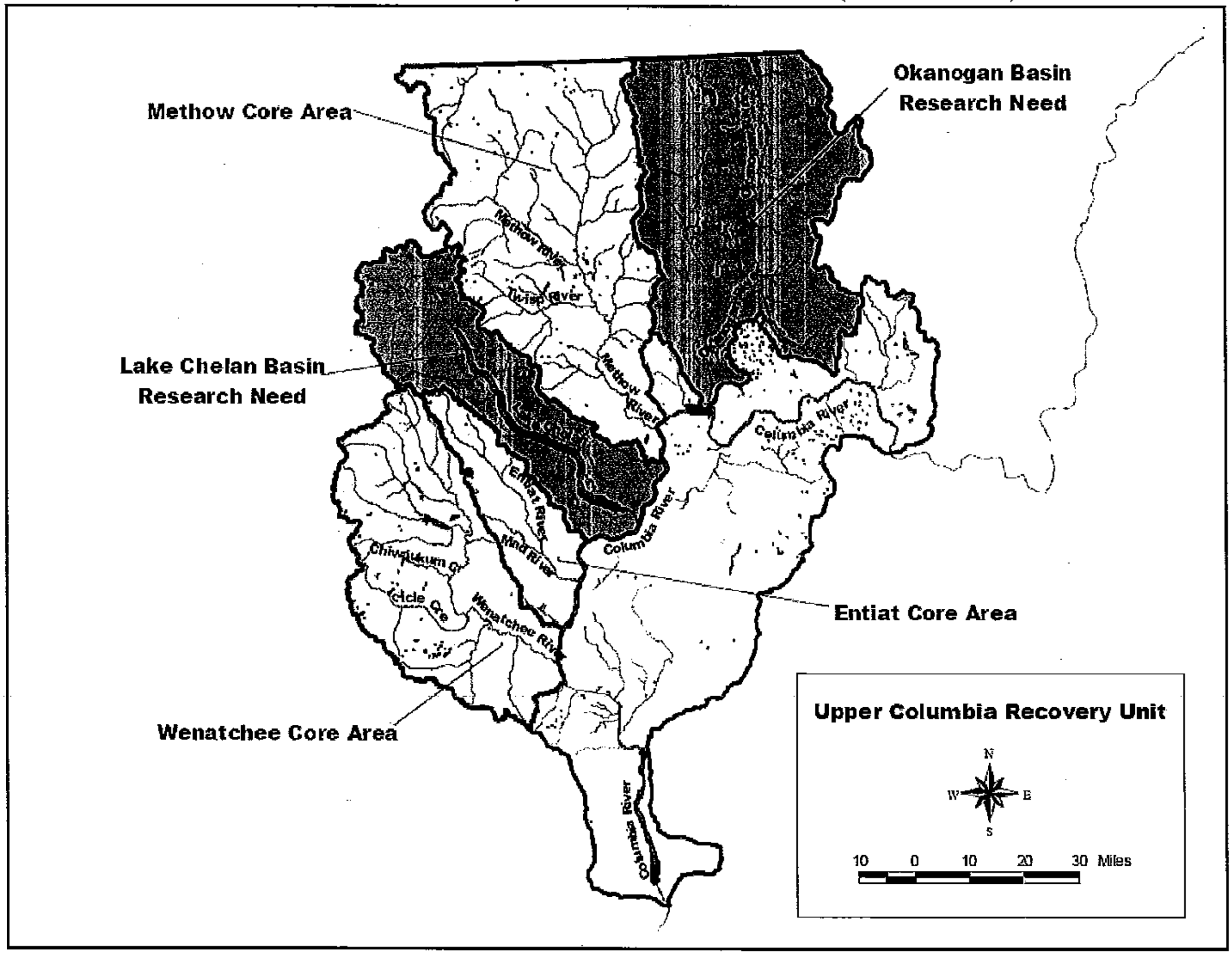

Figure B-2. As part of the Columbia River Distinct Population Segment the Draft Middle Columbia River Bull Trout Recovery Plan Unit is shown below (Service 2002a).

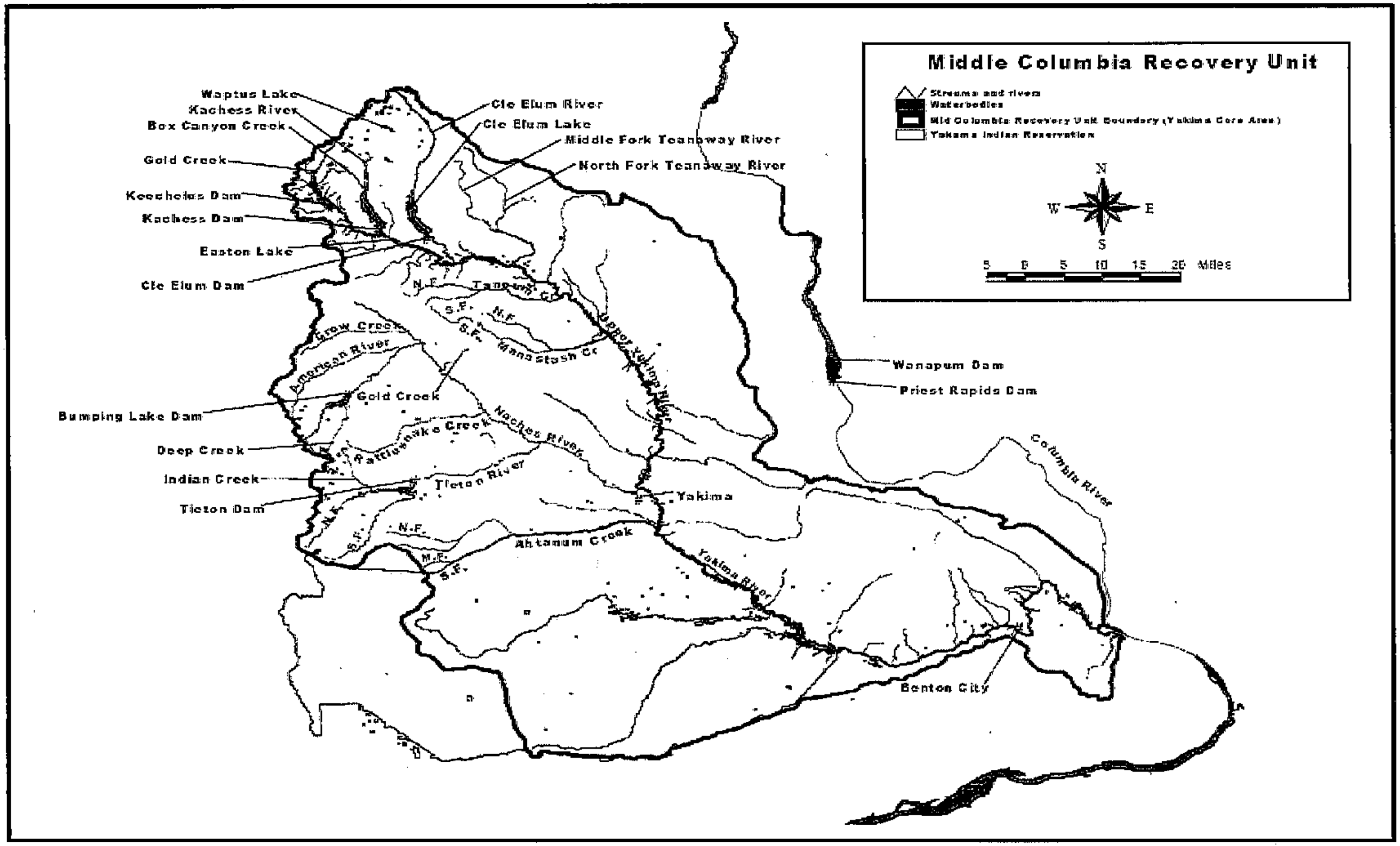

Figure B-3. Map of Bull Trout Critical Habitat in the Methow, Entiat, and Wenatchee Basins: Unit 10-Upper Columbia River Basins (Service 2010a)

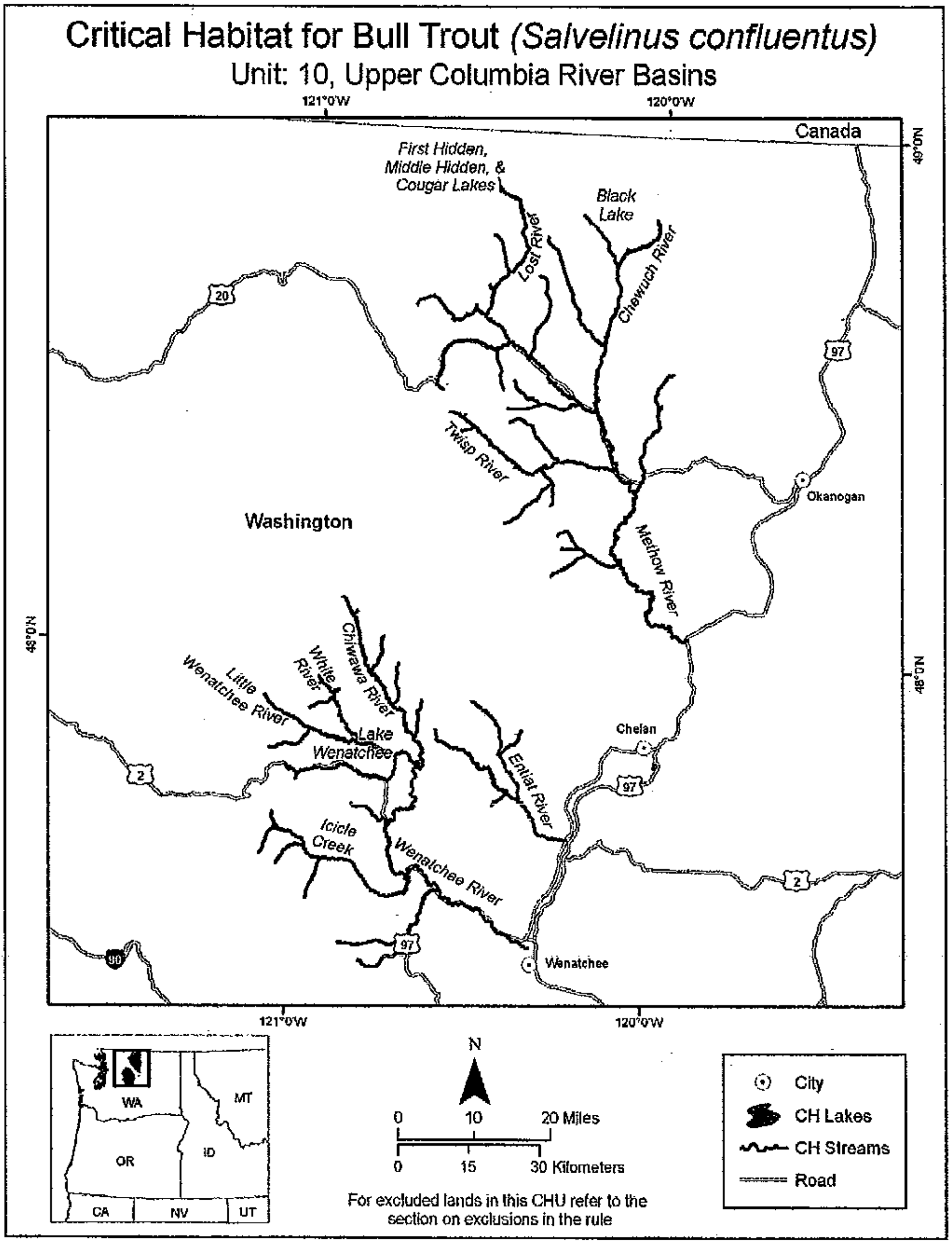

Figure B-4. List of Waterbodies designated as Critical Habitat in Unit 10- Upper Columbia River Basins (Service 2010a).

Waterbody Name	Stream Begin Point or Lake Center Latitude	Stream Begin Point or Lake Center Longitude	Stream End Point Latitude	Stream End Point Longitude
Alder Creek	47.845	-120.666	47.919	-120.647
Alpine Creek	48.084	-120.864	48.083	-120.866
Andrews Creek	48.782	-120.108	48.787	-120.113
Beaver Creek	48.327	-120.066	48.492	-119.993
Black Lake	48.829	-120.208		
Blue Buck Creek	48.486	-120.005	48.553	-119.963
Buck Creek	48.104	-120.878	48.106	-120.886
Buttemilk Creek	48.363	-120.339	48.340	-120.303
Canyon Creek	47.907	-120.895	47.891	-120.965
Cedar Creek	48.589	-120.471	48.566	-120.475
Chelan River	47.803	-119.980	47.812	-119.985
Chewuch River	48.476	-120.183	48.844	-120.023
Chikamin Creek	47.904	-120.731	47.985	-120.718
Chiwaukum Creek	47.679	-120.728	47.715	-120.839
Chiwawa River	47.788	-120.660	48.104	-120.878
Cougar Lake	48.881	-120.466		
Crater Creek	48.214	-120.209	48.215	-120.270
Diamond Creek	48.849	-120.422	48.855	-120.416
Drake Creek	48.781	-120.396	48.787	-120.389
Early Winters Creek	48.601	-120.438	48.503	-120.625
East Fork Buttermilk Creek	48.340	-120.303	48.296	-120.308
Eightmile Creek	48.604	-120.163	48.804	-120.338
Entiat River	47.660	-120.218	47.920	-120.507
Eureka Creek	48.700	-120.492	48.709	-120.506
First Hidden Lake	48.899	-120.487		
Foggy Dew Creek	48.204	-120.190	48.161	-120.297
French Creek	47.628	-120.963	47.593	-121.042
Goat Creek	48.574	-120.379	48.730	-120.360
Gold Creek	48.188	-120.095	48.185	-120.116
Henry Creek	47.768	-120.991	47.754	-120.996
Huckleberry Creek	48.569	-120.473	48.511	-120.450
Icicle Creek	47.550	-120.679	47.558	-120.672
Ingalls Creek	47.463	-120.661	47.448	-120.859
Jack Creek	47.608	-120.900	47.529	-120.952
James Creek	48.077	-120.858	48.075	-120.861
Lake Creek	48.750	-120.137	48.848	-120.239
Lake Wenatchee	47.823	-120.778		
Leland Creek	47.662	-121.041	47.612	-121.089
Lightning Creek	48.451	-119.999	48.453	-119.996
Little Bridge Creek	48.379	-120.286	48.449	-120.432
Little Wenatchee River	47.827	-120.819	47.913	-121.094
Lost River	48.650	-120.512	48.896	-120.486
Mad River	47.736	-120.363	47.864	-120.608
Methow River	48.050	-119.894	48.651	-120.513
Middle Hidden Lake	48.908	-120.489		
Mill Creek	47.777	-121.011	47.772	-121.021
Monument Creek	48.732	-120.449	48.803	-120.495
Napeequa River	47.921	-120.897	47.931	-120.879
Nason Creek	47.809	-120.716	47.784	-121.028
Negro Creek	47.444	-120.662	47.418	-120.797
North Creek	48.454	-120.563	48.462	-120.559
North Fork Gold Creek	48.185	-120.116	48.238	-120.283
North Fork Wolf Creek	48.485	-120.347	48.530	-120.424
Panther Creek	47.941	-120.929	47.938	-120.943
Peshastin Creek	47.558	-120.574	47.444	-120.662
Phelps Creek	48.070	-120.853	48.080	-120.839
Ptarmigan Creek	48.891	-120.482	48.885	-120.483
Rainy Creek	47.852	-120.955	47.816	-121.075
Rattlesnake Creek	48.648	-120.566	48.651	-120.571
Reynolds Creek	48.406	-120.479	48.404	-120.490
Robinson Creek	48.659	-120.538	48.673	-120.539
Rock Creek	47.963	-120.796	48.037	-120.763
South Creek	48.438	-120.529	48.428	-120.568
Stormy Creek	47.822	-120.422	47.867	-120.360
Tillicum Creek	47.747	-120.394	47.723	-120.439
Trout Creek	48.640	-120.599	48.664	-120.711
Twisp River	48.369	-120.119	48.464	-120.606
Unnamed stream	47.592	-120.661	47.590	-120.663
Unnamed stream	47.578	-120.666	47.575	-120.670
Unnamed stream	47.834	-120.875	47.838	-120.900
Unnamed stream	47.837	-120.878	47.835	-120.885
W. Fork Buttermilk Creek	48.340	-120.303	48.259	-120.437
War Creek	48.361	-120.396	48.362	-120.411
Wenatchee River	47.456	-120.317	47.808	-120.728
West Fork Methow River	48.648	-120.512	48.641	-120.609
White River	47.834	-120.816	47.953	-120.940
Wolf Creek	48.491	-120.232	48.476	-120.441

Figure B-5. Map of Bull Trout Critical Habitat in the Upper Columbia River mainstem: Unit 22-Mainstem Upper Columbia River (Service 2010a)

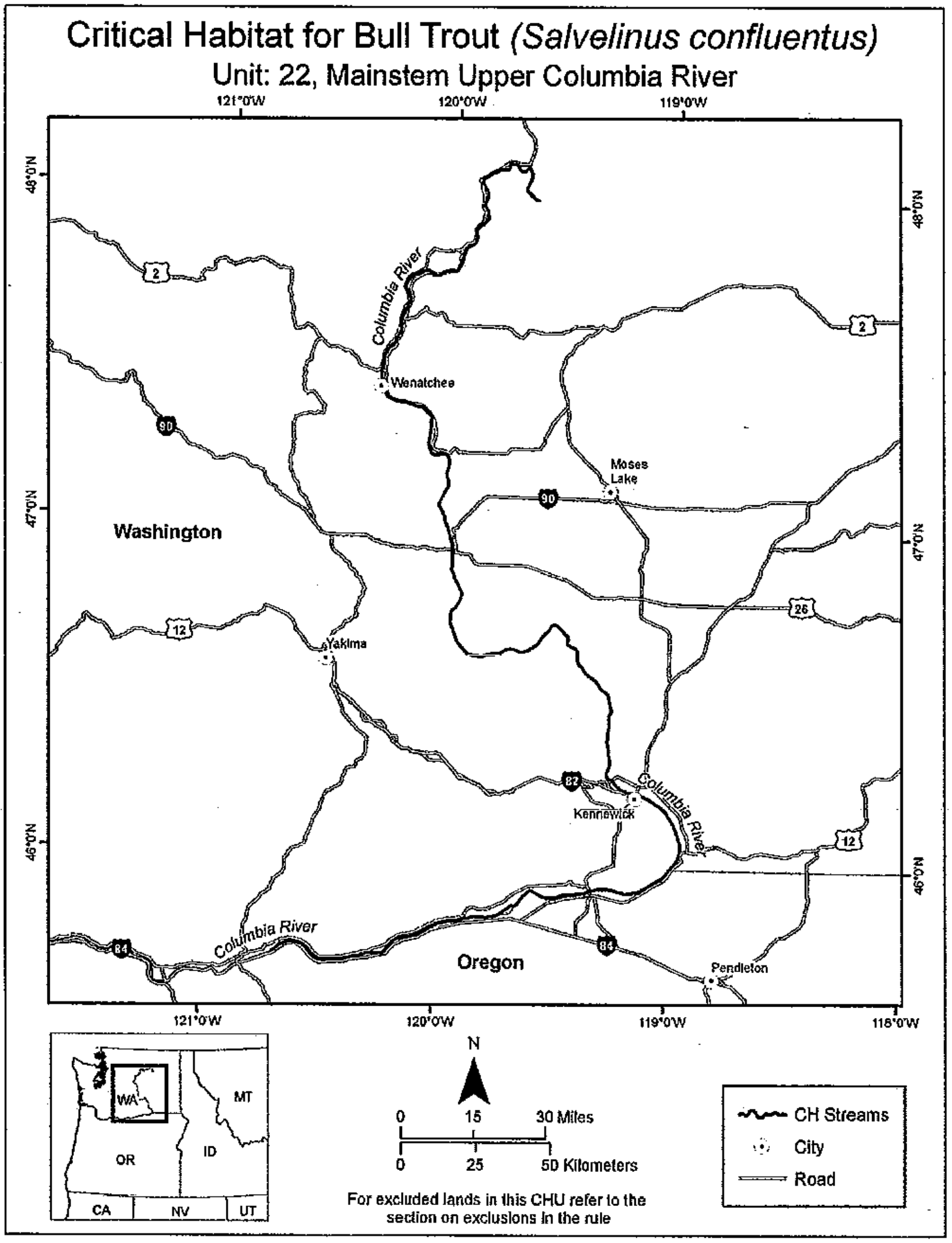

Figure B-6. List of Waterbodies designated as Critical Habitat in Unit 22-Mainstem Upper Columbia River (Service 2010).

Waterbody Name	Stream Begin Point or Lake Center Latitude	Stream Begin Point or Lake Center Longitude	Stream End Point Latitude	Stream End Point Longitude
Columbia River	45.715	-120.693	47.997	-119.633

Appendix C

Tributary Use by Radio-tagged Adult Bull Trout from PUD Study, 2001-2005 (BioAnalysts, Inc. 2004).

Table C-1: Table 6 as referenced in BioAnalysts, Inc. 2004

Table 6: Tributaries selected by adult bull trout tagged at Rock Island, Rocky Reach, and Wells dams and the dates they entered and left those tributaries, 2001.

Tagging Information			Tributary Residence			
Release	Code	Date	Entrance	Exit	Subbasin	Location
			Rock Island Dam			
Down	32	21-May-01	04-Jun-01	23-Nov-01	Entiat	Mad River
Down	55	19-Jun-01	28-Jun-01	---	Entiat	Mad River
Down	35	30-May-01	13-Jun-01	---	Wenatchee	Peshastin Creek
Up	48	03-Jul-01	NA	NA	Dead	
Up	4	17-May-01	30-May-01	---	Methow	Twisp River
Up	13	24-May-01	11-Jun-01	---	Methow	Twisp River
Up	36	13-Jun-01	21-Sep-01	02-Nov-01	Wenatchee	Mainstem Wenatchee River
			Rocky Reach Dam			
Down	29[1]	21-May-01	06-Jun-01	---	Entiat	Mad River
Down	18[1]	23-May-01	07-Jun-01	---	Entiat	Mad River
Down	15	25-May-01	06-Jun-01	02-Nov-01	Entiat	Mainstem Entiat River
Down	11	29-May-01	06-Jun-01	02-Nov-01	Entiat	Mainstem Entiat River
Down	54	30-May-01	11-Jun-01	---	Methow	Libby Creek
Down	8	11-Jun-01	30-Jun-01	---	Wenatchee	Chiwawa River
Down	46	18-Jun-01	23-Jun-01	11-Dec-01	Wenatchee	Icicle Creek
Down	5	17-May-01	30-May-01	---	Wenatchee	Mainstem Wenatchee River
Down	9	07-Jun-01	27-Aug-01	16-Nov-01	Wenatchee	Mainstem Wenatchee River
Down	25	25-Jun-01	29-Jun-01	---	Wenatchee	Mainstem Wenatchee River
Down	34[1]	10-Jul-01	16-Jul-01	---	Wenatchee	Mainstem Wenatchee River
Up	45	15-Jun-01	29-Jun-01	---	Entiat	Mad River
Up	47	19-Jun-01	01-Jul-01	---	Entiat	Mad River
Up	3	15-May-01	22-May-01	---	Entiat	Mad River
Up	24	22-May-01	04-Jun-01	---	Entiat	Mad River
Up	6	29-May-01	10-Jun-01	17-Oct-01	Entiat	Mainstem Entiat River
Up	7	04-Jun-01	08-Jun-01	11-Nov-01	Entiat	Mainstem Entiat River
Up	37	06-Jun-01	11-Jun-01	09-Nov-01	Entiat	Mainstem Entiat River
Up	50	13-Jul-01	18-Jul-01	24-Sept-01	Entiat	Mainstem Entiat River
Up	20	21-May-01	30-May-01	16-Dec-01	Methow	Twisp River
Up	12	24-May-01	10-Jun-01	07-Oct-01	Methow	Twisp River
Up	14	25-May-01	02-Jun-01	---	Methow	Twisp River
			Wells Dam			
Down	17	24-May-01	02-Jun-01	10-Aug-01	Entiat	Mainstem Entiat River
Down	22	29-May-01	08-Jun-01	---	Methow	Mainstem Methow River
Down	26	22-May-01	01-Jun-01	16-Dec-01	Methow	Twisp River
Down	19	22-May-01	01-Jun-01	---	Methow	Twisp River
Down	33	22-May-01	08-Jun-01	13-Apr-02	Methow	Twisp River
Up	28	22-May-01	24-May-01	---	Methow	Mainstem Methow River
Up	23[1]	29-May-01	01-Jun-01	---	Methow	Mainstem Methow River
Up	21	22-May-01	24-May-01	02-Nov-01	Methow	Twisp River
Up	31[1]	21-May-01	27-May-01	---	Methow	Buttermilk Creek
Up	16	23-May-01	25-May-01	---	Methow	Buttermilk Creek

[1] Based on detection histories for these fish, it appears that they exited the tributary of residence. However, due to a lack of detections at the fixed telemetry sites on the tributary of residence, a date of exodus can not be established.

Table C-2 Table 7 as referenced in BioAnalysts, Inc. 2004.

Table 7: Tributaries selected by adult bull trout tagged at Rock Island, Rocky Reach, and Wells dams and the dates they entered and left those tributaries, 2002.

Tagging Information			Tributary Residence			
Release	Code	Date	Entrance	Exit	Subbasin	Location
			Rock Island Dam			
Down	105	04-Jun-02	27-Jun-02	17-Dec-02	Wenatchee	Mainstem Wenatchee River
Down	113	07-Jun-02	22-Jun-02	06-Nov-02	Wenatchee	Mainstem Wenatchee River
Down	90[3]	23-May-02	01-Jul-02	04-Sep-02	Entiat	Mainstem Entiat River
Down	115	12-Jun-02	01-Jul-02	04-Sep-02	Entiat	Mainstem Entiat River
Up	110[1]	04-Jun-02	---	---	Columbia River	---
Up	97[2]	20-May-02	19-Jun-02	---	Entiat	Mad River
Up	119[4]	12-Jun-02	29-Jun-02	---	Entiat	Mad River
Up	109[3]	07-Jun-02	20-Jun-02	17-Dec-02	Entiat	Mad River
			Rocky Reach Dam			
Down	127	27-Jun-02	---	---	Columbia River	---
Down	104	30-May-02	01-Jul-02	09-Oct-02	Wenatchee	Mainstem Wenatchee River
Down	125	26-Jun-02	06-Jul-02	06-Nov-02	Wenatchee	Mainstem Wenatchee River
Down	126	18-Jun-02	14-Jul-02	14-Jan-03	Wenatchee	Mainstem Wenatchee River
Down	101	03-Jun-02	25-Jun-02	06-Nov-02	Entiat	Mad River
Down	106	06-Jun-02	27-Jun-02	09-Oct-02	Entiat	Mainstem Entiat River
Down	111	04-Jun-02	18-Jun-02	06-Nov-02	Entiat	Mad River
Down	118	11-Jun-02	01-Jul-02	09-Oct-02	Entiat	Mainstem Entiat River
Down	114	10-Jun-02	01-Jul-02	09-Oct-02	Entiat	Mad River
Down	120	27-Jun-02	13-Jul-02	09-Oct-02	Entiat	Mad River
Down	95[1]	29-May-02	09-Jun-02	---	Entiat	Mainstem Entiat River
Down	89[2]	21-May-02	09-Jun-02	---	Methow	Twisp River
Down	46	18-Jun-01	04-Jul-02	01-Aug-02	Entiat	Mainstem Entiat River
Up	124	24-Jun-02	---	---	Columbia River	---
Up	103	06-Jun-02	21-Jun-02	09-Oct-02	Entiat	Mainstem Entiat River
Up	121	07-Jun-02	20-Jun-02	06-Nov-02	Entiat	Mad River
Up	88[2]	20-May-02	06-Jun-02	---	Entiat	Mad River
Up	92	23-May-02	19-Jun-02	04-Sep-02	Entiat	Mad River
Up	122[4]	12-Jun-02	20-Jun-02	---	Entiat	Mainstem Entiat River
Up	123[4]	21-Jun-02	01-Jul-02	---	Entiat	Mainstem Entiat River
Up	98[3]	30-May-02	12-Jun-02	09-Oct-02	Entiat	Mad River
Up	116	10-Jun-02	24-Jun-02	---	Methow	Twisp River
Up	100	04-Jun-02	27-Jun-02	---	Methow	Twisp River
Up	108[2]	03-Jun-02	23-Jun-02	---	Methow	Twisp River
Up	7	04-Jun-01	11-Jun-02	04-Aug-02	Entiat	Mainstem Entiat River
			Wells Dam			
Down	112	11-Jun-02	19-Jun-02	15-Nov-03	Methow	Mainstem Methow River
Down	93[1]	28-May-02	24-Jun-02	---	Methow	Twisp River
Down	96[1]	03-Jun-02	22-Jun-02	---	Methow	Twisp River
Down	102[2]	04-Jun-02	26-Jun-02	---	Methow	Twisp River
Up	99	04-Jun-02	01-Aug-02	06-Nov-02	Wenatchee	Mainstem Wenatchee River
Up	91	23-May-02	03-Jun-02	---	Methow	Mainstem Methow River
Up	94	03-Jun-02	20-Jun-02	---	Methow	Mainstem Methow River
Up	107[1]	03-Jun-02	09-Jun-02	---	Methow	Twisp River
Up	117[1]	12-Jun-02	21-Jun-02	---	Methow	Twisp River

[1] The transmitters for these fish were recovered at the tributary or location of residence during the 2002 study period.
[2] The transmitters for these fish were recovered at the tributary or location of residence during the 2003 study period.
[3] The transmitters for these fish were recovered after tributary exodus during the 2003 study period in the Columbia River.
[4] These fish are suspected of perishing or shedding their tags in the tributary of residence.

Table C-3: Table 8 as referenced in BioAnalysts, Inc. 2004.

Table 8: Tributaries selected by adult bull trout tagged at Rock Island, Rocky Reach, and Wells dams and the dates they entered and left those tributaries, 2003.

Tagging Information			Tributary Residence			
Release	Code	Date	Entrance	Exit	Subbasin	Location
			Rock Island Dam			
Down	113	07-Jun-02	16-Jun-03	21-Nov-03	Wenatchee	Chiwawa River
			Rocky Reach Dam			
Down	101	03-Jun-02	22-Jun-03	17-Oct-03	Wenatchee	Peshastin Creek
Down	104	30-May-02	01-Jun-03	21-Oct-03	Entiat	Mainstem Entiat River
Down	106	06-Jun-02	20-Apr-03	23-Nov-03	Entiat	Mainstem Entiat River
Down	114	10-Jun-02	22-Jun-03	04-Oct-03	Entiat	Mad River
Down	118	11-Jun-02	08-Apr-03	17-Oct-03	Entiat	Mad River
Down	120	27-Jun-02	18-Jun-03	18-Nov-03	Entiat	Mad River
Down	125	26-Jun-02	18-Jun-03	---	Entiat	Mad River
Down	126	18-Jun-02	18-Jun-03	22-Nov-03	Wenatchee	Chiwawa River
Down	127	27-Jun-02	13-Jun-03	17-Oct-03	Entiat	Mad River
Up	92	23-May-02	14-Jun-03	---	Entiat	Mad River
Up	103	06-Jun-02	13-Jun-03	21-Oct-03	Entiat	Mainstem Entiat River
Up	121	07-Jun-02	08-Jun-03	21-Oct-03	Entiat	Mad River
			Wells Dam			
Up	99	04-Jun-02	03-Jun-03	28-Oct-03	Methow	Mainstem Methow River

Appendix D.

Crosswalk between the Bull Trout Matrix and Bull Trout Critical Habitat Primary Constituent Elements

Prepared by: Jeff Krupka, Karl Halupka, and Judy De La Vergne, CWFO

March 31, 2011

The purpose of this document is to provide a consistent means for analyzing baseline conditions and project effects to both the bull trout and designated critical habitat for the bull trout using the Matrix of Pathways and Indicators.

The Matrix of Pathway Indicators (Matrix) for bull trout is used to evaluate and document baseline conditions and to aid in making effect determinations for proposed projects (USFWS 1999). The Matrix analysis incorporates 4 population indicators and 19 physical habitat indicators. Analysis of these indicators provides a systematic approach for evaluating the existing baseline condition and potential impacts in terms of metrics meaningful to bull trout.

Designated critical habitat for the bull trout (75 FR 63898) is comprised of nine primary constituent elements (PCEs). These physical, chemical, and biological features correspond to many of the Matrix habitat parameters. Table 1 shows the relationship between the PCEs for bull trout critical habitat and the Matrix habitat indicators. The *refugia* indicator is relevant to all PCEs because in order for the refugia indicator to be rated "functioning appropriately" most if not all of the PCEs must be present. Only one indicator from the population pathways, *persistence and genetic integrity*, applies to evaluation of the condition of PCEs, but this indicator is not depicted in the Crosswalk to simplify Table 1. The following information provides the rationale for how the nine PCEs for bull trout critical habitat can be addressed by using the Matrix indicators (named using italics font).

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

   The analysis of *floodplain connectivity* considers the hydrologic linkage of off-channel areas with the main channel and overbank-flow maintenance of wetland function and riparian vegetation and succession. Floodplain and riparian areas provide hydrologic connectivity for springs, seeps, groundwater upwelling and wetlands and contribute to the maintenance of the water table. The *sediment* and *substrate embeddedness* indicators describe the level of fine sediment in the gravel which affects hyporheic flow. Fine sediment fills interstitial spaces making the movement of water through the substrate less efficient. The *chemical contamination/nutrients* and *temperature* indicators evaluate the water quality of groundwater. The *off-channel habitat* indicator suggests how much off-channel habitat is available, and generally off-channels are connected to adjacent channels via subsurface water. The *change in peak/base flows* indicator considers whether or not peak flow, base flow, and flow timing are comparable to an undisturbed watershed of similar size, geology, and geography. Peak flows, base flows, and flow timing are directly related to subsurface water connectivity and the degree to which soil compaction has decreased infiltration and increased surface runoff. The *drainage network increase* and *road density and location* indicators assess the influence of the road and trail networks on subsurface water connectivity. If there is an increase in drainage network and roads are located in riparian areas, it is likely that subsurface water is being intercepted before it reaches a stream. If groundwater is being intercepted then it is likely that water quality is being degraded through increased temperatures, fine sediment, and possibly chemical contamination. *Streambank condition* addresses groundwater influence through an assessment of stability. The *disturbance history* indicator evaluates disturbance across the watershed and provides a picture of how management may be affecting hydrology. The *riparian conservation areas* indicator determines whether riparian areas are intact and providing connectivity. If riparian areas are intact it is much more likely that springs, seeps, and groundwater sources are able to positively affect water quality and quantity.

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 *physical barriers* indicator provides the most direct assessment of this PCE. Analysis of this indicator includes consideration of whether man-made barriers within the watershed allow upstream and downstream passage of all life stages at all flows. However, some indicators further evaluate physical impediments and others evaluate the biological or water quality impediments that may be present. The *temperature, sediment, substrate embeddedness,* and *chemical contamination/nutrients* indicators assess whether other barriers may be created, at least seasonally, by conditions such as high temperatures, high concentrations of sediment, or contaminants. The *average wetted width/maximum depth ratio* indicator can help identify situations in which water depth for adult passage may be a problem. A very high average wetted width/maximum depth value may indicate a situation where low flows, when adults migrate, are so spread out that water depth is insufficient to pass adults. The *change in peak/base flows* indicator can help determine if change in base flows have been sufficient to prevent adult passage during the spawning migration. The *persistence and genetic integrity* indicator addresses biological impediments by evaluating negative interactions (e.g., predation, hybridization, and competition) with other species.

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

   None of the indicators directly address this PCE, but a number of them address it indirectly. The *sediment* and *substrate embeddedness* indicators document the extent to which substrate interstitial spaces are filled with fine sediment. Interstitial spaces provide important habitat for aquatic macroinvertebrates, sculpin, and other substrate-oriented prey which are important food sources for bull trout. The *chemical* *contamination/nutrients* indicator evaluates the level to which a stream is contaminated by chemicals or has a high level of nutrients. Chemicals and nutrients greatly affect the type and diversity of aquatic invertebrate communities present in a water body. The *large woody debris* and *pool frequency and quality* indicators assess habitat complexity. High stream habitat complexity is associated with diverse and abundant macroinvertebrate and fish prey. The *off-channel habitat* and *floodplain connectivity* indicators document the presence of off-channels which are generally more productive than main channels. Off channel areas are important sources of forage, particularly for juveniles. The *streambank condition* and *riparian conservation areas* indicators both shed light on the very basis of the food base of a stream. Vegetation along streambanks and in riparian areas provide important habitat for terrestrial macroinvertebrates that can fall into the water as well as sources of nutrient inputs that support aquatic invertebrate production.

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.**

Several indicators address this PCE directly. The *sediment* and *substrate embeddedness* indicators provide insight into how complex substrates are within a stream by documenting percent fines and embeddedness. As percent fines and embeddedness increase, substrate complexity decreases. The *large woody debris* indicator provides an excellent picture of habitat complexity. The indicator rates the stream based on the amount of in-channel large woody debris. Habitat complexity increases as large wood increases. The *pool frequency and quality* and *large pools* indicators address habitat complexity by rating the stream based on the frequency of pools and their quality. Habitat complexity increases as the number of pools and their quality increase. The *off-channel habitat* indicator directly addresses complexity associated with side channels. The indicator is rated based on the amount of off-channel habitat, cover associated with off-channels, and flow energy levels. *Average wetted width/maximum depth ratio* is an indicator of channel shape and pool quality. Low ratios suggest deeper, higher quality pools. The *streambank condition* and *riparian conservation areas* indicators both shed light on the complexity of river and stream shorelines. Vegetation along streambanks and in riparian areas provides important habitat complexity and channel roughness. The *streambank condition* indicator also provides information about the capacity of an area to produce undercut banks, which can be a very important habitat feature for bull trout. The *floodplain connectivity* indicator addresses complexity added by side channels and the ability of floodwaters to spread across the floodplain to dissipate energy and provide access to high-flow refugia for fish. The *road density and location* indicator addresses complexity by identifying if roads are located in valley bottoms. Roads located in valley bottoms reduce complexity by eliminating vegetation and replacing complex habitats with riprap or fill, and often confine the floodplain. The *disturbance regime* indicator documents the frequency, duration, and size of environmental disturbance within the watershed. If scour events, debris torrents, or catastrophic fires are frequent, long in duration, and large, then habitat complexity will be greatly reduced.

5. **Water temperatures ranging from 2 to 15 °C (36 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.**

   The *temperature* indicator addresses this PCE directly. The indicator rates streams according to how well temperatures meet bull trout requirements. Other matrix indicators address temperature indirectly. The *off-channel habitat* and *floodplain connectivity* indicators address how well stream channels are hydrologically connected to off-channel areas. Floodplains and off-channels are important to maintaining the water table and providing connectivity to the channel for springs, seeps, and groundwater sources which contribute cool water to channels. The *average wetted width/maximum depth ratio* indicator also corresponds to temperature. Low width to depth ratios indicate that channels are narrow and deep with little surface area to absorb heat. The *streambank condition* indicator documents bank stability. If the streambanks are stabilized by vegetation rather than substrate then it is likely that the vegetation provides shade which helps prevent increases in temperature. The *change in peak/base flows* indicator evaluates flows and flow timing characteristics relative to what would be expected in an undisturbed watershed. If base flow has been reduced, it is likely that water temperature during base flow has increased since the amount of water to heat has decreased. The *road density and location* and *drainage network increase* indicators documents where roads are located. If roads are located adjacent to a stream then shade is reduced and temperature is likely increased. Roads also intercept groundwater and can reduce this cooling influence, as well as discharge typically warmer stormwater. The *disturbance history* indicator describes how much of the watershed has been altered by vegetation management and therefore indicates how much shade has been removed. The *riparian conservation areas* indicator addresses stream shade which keeps stream temperatures cool. The presence of *large pools* may provide thermal refugia when temperatures are high.

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 *sediment* and *substrate embeddedness* indicators directly address this PCE. These indicators evaluate the percent fines within spawning areas and the percent embeddedness within rearing areas. The *streambank condition* and *riparian conservation areas* indicators indirectly address this PCE by documenting the presence or lack of potential fine sediment sources. If streambanks are stable and riparian conservation areas are intact then there is a low risk of introducing fine sediment from bank erosion. Also, the *floodplain connectivity* indicator indirectly addresses this PCE. If the stream channel is connected to its floodplain, then there is less risk of bank erosion during high flows because stream energy is reduced as water spreads across the floodplain. The *increase in drainage network* and *road density and location* indicators assess the effects of roads on the channel network and hydrology. If the drainage network has significantly increased as a result of human-caused disturbance or road density is high within a watershed and roads are located adjacent to streams, then it is likely that in-channel fine sediment levels will be elevated above natural levels. The *disturbance regime* indicator documents the nature of environmental disturbance within the watershed. If the disturbance regime includes frequent and unpredictable scour events, debris torrents, and catastrophic fire, then it is likely that fine sediment levels will be elevated above background levels. A consideration for all indicators directly or indirectly influencing this PCE is that it is desirable to achieve an appropriate balance of stable areas to provide undercut banks and eroding areas that are sources for recruiting new spawning gravels. Too little sediment in a stream can also be detrimental.

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.**

The *change in peak/base flows* indicator addresses this PCE directly by documenting the condition of the watershed hydrograph relative to an undisturbed watershed of similar size, geology, and geography. There are several indicators that address this PCE indirectly. The *streambank condition* indicator documents bank stability. If the streambanks are stabilized by vegetation rather than substrate then it is likely that the streambank can store water during moist periods and releases that water during dry periods which contributes to water quality and quantity. The *floodplain connectivity* indicator is relevant to water storage within the floodplain which directly affects base flow. Floodplains are important to maintaining the water table and providing connectivity to the channel for springs, seeps, and groundwater sources which contribute to water quality and quantity. The *increase in drainage network* and *road density and location* indicators assess the influence of the road and trail networks on hydrology. If there is an increase in drainage network and roads are located in riparian areas, it is likely is being intercepted and quickly routed to a stream which can increase peak flow. The *disturbance history* indicator evaluates disturbance across the watershed and provides a picture of how management may be affecting hydrology; for example, it may suggest the degree to which soil compaction has decreased infiltration and increased surface runoff. The *riparian conservation areas* indicator determines whether riparian areas are intact, functioning, and providing connectivity. If riparian areas are intact it is much more likely that springs, seeps, and groundwater sources are able to positively affect water quality and quantity.

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

This PCE is closely related to PCE 7, with PCE 8 adding a water quality component (i.e., there is a high level of overlap in indicators that apply to both PCEs 7 and 8). The *temperature* and *chemical contamination/nutrients* indicators directly address water quality by comparing water temperatures to bull trout water temperature requirements, and documenting 303(d) designated stream reaches. Several other indicators indirectly address this PCE by evaluating the risk of fine sediment being introduced that would result in decreased water quality through increased turbidity. The *streambank condition* and *riparian conservation areas* indicators indirectly address this PCE by documenting the presence or lack of potential fine sediment sources. If streambanks are stable and riparian conservation areas are intact then there is a low risk of introducing fine sediment from bank erosion. Also, the *floodplain connectivity* indicator indirectly addresses this PCE. If the stream channel is connected to its floodplain, then there is less risk of bank erosion during high flows because stream energy is reduced as water spreads across the floodplain. *Average wetted width/maximum depth ratio* is an indication of water volume, which indirectly indicates water temperature, (i.e., low ratios indicate deeper water, which in turn indicates possible high-flow refugia). This indicator in conjunction with *change in peak/base flows* is an indicator of potential water quality and quantity deficiencies, particularly during low flow periods. The *increase in drainage network* and *road density and location* indicators assess the effects of roads on the channel network and hydrology. If the drainage network has significantly increased as a result of human-caused disturbance or road density is high within a watershed and roads are located adjacent to streams, then it is likely that suspended fine sediment levels will be elevated above natural levels. If roads are located adjacent to a stream then shade is reduced and temperature is likely increased. Roads also intercept groundwater and can reduce this cooling influence, as well as discharge typically warmer stormwater. The *disturbance regime* indicator documents the nature of environmental disturbance within the watershed. If the disturbance regime includes frequent and unpredictable scour events, debris torrents, and catastrophic fire, then it is likely that turbidity levels will be elevated above background levels.

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 only indicator that directly addresses this PCE is the *persistence and genetic integrity* indicator. This indicator addresses the likelihood of predation, hybridization, or displacement of bull trout by competitive species. The *temperature* indicator can provide indirect insights about whether conditions are conducive to supporting "warm water" species.

Table 1. Relationship of the Matrix Indicators to the Primary Constituent Elen of Bull Trout Critical Habitat

Pathways (bold) and Indicators	**PCE 1 - Springs, Seeps, Groundwater**	**PCE 2- Migratory Corridors***	**PCE 3 - Abundant Food Base**	**PCE 4 - Complex Habitats**	**PCE 5 - Temperature**	**PCE 6 - Substrate**	**PCE - 7 Hydrograph**	**PCE 8 - Water Quality/ Quantity**	**PCE 9 - Nonnative Species***
Water Quality									
Temperature	X	X			X			X	X
Sediment	X	X	X	X		X			
Chemical Contamination/Nutrients	X	X	X					X	
Habitat Access									
Physical Barriers		X							
Habitat Elements									
Substrate Embeddedness	X	X	X	X		X			
Large Woody Debris			X	X					
Pool Frequency and Quality			X	X					
Large Pools				X	X				
Off-Channel Habitat	X		X	X	X				
Refugia	X	X	X	X	X	X	X	X	X
Channel Conditions and Dynamics									
Wetted With/Max. Depth Ratio		X		X	X			X	
Streambank Condition	X		X	X	X	X	X	X	
Floodplain Connectivity	X		X	X	X	X	X	X	
Flow/Hydrology									
Changes in Peak/Base Flows	X	X			X		X	X	
Drainage Network Increase	X				X	X	X	X	
Watershed Conditions									
Road Density and Location	X			X	X	X	X	X	
Disturbance History	X				X		X		
Riparian	X		X	X	X	X	X	X	

Conservation Areas									
Disturbance Regime				X		X		X	

* = PCE is also related to the population pathway, *persistence and genetic integrity* indicator

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