UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

NMFS Tracking No: 2009/06062

April 15, 2010

Jerrold D. Gregg, Area Manager
U.S. Bureau of Reclamation
Snake River Area Office
230 Collins Road
Boise, Idaho 83702-4520

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Operation and Maintenance of the Lewiston Orchards Project (17060306 (Clearwater River), 17060103 (Lower Snake River - Asotin), 170601 (Lower Snake River), 170701 (Middle Columbia River) and 170800 (Lower Columbia River), Nez Perce County, Idaho (One Project)

Dear Mr. Gregg:

The enclosed document is a biological opinion (Opinion) prepared by the National Marine Fisheries Service (NMFS) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) on the effects of the Operation and Maintenance of the Lewiston Orchards Project (LOP). In this Opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of ESA listed species in the Columbia River Basin or result in the destruction or adverse modification of designated critical habitat for listed species in the Columbia River Basin.

As required by section 7 of the ESA, NMFS provided an incidental take statement with the Opinion. The incidental take statement describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The take statement sets forth nondiscretionary terms and conditions, including reporting requirements, that the Federal agency and any person who performs the action must comply with to carry out the reasonable and prudent measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA take prohibition.

This document also includes the results of our analysis of the action’s likely effects on essential fish habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes three conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. These conservation recommendations are not identical to the ESA Terms and Conditions. Section 305(b) (4) (B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations.

If the response is inconsistent with the EFH conservation recommendations, the Bureau of Reclamation must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

If you have any questions regarding this consultation, please contact Bob Ries, Biologist at (208) 882-6148, or Dale Brege, Branch Chief at (208) 983-4060, of the North Idaho Branch Office at 104 Airport Road, Grangeville, Idaho, 83530.

Sincerely,

for Michael Tehan

Barry Thom
Acting Regional Administrator

cc: K. Wirkus, BOR
G. Burton, USFWS
R. Hennekey, IDFG
S. Penney, NPT

Endangered Species Act – Section 7 Formal Consultation Biological Opinion

and

Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

for the

Operation and Maintenance of the Lewiston Orchards Project

Snake River Basin Steelhead, Snake River spring/summer Chinook Salmon, Snake River Fall Chinook Salmon, and Snake River sockeye Salmon

Sweetwater, Webb, Lapwai, and Captain John Creeks
Lower Clearwater, Lower Snake and Lower Columbia Rivers
17060306 (Clearwater River), 17060103 (Lower Snake River - Asotin), 170601 (Lower Snake River), 170701 (Middle Columbia River) and 170800 (Lower Columbia River).
Idaho, Oregon, and Washington

Lead Action Agency:	U.S. Bureau of Reclamation, Snake River Area Office
Consultation Conducted By:	National Marine Fisheries Service, Northwest Region
Date Issued:	April 15, 2010
Issued By:	for ____________________ Barry A. Thom Acting Regional Administrator

NMFS Consultation No. 2009/06062

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ACRONYMS

~	Approximately
af	acre-feet
APA	Administrative Procedures Act
BA	Biological Assessment
BOR	Bureau of Reclamation
cfs	cubic feet per second
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
HUC	Hydrologic Unit Codes
IDFG	Idaho Department of Fish and Game
IFIM	Instream Flow Incremental Methodology
ITS	Incidental Take Statement
lambda (λ)	Population Growth Rate
LOID	Lewiston Orchards Irrigation District
LOP	Lewiston Orchards Project
MPG	Major Population Groups
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NMFS	National Marine Fisheries Service
O. mykiss	*Oncorhynchus mykiss*
Opinion	Biological Opinion
Parties	Tribe, LOID, BOR, and NMFS
PCE	Primary Constituent Elements
PFMC	Pacific Fishery Management Council
PHABSIM	Physical Habitat Simulation
QET	Quasi-Extinction Threshold
R/S	Recruit/Spawner
RPA	Reasonable and Prudent Alternative
RPMs	Reasonable and Prudent Measures
SCA	Supplemental Comprehensive Analysis
SRBA	Snake River Basin Adjudication
Tribe	Nez Perce Tribe
TRT	Technical Recovery Team
UI	University of Idaho
USGS	U.S. Geological Survey
VSP	Viable Salmonid Population
WUA	Weighted Usable Area
YOY	Young-of-the-Year

1. INTRODUCTION

The biological opinion (Opinion) and incidental take statement (ITS) portions of this consultation were prepared by the National Marine Fisheries Service (NMFS) in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, *et seq*.), and implementing regulations at 50 CFR 402. With respect to designated critical habitat, the following analysis relied only on the statutory provisions of the ESA, and not on the regulatory definition of "destruction or adverse modification" at 50 CFR 402.02.

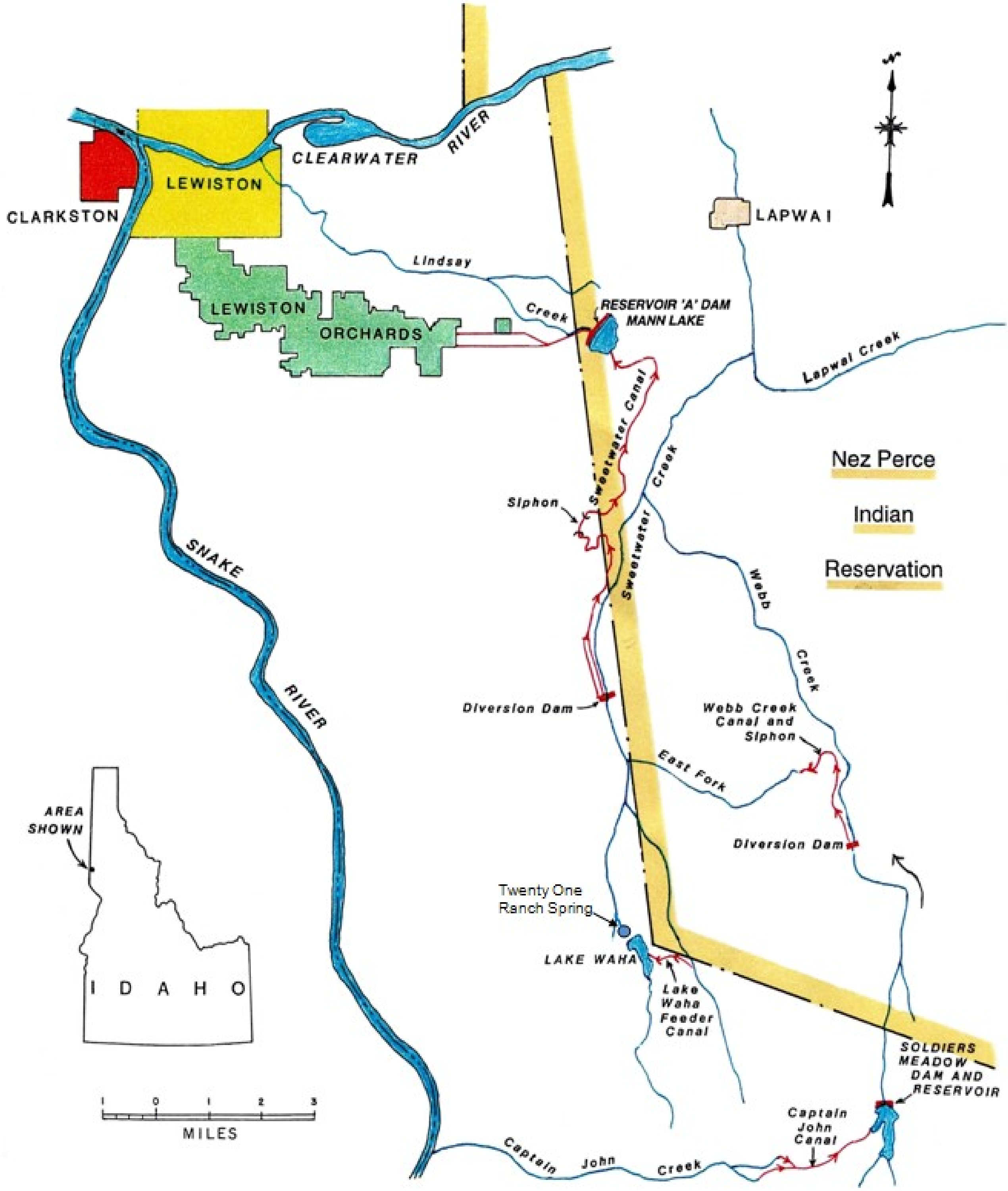
The Essential Fish Habitat (EFH) consultation was prepared in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801, *et seq*.) and implementing regulations at 50 CFR 600. The administrative record for this consultation is on file at the Idaho State Habitat Office in Boise, Idaho.

The Bureau of Reclamation (BOR) proposes the future operation and maintenance of the Lewiston Orchards Project (LOP), which began as a private enterprise in 1906. The LOP consists of a series of water storage reservoirs, diversion dams, and canals that provide irrigation water to the Lewiston Orchards area of Lewiston, Idaho. The LOP was authorized by the Act of July 31, 1946, (60 Stat. 717, Public Law 79-569). The purpose of the 1946 authorization was to repair and improve the water collection and distribution system for irrigation and industrial water supply. In November 1948, the Lewiston Orchards Irrigation District (LOID) deeded the entire collection, reservoir, distribution systems, and all water rights to the BOR. The facilities and water rights remain in ownership of the BOR. A July 10, 1947, contract specifies the responsibilities of LOID for operating and maintaining the LOP facilities, and obligations and limitations of BOR for providing water to LOID. The contract between BOR and LOID entitles "each assessable acre of land in the District to an irrigation water supply of not to exceed two and two-tenths (2.2) acre-feet." The contract reserves a Federal right to provide less than the maximum amount "on account of accidents, failure of the power supply, drought, inaccuracy in distribution, hostile diversion, prior or superior claims, or other causes, it is expected that there will occur at times a shortage in the quantity of water which will be available through the project works."

The LOP is managed by LOID, which provides irrigation water for agricultural, urban, and suburban lands. The LOP originally served an agricultural based community that has experienced steady urban and suburban development. Approximately 90% of the area within the district boundaries is presently urban or suburban, with the majority of irrigation water applied to lawns, landscaping, and gardens. The irrigation system serves about 5,700 accounts with an approximate consumption of 1,800 million gallons of water per year. The customer demands for water have exceeded the amount of water available in the past few decades.

The irrigation water comes from surface water collected from the Craig Mountain watershed, which consists of natural streams, diversion dams, canals, and reservoirs (See map, Figure 1). The LOP collects water from the watershed at Soldiers Meadow Reservoir and Lake Waha. The water is brought to Mann Lake through portions of Sweetwater and Webb Creeks and canals.

Figure 1. Map of the Lewiston Orchards Project area.



The LOID is required by local government to reserve water in Reservoir "A" (Mann Lake) for fire suppression at the Lewiston Airport and for most of the fire hydrants within the LOID boundary; consequently, some of the water stored in Mann Lake is not available for irrigation. The crest elevation of the dam is 1810 feet, with an active pool elevation that was previously restricted to 1800 feet. This safety restriction has been modified to 1804 feet as of September 2009, and storage to this new maximum will likely occur in 2010.

1.1. Background and Consultation History

The BOR initiated consultation with NMFS in 1998 on the effects of ongoing operations and maintenance activities at BOR facilities in the Snake River Basin, upstream from Lower Granite Dam. Consultation on the LOP was suspended during Snake River Basin Adjudication (SRBA) negotiations. When the LOP was dropped from the SRBA, consultation on the LOP was resumed. On April 26, 2001, NMFS received a supplemental biological assessment (BA) from BOR with a "not likely to adversely affect" determination for the effects of the LOP on Snake River Basin steelhead.

The 2001 supplemental BA contained little biological information and focused primarily on the effects to the district that would occur to LOID and its patrons if no water was diverted, rather than on the effects of diverting water on steelhead and habitat within the project area. The initial proposed action did not provide any flows in Sweetwater and Webb Creeks because the BOR concluded there had been no recent documentation of steelhead returns to Sweetwater Creek. After the 2001 BA was completed, fish surveys by the Nez Perce Tribe (Tribe) documented the presence of juvenile *Oncorhynchus mykiss* (*O. mykiss*) in Sweetwater and Webb Creeks, and steelhead spawning in Lapwai Creek near the mouth of Sweetwater Creek. Much of the LOP is located within the Nez Perce Tribe Indian Reservation, and the Tribe is very concerned with the effects of the LOP on steelhead.

In a letter to BOR on April 16, 2002, and based on the new information that *O. mykiss* were present in Lapwai and Sweetwater Creeks, NMFS recommended that BOR consider increased flows in Sweetwater and Webb Creeks, provide fish passage at the Sweetwater Creek diversion dam, and screen the diversion. NMFS was reasonably certain the LOP harmed or killed steelhead in the action area through effects of dewatering stream channels, and was reasonably certain that stream reaches designated as critical habitat were adversely affected by the LOP when they were dewatered as a result of LOP water diversions. On May 2, 2002, however, the BOR responded by stating changes in the proposed action were not warranted and that consultation should be based on the current and supplemental BAs.

NMFS sent a draft jeopardy Opinion to BOR on July 19, 2004, which included an approach for developing a reasonable and prudent alternative (RPA) for achieving minimum flows during the irrigation season, a default minimum flow, and a larger flow under specified circumstances. The minimum flows in the draft Opinion were preliminary figures intended to initiate discussion between NMFS and BOR, and were not derived from a complete analysis of available information. On August 20, 2004, the BOR responded and corrected factual errors in the draft Opinion, but questioned the basis for NMFS' preliminary jeopardy determination and did not comment on the draft RPA.

On January 10, 2004, BOR decided that while they did not agree with the conclusion of the draft Opinion, they would submit a draft proposed action to provide 300 af of water for instream flows. This amount of water (300 af) would have provided approximately 1.67 cubic feet per second (cfs) in Sweetwater Creek for 3 months, or less than that flow if any portion of the 300 af of water were allocated to Webb Creek, or if the flow were apportioned for longer than 3 months. NMFS evaluated the proposal and informed BOR on a February 11, 2005, conference call that the 300 af would be insufficient to avoid jeopardy and adverse modification of critical habitat. The BOR again questioned the basis for NMFS' determination and the need for more water. During the summer of 2005, BOR provided a voluntary flow of approximately 1 cfs in Sweetwater Creek.

NMFS sent another draft of the Opinion to BOR on April 13, 2005, requesting comments on two draft RPAs. On June 2, 2005, BOR sent comments about the draft Opinion, but declined to comment on the RPAs due to unresolved disagreements over the analysis and determinations.

On July 15, 2005, the Tribe sued NMFS in Federal Court under the Administrative Procedures Act (APA) claiming that NMFS had failed to complete an Opinion in a timely manner and asked the court to compel NMFS to issue the Opinion. NMFS, BOR, and the Tribe met on November 3, 2005, to discuss progress on the consultation. At that meeting, BOR described tentative minimum flows and other likely changes to the proposed action. Based on BOR's tentative changes to the proposed action, NMFS agreed to prepare a new draft Opinion to submit to BOR and the Tribe for review. A schedule for Tribal review of draft documents and a March 1, 2006, completion of the draft Opinion was agreed upon to settle the Tribe's claim.

In a continuing effort to resolve differences, BOR, NMFS, and LOID met in Boise on October 12, 2005, and followed up that meeting with a series of telephone calls over the next 2 weeks. On October 25, 2005, BOR tentatively agreed to change their proposed action to incorporate minimum flows and operational procedures to benefit fish. The BOR, however, still did not agree with the jeopardy determination in the last NMFS' draft opinion.

On November 15, 2005, NMFS sent to the Tribe and BOR an electronic preliminary draft Opinion based on assumed changes to the proposed action. NMFS received substantial comments from BOR and the Tribe. The comments from BOR addressed a wide array of issues, with primary emphasis on the information and procedures used in the effects analysis. Comments from the Tribe largely questioned the adequacy of the minimum flows, raised objections to a potential 10-year delay before flow levels would reach their target, reiterated Federal trust responsibilities, and suggested an alternative approach to the proposed action.

The BOR amended the proposed action and transmitted it to NMFS via e-mail on February 17, 2006. After evaluation of the modified proposed action, NMFS determined that the action would not jeopardize listed Snake River Basin steelhead or destroy or adversely modify critical habitat. NMFS revised the draft Opinion to document BOR's changes to the proposed action, effects analysis, and the determination of effects and signed the LOP Opinion on March 1, 2006 (NMFS # 2002/00474).

After issuance of the 2006 LOP Opinion, the Tribe did not agree with NMFS' analysis in the Opinion and filed a lawsuit against NMFS and BOR under the APA and the ESA. The Tribe charged NMFS with being arbitrary and capricious in the conclusions of the 2006 Opinion. On April 7, 2008, the U.S. District Court of Idaho ruled in favor of the Tribe. The Tribe, LOID, BOR, and NMFS (Parties) participated in a court-ordered mediation and agreed to a remand of the 2006 Opinion to NMFS without vacatur. The Parties also agreed to meet and attempt to develop items to be included in the proposed action and narrow differences regarding scientific and technical information prior to completion of a new biological opinion by January 31, 2010.

The settlement agreement called for quarterly meetings to explore long-term LOP operations with Judge Candy Dale as a mediator, quarterly reports on progress, and a series of unsupervised meetings between the Parties to try to narrow areas of disagreement on scientific and technical information and develop interim operating guidelines. Beginning in September 2008, the Parties met eight times in a collaborative work process. The process was documented by a facilitator and the minutes are included in the consultation file at the NMFS Boise office.

On August 12, 2009, the BOR sent an electronic draft BA for external review to the Tribe, LOID, and NMFS. The Tribe responded to BOR with comments concerning the draft BA and proposed action on August 19, 2009. The BOR responded to the Tribe's comments on September 21, 2009. On October 2, 2009, the BOR sent an electronic final BA to NMFS and requested formal consultation on the LOP. Consultation was initiated on that date.

NMFS sent a draft copy of the Opinion to BOR on January 29, 2010. The BOR then forwarded the Opinion to the Tribe on January 29, 2010. Both the Tribe and the BOR sent comments about the draft Opinion to NMFS via electronic letters on March 1, 2010. NMFS has fully considered all of the Tribe's comments, BOR's comments, and the information and discussions in the remand period.

In an exchange of letters between the Tribe (Samuel N. Penney, Chairman) and NMFS (Barry A. Thom, Acting Regional Administrator for NMFS Northwest Region) dated January 14, 2010, and January 25, 2010, the Tribe and NMFS agreed to a negotiated schedule that allowed time for the Tribe to review and comment on the draft LOP Opinion. The letter called for two NMFS staff meetings with the Tribe, a pre-release briefing to the Tribe, and release of the final Opinion by April 15, 2010. In their letter, the Tribe consented to the instream flow values of 7.8 cfs at the Sweetwater Creek diversion and 4.0 cfs at the Webb Creek diversion for the February 1 to April 15 interim period (or all inflow if inflow was less than these values), although the Tribe did express its concerns for additional flows in Webb Creek.

On April 7, 2010, the BOR sent a letter to NMFS requesting a change to the proposed action for a ramping rate change from 0.5 cfs per 12-hour period to 1 cfs per 24-hour period when stream flows are less than 20 cfs. The BOR stated that this change was necessary due to limitations in the gate automation system at the dams.

1.1.1. Major changes from the 2006 Proposed Action

The proposed action for the LOP, as described in BOR's October 2009, BA, has the following changes from their February 17, 2006, proposal:

A. Initial 10-year period of the 2006 Opinion

The 2006 proposed action included an initial 10-year period during which instream flows would be lower than in the subsequent long-term operation. There were concerns that the flow levels proposed during this initial period would not provide continuous surface flows, or connectivity, in Sweetwater Creek. The initial flow level for Sweetwater Creek was based on anecdotal evidence of past operations and required monitoring to assure the minimum flows were delivered. It did not, however, contain an adaptive management approach to ensure that connectivity occurred. During the collaborative process, BOR eliminated the short-term flow concept making the lower interim flow levels a moot point. Additionally, the Parties worked together to collect field data to characterize physical habitat conditions in Sweetwater and Webb Creeks, including data regarding connectivity in Sweetwater Creek.

B. Drought Exemption

The 2006 proposed action provided that flows could be "waived" one out of three years under circumstances characterized as a drought. There were concerns expressed that NMFS' assumption in the 2006 Opinion that the drought exemption would not be used more than once in the initial 10-year period lacked support. During the collaborative work process, the BOR eliminated the drought exemption, making this issue a moot point.

C. Long-Term Flows

During the remand period, the Parties were able to collect additional data to use in the analysis, and have a more robust discussion of the data and possible analytical methods. However, the Parties were not able to agree upon what the "best available data" is or how to analyze the data. Therefore, NMFS will make and defend its independent decisions regarding how to use the information available.

In this Opinion, NMFS uses recently collected site-specific data for Sweetwater and Webb Creeks. These data include 65 cross-sections at three different flows, physical habitat simulation (PHABSIM) modeling, instream flow incremental methodology (IFIM) study, connectivity surveys, actual stream flows measured by stream gages in the action area, estimates of unregulated flows calculated by direct measurements of water flowing in and out of the reservoirs and canals, and actual stream flows in Sweetwater and Webb Creeks or estimated stream flows for Sweetwater and Webb Creeks in years when stream gage data are not available.

The BOR conducted a connectivity survey in Sweetwater Creek on August 2, 3, and 6, 2006, when the mean daily streamflow was 0.4 cfs at the diversion dam and 0.8 cfs at the mouth. The

BOR documented one location where flow was not continuous and was not adequate for connectivity of stream habitats (BOR 2007a). The BOR conducted another connectivity survey in Sweetwater Creek in August 2007 when the mean daily flow was 1.0 cfs at the Sweetwater diversion dam. The location that was dewatered during the 2006 connectivity survey was now approximately 4 inches deep. The BOR determined that the 1.0 cfs flow at that time was adequate for connectivity for juvenile fish in Sweetwater Creek (BOR 2007b).

The BOR conducted a connectivity survey in Webb Creek between the Webb diversion dam and the mouth at Sweetwater Creek on June 26 and 28, 2008. However, during the survey, the headgates at the Webb diversion dam were open and all the stream flow was being diverted into the Webb canal. Because flows were declining, the BOR was not able to conduct an adequate connectivity survey for Webb Creek.

The BOR conducted similar connectivity surveys in Lapwai Creek between Sweetwater Creek and the mouth at the Clearwater River on September 8 and 9, 2008. The flow at the Sweetwater diversion dam was 2.18 cfs, flows at the Sweetwater Creek mouth ranged from 3.7 to 4.2 cfs, and flows on Lower Lapwai Creek ranged from 4.4 to 4.8 cfs. No locations were dewatered during the survey, but two locations, found just below the Tribal horse facility building, were considered borderline for juvenile fish passage since the riffle depth was only 2 inches deep (BOR 2009).

The BOR's 2010 proposed action contains minimum instream summertime flows (2.5 cfs for Sweetwater Creek and 1.0 cfs for Webb Creek) that will become effective immediately upon signing of this Opinion.

In addition to the proposed minimum flows, the BOR has also included additional summertime flows based on hydrologic conditions and accumulated water storage on June 1. Although NMFS cannot conclusively predict how often additional flows might be available, the data (see BA pages 4 to 10) show that some amount of additional flows would have been available in five of the past 7 years (2003 to 2009). NMFS, however, uses only the minimum instream flows, as found in Table 1, in making its conclusions in this Opinion.

D. Gravel Management and Ramping Rates.

Through collaboration during the remand process, the gravel management and instream flow ramping rates were finalized. In general, the Parties considered previously existing and any new information to agree on plans for sediment management needs at the diversion dam sites and spawning-size gravel replacement. The Parties also agreed to make gradual flow rate adjustments to avoid stranding fish when reducing flows and to avoid flushing fish downstream when increasing flows.

In summary, the key developments and activities during the collaborative process among the Parties included:

- Elimination of lower flows during a 10-year initial period as part of the proposed action;

- Elimination of the drought exemption as part of the proposed action;
- Collection of field data along Sweetwater and Webb Creeks;
- Finalization of ramping rates;
- Finalization of the sediment removal and gravel replacement plan;
- Development of hydrologic and operational analysis tools to test the feasibility, reliability, and
- Development of hydrologic and operational analysis tools to test the feasibility, reliability, and potential tradeoffs associated with candidate flow regimes;
- Robust discussions among the Parties regarding minimum instream flows; and
- Provisions for additional summertime flows under given hydrologic and storage conditions.

1.2. Proposed Action – Operation and Maintenance of the LOP

Proposed actions are defined in the consultation regulations (50 CFR 402.02) as "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas." Additionally, U.S. Code (16 U.S.C. 1855(b)(2)) further defines a Federal action as "any action authorized, funded, or undertaken or proposed to be authorized, funded, or undertaken by a Federal agency." Because BOR proposes the future operation and maintenance of the LOP, which may affect listed species, it must consult under ESA section 7(a)(2) and MSA section 305(b)(2).

It is important to note that the obligation of NMFS is to assist BOR in determining if the action complies with section 7 of the ESA. NMFS is not responsible for operating the LOP, nor is it responsible for developing proposed actions. It is the role of BOR to resolve competing demands and operations of the LOP.

For purposes of this consultation, the action as proposed by the BOR is the future operations and routine maintenance of the LOP. The proposed action includes storage and release of water from Soldiers Meadow Reservoir, Lake Waha and Reservoir A; diversion of water at Captain John Creek diversion, Webb Creek diversion, West Fork Sweetwater Creek diversion, and Sweetwater Creek diversion; and routine maintenance of storage, conveyance, access, and associated facilities (Figure 1). This proposed action covers the future operations and maintenance of the project for a 10-year period starting January 31, 2010, through January 31, 2020. Elements of the proposed action are described as follows.

Instream Flow Regime

The BOR is proposing new operating and maintenance procedures that ensure certain minimum flows for conservation of Snake River Basin steelhead. The LOID will provide instream flows through the Idaho State Water Bank, consistent with LOP authorities and Idaho State law. The LOP will forego storage in Reservoir A and diversions at Sweetwater and Webb Creeks diversion dams to provide the minimum flows described in this proposed action. It is the responsibility of the Idaho Department of Water Resources Board to protect and monitor water rights and releases. The BOR's authority and ability to control this water ends at the Sweetwater and Webb diversion dams where the bypass flows will be provided. The proposed minimum instream flow regime for the LOP is shown in Table 1.

The proposed instream flow regime in Table 1 addresses all months of the year; these flows will be used to support spawning conditions during February through April and juvenile rearing conditions from May through January. The LOP will not operate the Sweetwater and Webb diversion dams during November, December, and January; therefore, all instream flow reaching the dams will be bypassed during those months. During February and March, if the inflows to either Sweetwater or Webb diversion dams are below the specified minimum flow, the LOID will bypass all inflow to that diversion dam. The minimum flow specifications for some months include an "I" (inflow) designator. The specified minimum flow will be provided when inflows to the diversion dams are higher than the minimums; the "I" flow will be provided when inflows to the dams are below specified minimums.

Table 1. Instream flow minimum releases (cfs) for Sweetwater and Webb Creeks at their respective diversion dam sites.

Life Stage	**Spawning**			**Juvenile Rearing**							
Month	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 1-15	Sep 16-30	Oct	Nov Dec Jan
Sweet-water Cr.	7.8/I[b]	7.8/I	7.8	3.0	2.5	2.5	2.5	2.5	2.5	2.5	I[a]
Webb Creek	4.0/I[b]	4.0/I	4.0	1.5	1.0	1.0	1.0	1.0	1.0	1.0	I[a]

[a] During November, December, and January, all inflow (I) at Sweetwater and Webb Creeks diversion dams will be bypassed.
[b] During February and March, either the specified stream flow will be provided or all inflow (I) to the Sweetwater and Webb Creeks diversion dams will be bypassed, whichever is less.

For Webb Creek, the "I" flow is composed of all runoff from the watershed upstream of the diversion below Soldiers Meadow Dam. For Sweetwater Creek, the "I" flow is composed of all runoff from the watershed upstream of the dam, except for any diversions occurring at the West Fork diversion which are being conveyed to Lake Waha.

When conditions permit, the BOR proposes to supply water to the system in addition to the minimum flows shown in Table 1. Due largely to the high variability in local hydrologic and climatic conditions, the BOR will provide additional flows for June through mid-September based on the status of the combined storage in Soldiers Meadow Reservoir and Reservoir A, as assessed on June 1. Table 2 shows the BOR's proposed allocations for Sweetwater and Webb Creeks and the storage conditions under which they would occur.

Table 2. Increments of additional juvenile rearing flow as a function of combined storage.

Combined Storage (af):	<3,800	3,900	4,000	4,100	4,200	>4,250
Sweetwater Creek (cfs)	2.50	3.00	3.40	3.50	3.50	3.50
Webb Creek (cfs)	1.00	1.00	1.00	1.30	1.80	2.00
Total Flow (cfs)	3.50	4.0	4.40	4.80	5.30	5.50

Operational Criteria

The LOID will take water measurements for stream flow compliance using the weirs installed on the diversion dams at Sweetwater and Webb Creeks. Water measurement at these weirs exceeds the accuracy of measuring discharge in a natural channel. The BOR posts data from these measurement points on their website (http://www.pn.usbr.gov/hydromet).

The BOR will measure stream flows continuously at the Sweetwater and Webb diversion dams. The automated gates adjust continuously to maintain designated stream flow within the capabilities of the equipment. The BOR expects the measurement and gate automation to stay within 15% of the intended minimum bypass stream flow. The BOR historically has measured outflow at Soldiers Meadow and Reservoir A, and has installed measurement equipment on the pump at Lake Waha.

The BOR intends to make gradual changes (ramping) of stream flows during gate operations to allow fish sufficient time to adjust to changes in stream habitat. This will avoid stranding fish in dewatered or pooled areas when stream flows are reduced, or flushing fish downstream when stream flows are increased. The BOR will implement ramping criteria, unless equipment failure occurs, at the Sweetwater and Webb diversion headgates during the following periods: (1) At the start of the irrigation season; (2) down-ramping from spawning flows to juvenile rearing flows on May 1; (3) at the end of the irrigation season; and (4) any other time during the irrigation season for operation or maintenance purposes.

Maintenance Activities

The BOR, through LOID, will conduct routine maintenance activities that consist of:

- Flushing of sediment accumulations at the Sweetwater Canal headgate;
- Periodic mechanical removal of fine sediment that accumulates above the Sweetwater diversion dam;
- Gravel replacement downstream at Sweetwater Dam;

- Repairs and minor modifications to facility structures, such as gate operation hardware water measurement equipment, etc.;
- Canal improvements and maintenance;
- Road maintenance and drainage; and
- Culvert maintenance and/or replacement.

To maintain proper headgate and dam function, the BOR intends to flush sediment accumulations at the Sweetwater Canal headgate and mechanically remove fine sediment that accumulates above the Sweetwater diversion dam. LOID removes accumulated sediment upstream of the Sweetwater diversion dam once every 3 to 4 years. Much of this sediment is sand and silt-sized material; however, some spawning-sized gravel is trapped and removed from the stream. The BOR has agreed to a sampling and management plan to replace the spawning gravel removed during sediment removal activities.

Maintenance activities include repairs and minor modifications to the structures, such as repair and replacement of gate operation hardware and water measurement equipment. These repairs and modifications to these structures are not expected to affect the bypass stream flows or water quality.

The LOP operations includes road maintenance necessary to reliably access the facilities. LOID maintains 15.2 miles of gravel and/or dirt road. About 1.5 miles, 10.6 miles, and 3.1 miles of the roads are located in the Lindsay, Sweetwater, and Webb drainages, respectively. In addition, LOID has less than 5 miles of unmaintained vegetated two-track that is traveled by vehicle about once per year to access the West Fork Sweetwater Creek and Captain John Creek diversion canals. LOID accesses the other dams and facilities from county roads not maintained by LOID. Road maintenance includes graveling and grading of the road surface, culvert repair and/or replacements, and road drainage. These activities are necessary to maintain the road for safe travel by heavy equipment, trucks, and manual labor, to minimize road effects, and to ensure access to the canals and the diversion dams. LOID purchases the gravel and rock from commercial sources.

The LOP operations also includes canal maintenance necessary to reliably divert and deliver water and prevent failure of the facilities. LOID maintains 14.3 miles of earthen canal, concrete flume, or pipeline between the Sweetwater and Webb Creeks diversion dams and Reservoir A. LOID conducts canal lining and other canal maintenance during the winter months when the canal is dewatered. Canal projects generally occur on the ridgeline away from the creek and riparian environment.

1.2.1. Precautionary Measures and Project Design Criteria

The project design criteria described here and in BOR's BA as part of their proposed action are intended to reduce or avoid adverse effects on ESA-listed species and their habitats. NMFS regards these precautionary measures as integral components of the proposed action and expects that all project activities will be completed in a manner consistent with these measures. The precautionary measures as brought forward by BOR to reduce or avoid adverse effects consist of the following measures:

1. The BOR and LOID will provide the stream flows at the diversion dams as specified in Table 1.

    a. Occasional deficits in minimum flows may occur due to circumstances such as rapid drops in the water table, operational limitations and mechanical failures, natural events that prevent normal operation, or emergency repairs or maintenance.

    b. The BOR and LOID will strive to minimize occurrences when deficits in minimum flow might occur.

    c. When the automation equipment is not operational, LOID will adjust the headgates once each day to provide the intended minimum bypass stream flow.

    d. The BOR has committed that they will communicate with NMFS as soon as possible to determine the appropriate course of action if minimum target flows are not met.

2. The BOR and LOID will implement the gravel replacement plan.

    a. The amount of gravel replaced will equal or exceed an estimate of the amount of spawning-size gravel removed following the procedure as outlined in the BA (BA, pages 4 to 13).

    b. The BOR will deliver gravel (washed) to the stream downstream of the diversion dam using best management practices to minimize impact to the stream banks and riparian vegetation, and hand-spread the gravel along the wetted stream channel to avoid piling and disconnecting the stream habitats.

    c. The BOR will place the gravels in the active streambed and allow subsequent high water events to distribute the gravel downstream.

3. The BOR will follow ramping criteria at all times, unless equipment failure occurs. The maximum gate adjustments for ramping will be:

    a. At flows more than 70 cfs, the maximum gate adjustment will be 10 cfs per day.

    b. At flows between 20 cfs to 70 cfs, the maximum gate adjustment will be 5 cfs per day.

    c. At flows less than 20 cfs, the maximum gate adjustment will be 1 cfs per day.

1.2.2. Monitoring and Reporting

The BOR and LOID will maintain stream flow measurements at the diversion dams and the canals to document compliance with the minimum bypass stream flows in the proposed action. The BOR will submit an annual report to NMFS by May 20 that documents operational activities and bypass stream flow compliance relevant to this consultation.

1.2.3. Interrelated and Interdependent Actions

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification; interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02). There are no interrelated and interdependent actions.

1.3. Description of the ESA Action Area and EFH Affected by the Proposed Action

An action area is defined under the ESA as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR Part 402). The LOP takes water directly from Sweetwater and Webb Creeks of the Lapwai Creek watershed and from Captain John Creek in the Snake River watershed.

The LOP diverts water at dams in Webb, Sweetwater, Captain John, and West Fork Sweetwater Creeks, and stores water at Soldiers Meadow reservoir, Lake Waha, and Mann Lake. Mann Lake is an artificial reservoir that is within the area affected by operation of the LOP; however, use of Mann Lake for water storage has no appreciable effects on listed fish or fish habitat apart from the diversion of water from Sweetwater Creek. Mann Lake is located on a plateau in the upper portion of the Lindsay Creek drainage. Although Mann Lake likely increases stream flows in Lindsay Creek through seepage captured by the creek, Lindsay Creek is inaccessible to anadromous fish because the mouth of Lindsay Creek is funneled into a drain that siphons water over a levee and into the pool created by Lower Granite Dam. Surface flows are directly affected by the LOP water withdrawals in nearly 24 miles of fish-bearing streams in the Lapwai Creek drainage (over 8 miles in Sweetwater Creek, over 9 miles in Webb Creek, and over 6 miles in Lapwai Creek). The diversion dam in Sweetwater Creek precludes upstream fish passage to an additional 11 miles of stream that presently supports resident *O. mykiss* (Chandler and Parot 2003; Chandler and Richardson 2006). Table 3 summarizes the reservoirs, diversion dams, and canals along with their operation periods and capacities.

Table 3. Lewiston Orchards Project facilities and specifications.

Reservoirs	
Reservoir A (Mann Lake)	Capacity: 2400 af @ 1804 foot elevation
Soldiers Meadow	Capacity: 2,370 af active storage, with 492 af capacity reserved for flood operations.
Lake Waha (natural lake)	Lake capacity: 6,900 af; Volume pumped annually: 0 to 2,500 af Annual flux in water height: 30' to 50' elevation Pump operation: May-November; typical August-September
Diversion Dams	
Webb Creek	Operation: February through October
Sweetwater Creek	Operation: February through October
Captain John Creek	Operation: Typically late April through early May
West Fork Sweetwater Creek	Operation: February through October
Canals	
Captain John Creek	Capacity: 6.3 cfs
Lake Waha Feeder	Capacity: 15 cfs
Webb Creek	Capacity: 20 cfs
Sweetwater Creek	Operational capacity: ~32 cfs

The LOP affects Captain John Creek by the diversion of water from an intermittent headwater tributary of the drainage. This diversion transfers water into the Webb Creek drainage (and into Soldiers Meadow Reservoir) when the intermittent tributary is flowing. The lower reaches of Captain John Creek serve as spawning and rearing habitat for Snake River Basin steelhead and rearing habitat for Snake River spring/summer Chinook salmon, but a passage barrier limits upstream fish migration at stream mile 6. The Captain John Creek drainage includes designated critical habitat for Snake River spring/summer Chinook salmon and the Snake River Basin steelhead distinct population segment (DPS), and the drainage is designated as EFH for Chinook salmon and coho salmon.

The LOP affects stream flows in Sweetwater and Webb Creeks through storage and release of water in reservoirs, and transfer of water from Webb Creek to the East Fork of Sweetwater Creek, and from Sweetwater Creek out of the drainage into Mann Lake. Flows in Lapwai Creek, below the confluence with Sweetwater Creek, are affected by the flows from Sweetwater Creek. Sweetwater, Webb, and Lapwai Creeks serve as spawning, rearing, and migratory habitat for Snake River Basin steelhead. The affected streams include designated critical habitat for the Snake River Basin Steelhead DPS, and are designated as EFH for Chinook salmon and coho salmon.

Wild fall Chinook salmon are likely to occur in the Clearwater River near the mouth of Lapwai Creek, but are unlikely to occur upstream in Lapwai Creek. Wild Snake River fall Chinook salmon in the Clearwater River Basin are not known to occur in small tributaries, such as Lapwai Creek, although juveniles are likely to occur at the confluence of Lapwai Creek and the Clearwater River. At the confluence of Lapwai Creek and the Clearwater River, habitat conditions are determined almost entirely by characteristics of the Clearwater River during summer when juvenile fall Chinook salmon are likely to be migrating downstream. Listed fall Chinook salmon from the Cherry Lane hatchery are reared by the Tribe at the North Lapwai Valley satellite rearing facility, located adjacent to Lapwai Creek, approximately 0.8 miles above its mouth. Spring/summer Chinook salmon are found in the Clearwater River, but due to the Lewiston Dam eliminating their passage on the lower mainstem Clearwater River at Lewiston, Idaho, from 1927 to 1973, spring/summer Chinook salmon are not listed under the ESA in the Clearwater River.

In summary, the LOP most directly affects stream flows in Sweetwater, Webb, and Lapwai Creeks, and has a smaller direct effect on flows in Captain John Creek. Water consumptively used due to the proposed action will also affect flow in the lower Clearwater, Snake and Columbia Rivers.

Based on the location of water diversions, the action area considered in this Opinion consists of the following streams: (1) Captain John Creek from the headwaters of the North Fork to its mouth; (2) all portions of the Webb and Sweetwater Creek drainage systems where flows are altered by the LOP; (3) Lapwai Creek from its confluence with Sweetwater Creek, downstream to its mouth at the Clearwater River, and (4) the mainstems of the Clearwater River downstream of Lapwai Creek, the Snake River downstream of Captain John Creek to its confluence with the Columbia River, and the Columbia River downstream of the Snake River to the Pacific Ocean. The hydrologic unit codes (HUC) encompassing the action area are: 17060306 (Clearwater River), 17060103 (Lower Snake River - Asotin), 170601 (Lower Snake River), 170701 (Middle Columbia River), and 170800 (Lower Columbia River). Although the entire action area encompasses the Lower Snake, Middle Columbia, and the Lower Columbia Rivers, the effects of BOR's proposed action on flow velocities and depths are negligible outside the Lapwai Creek and Captain John Creek drainages.

2. ENDANGERED SPECIES ACT

The ESA establishes a national program to conserve threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with U.S. Fish and Wildlife Service, NMFS, or both, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats. Section 7(b)(4) requires the provision of an ITS that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) to minimize such impacts.

2.1. Biological Opinion

This Opinion presents NMFS' review of the status of each listed species of Pacific salmon and steelhead[1] considered in this consultation, the condition of designated critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects (50 CFR 402.14(g)). For the jeopardy analysis, NMFS analyzes those combined factors to conclude whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the affected listed species.

The critical habitat analysis determines whether the proposed action is likely to destroy or adversely modify designated critical habitat for listed species by examining any change in the conservation value of the essential features of that critical habitat. This analysis relies on statutory provisions of the ESA, including those in section 3 that define "critical habitat" and "conservation," in section 4 that describe the designation process, and in section 7 that sets forth the substantive protections and procedural aspects of consultation. The regulatory definition of "destruction or adverse modification" at 50 CFR 402.02 is not used in this Opinion.

In their BA, the BOR made a "no effect" determination for Snake River spring/summer Chinook salmon and their designated critical habitat. The BOR did not make any determination of effect calls for fall Chinook salmon, sockeye salmon, and all other downriver populations of Columbia River salmon and steelhead. Because the proposed action withdraws water from Captain John Creek and from Webb and Sweetwater Creeks, NMFS does not agree with the "no effect" call or the lack of determinations by the BOR. In addition, the BOR did not make a determination of effect for listed Snake River Basin steelhead and their designated critical habitat. However, based on BOR's analysis of effects for Snake River Basin steelhead in the BA and their request for a biological opinion, NMFS has made the assumption that the determination of effect made by BOR was "may affect, likely to adversely affect" listed Snake River Basin steelhead and their designated critical habitat. Therefore, NMFS has analyzed the LOP actions for their potential effects on these species and their designated critical habitat within this Opinion.

The purpose of this Opinion is to determine if BOR has ensured that the proposed future operation and maintenance of the LOP is not likely to jeopardize the continued existence of ESA-listed species or result in the destruction or adverse modification of critical habitat, as required under section 7(a)(2) of the ESA.

2.1.1. Status of the Species and Critical Habitat

This section defines the biological requirements of each listed species affected by the proposed action, and the status of designated critical habitat relative to those requirements. Listed species facing a high risk of extinction and critical habitats with degraded conservation value are more vulnerable to the aggregation of effects considered under the environmental baseline, the effects of the proposed action, and cumulative effects. Conversely, listed species facing a lower risk of extinction and critical habitats with better conservation value are less vulnerable to the

[1] An 'evolutionarily significant unit' (ESU) of Pacific salmon (Waples 1991) and a 'distinct population segment' (DPS) of steelhead (final FR notice) are considered to be 'species,' as defined in section 3 of the ESA.

aggregation of effects considered under the environmental baseline, the effects of the proposed action, and cumulative effects. Documents describing the listing status, critical habitat and descriptions of salmon and steelhead life histories are summarized in Table 4.

Table 4. Federal Register notices for final rules that list threatened and endangered species, designate critical habitats, or apply protective regulations to listed species considered in this consultation.

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon (*Oncorhynchus tshawytscha*)			
Snake River spring/summer run	T 6/28/05; 70 FR 37160	10/25/99; 64 FR 57399	6/28/05; 70 FR 37160
Snake River fall run	T 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	6/28/05; 70 FR 37160
Steelhead (*Oncorhynchus mykiss*)			
Snake River Basin	T 1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Sockeye salmon (*Oncorhynchus nerka*)			
Snake River	E 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	ESA section 9 applies

Note: Listing status: 'T' means listed as threatened and 'E' means listed as endangered under the ESA

2.1.1.1. Steelhead Life History

The listed Snake River Basin steelhead DPS includes all natural-origin populations of anadromous *O. mykiss* in the Snake River Basin of southeast Washington, northeast Oregon, and Idaho downstream from long-standing barriers, and six hatchery stocks, including Dworshak National Fish Hatchery and rearing facilities in Lolo Creek.

Steelhead are anadromous fish that spawn in freshwater streams and mature in the ocean. All salmonid species, including steelhead, are cold-water species (e.g. Magnuson et al. 1979) that survive in a relatively narrow range of temperatures, which limits the species distribution in fresh water to northern latitudes and high elevations. Adult Snake River Basin steelhead return to mainstem rivers from late summer through fall, where they hold in larger rivers for several months before moving upstream into smaller tributaries. Steelhead live primarily off stored energy during the holding period, with little or no active feeding (Pauley et al. 1986; Shapovalov and Taft 1954). Adult dispersal toward spawning areas varies with elevation, with the majority of adults dispersing into tributaries from March through May, with earlier dispersal at lower elevations, and later dispersal at higher elevations. Spawning begins shortly after fish reach spawning areas, which is typically during a rising hydrograph and prior to peak flows (Thurow 1987). Steelhead typically select spawning areas at the downstream end of pools, in gravels ranging in size from 0.5 to 4.5 inches in diameter (Pauley et al. 1986). Juveniles emerge from redds in 4 to 8 weeks, depending on temperature. After emergence, fry have poor swimming ability. Steelhead fry initially move from the redds into shallow, low velocity areas in side channels and along channel margins to escape high velocities and predators (Everest and Chapman 1972), and progressively move toward deeper water as they grow in size (Bjornn and Rieser 1991). Juveniles typically reside in fresh water for 2 to 3 years, or longer, depending on temperature and growth rate (Mullan et al. 1992). Juvenile steelhead in the action area appear to reside in fresh water for no more than 2 years, based on the absence or low numbers of *O. mykiss* greater than 2 years of age in inventories by Chandler and Richardson (2005), Kucera and Johnson (1986), and Fuller et al. (1984). Smolts migrate downstream during spring runoff, which occurs from March to mid-June in the Snake River Basin, depending on elevation.

Anadromous Snake River Basin steelhead exhibit two distinct morphological forms, identified as "A-run" and "B-run" fish, which are distinguished by differences in body size, run timing, and length of ocean residence. B-run fish predominantly reside in the ocean for 2 years, while A-run steelhead typically reside in the ocean for 1 year. As a result of differences in ocean residence time, B-run steelhead are typically larger than A-run fish. The smaller size of A-run adults allows them to spawn in smaller headwater streams and tributaries. The differences in the two fish stocks represent an important component of phenotypic and genetic diversity of the Snake River Basin steelhead DPS through the asynchronous timing of ocean residence, segregation of spawning in larger and smaller streams, and possible differences in the habitats of the fish in the ocean. Steelhead most directly affected by the proposed action are those in Sweetwater, Webb, and Lapwai Creeks and are A-run steelhead, with a 3 to 4 year life cycle.

2.1.1.2. Chinook Salmon Life History

Chinook salmon exhibit a variety of complex life history patterns that include variation in age at seaward migration; length of freshwater, estuarine, and oceanic residence; ocean distribution; ocean migratory patterns; and age and season of spawning migration. Two distinct races of Chinook salmon are generally recognized: "stream-type" and "ocean-type" (Healey 1991; Myers et al. 1998). Snake River spring/summer Chinook salmon exhibit a stream-type life history and Snake River fall Chinook salmon exhibit an ocean-type life history.

Stream-type Chinook adults return to natal streams several months prior to spawning in spring or summer. They typically reside in fresh water for 2 years following emergence, reside in the ocean for 2 to 3 years, and exhibit extensive offshore ocean migrations. Stream-type Chinook typically spawn in moderate to large-sized streams in shallow gravel bars at the downstream end of pools. During freshwater rearing, juvenile Chinook disperse into tributary streams near their natal streams, and are often concentrated near the mouths of stream confluences. Habitats used by juvenile stream-type Chinook salmon and their feeding habits are similar to those described for steelhead. In general, Chinook salmon tend to occupy streams with lower gradients than steelhead, but there is considerable overlap between the distributions of the two species.

Ocean-type Chinook adults return to natal streams within a few days to weeks before spawning in the fall. These fish typically begin downstream migration within a few days following emergence, reside in fresh water for no more than 3 months, and reside in coastal ocean waters 3 to 4 years before maturing. Ocean-type Chinook typically spawn in large mainstem rivers such as the Clearwater and Snake Rivers, and construct redds in coarse gravel areas where there is upwelling or high intergravel flow.

2.1.1.3. Sockeye Salmon Life History

The Snake River sockeye salmon (*O. nerka*) is listed as endangered under the ESA, and is the most imperiled species in the northwest region and the Columbia River Basin. Adult sockeye salmon enter the Columbia River in late-May through July and normally pass Bonneville Dam from June 1 to July 31, and Lower Granite Dam from June 25 to August 30, on their 900-mile migration to their spawning grounds of the Upper Salmon River near Stanley, Idaho. Adult Snake River sockeye salmon arrive at Redfish Lake in August and September. The adults are lake spawners and make their redds along the lake shoals. Juveniles typically utilize lake-rearing areas for 1 to 3 years after emergence from the gravel.

Juvenile sockeye migrate from the Sawtooth Valley lakes during late April through May. Pit-tagged smolts from Redfish Lake generally pass Lower Granite Dam during mid-May to mid-July. Anadromous sockeye may spend from 1 to 4 years in the ocean before returning to fresh water to spawn. Although sockeye are primarily anadromous, there are populations that spend their entire life cycle in fresh water without a period in the ocean.

Historically, Snake River sockeye salmon spawned in five lakes (Alturas, Stanley, Redfish, Yellow Belly, and Pettit Lakes) near Stanley, Idaho and the headwaters of the Salmon River, Big Payette Lake in central Idaho, and Wallowa Lake in eastern Oregon (Waples *et al.* 1991; Good *et al.* 2005). Payette Lakes and Wallowa Lake are blocked to sockeye by hydropower or irrigation dams (Chapman *et al*. 1990). Sockeye access to the Payette basin was eliminated in 1923 with the construction of Black Canyon Dam. The Sunbeam Dam on the Salmon River blocked sockeye from Redfish Lake and all other lakes in the Upper Salmon River from 1910 to 1934, but eyewitness accounts document spawning sockeye in Redfish Lake prior to dam removal in 1934. Waples *et al.* 1991 concluded that the original sockeye gene pool still existed and was distinct from kokanee. Irrigation diversions in Alturas Lake Creek eliminated return of sockeye to Alturas Lake. In 1997, the Idaho Department of Fish and Game (IDFG) removed the irrigation diversion to help with reintroduction efforts to Alturas Lake.

2.1.1.4. Status of the Species.

NMFS reviews the condition of the listed species affected by the proposed action using criteria that describe a 'viable salmonid population' (VSP) (McElhany *et al*. 2000). Attributes associated with a VSP include abundance, productivity, spatial structure, and genetic diversity that maintain its capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle, characteristics that are influenced, in turn, by habitat and other environmental conditions. A viable salmonid population is one that has sufficient abundance and spatial distribution to be able to withstand population downturns and catastrophic events. The TRT used the VSP concept to develop specific recovery criteria based on VSP parameters.

2.1.1.4.1. Snake River Basin Steelhead DPS Status and Trends. Snake River Basin steelhead were listed as threatened on August 18, 1997 (62 FR 43937). The listing was revised on January 5, 2006 (71 FR 834), after a review of relationship of wild steelhead with hatchery fish and resident *O. mykiss*. The revised Snake River Basin steelhead DPS includes all natural-origin populations of steelhead in the Snake River Basin of southeast Washington, northeast Oregon, and Idaho, and six hatchery stocks, including fish from the Dworshak National Fish Hatchery and the rearing facilities in Lolo Creek.

Information on the range-wide status of Snake River Basin steelhead is described in the steelhead status review (Busby *et al.* 1996), the status review update (BRT 2003), the DPS listing (January 5, 2006, 71 FR 834), the U.S. v. Oregon decision and its Supplemental Comprehensive Analysis (SCA) (NMFS 2008a), and the most recent status assessment update by Cooney (2010).

The SCA (NMFS 2008a) contains some of the most recent status and trend information available for salmon and steelhead and NMFS incorporates it into this Opinion by reference. Some portions particularly important to this Opinion have been excerpted directly into the Opinion.

The Snake River Basin steelhead DPS includes all anadromous populations that spawn and rear in the mainstem Snake River and its tributaries between Ice Harbor and the Hells Canyon hydro complex. Snake River Basin steelhead is a threatened species composed of 24 extant anadromous populations in five major population groups (MPGs) as listed in Table 5 (information from Cooney 2010).

Table 5. Characteristics of MPGs and independent populations for the Snake River Basin steelhead DPS.

MPG	Population	Life History	Size & Complexity	Threshold Abundance	Minimum Productivity	Population Viability Rating
Lower Snake	Tucannon	A-Run	Intermediate	1,000	1.2	High Risk
	Asotin	A-Run	Intermediate	1,000	1.14	High Risk
Imnaha River	Imnaha River	A-Run	Intermediate	1,000	1.15	Maintained
Grande Ronde	Upper Mainstem	A-Run	Large	1,500	1.10	Maintained
	Lower Mainstem	A-Run	Intermediate	1,000	1.14	Viable/Maint.
	Joseph Creek	A-Run	Basic	500	1.27	Highly Viable
	Wallowa River	A-Run	Intermediate	1,000	1.15	Maintained
Clearwater River	Lower Mainstem River	A-Run	Large	1,500	1.14	Maintained
	North Fork Clearwater	B-Run	Very Large	-	-	Extirpated
	Lolo Creek	A & B-Run	Basic	500	1.14	High Risk
	Lochsa River	B-Run	Intermediate	1,000	1.14	High Risk
	Selway River	B-Run	Intermediate	1,000	1.14	High Risk
	South Fork Clearwater	B-Run	Intermediate	1,000	1.14	High Risk
Salmon River	Little Salmon/Rapid	A-Run	Basic	500	1.27	Maintained
	Chamberlain Creek	A-Run	Basic	500	1.27	High Risk
	Secesh River	B-Run	Basic	500	1.27	High Risk
	South Fork Salmon	B-Run	Intermediate	1,000	1.14	High Risk
	Panther Creek	A-Run	Basic	500	1.27	High Risk
	Lower Middle Fork	B-Run	Intermediate	1,000	1.14	High Risk
	Upper Middle Fork	B-Run	Intermediate	1,000	1.14	High Risk
	North Fork	A-Run	Basic	500	1.27	Maintained
	Lemhi River	A-Run	Intermediate	1,000	1.14	Maintained
	Pahsimeroi River	A-Run	Intermediate	1,000	1.14	Maintained
	East Fork Salmon	A-Run	Intermediate	1,000	1.14	Maintained
	Upper Mainstem	A-Run	Intermediate	1,000	1.14	Maintained

Figure 2 shows the geographical range of the Snake River Basin steelhead DPS, the locations of the MPGs and the individual populations. All populations in this DPS return in the summer and are therefore referred to as “summer-run” in contrast to “winter-run” steelhead in some other DPSs. Steelhead are an anadromous form of rainbow trout. Inland steelhead in the Columbia River Basin are commonly referred to as either A-run or B-run, based on migration timing and differences in age and size at return. A-run steelhead are believed to occur throughout the steelhead streams in the Snake River Basin, and B-run are thought to produce only in the Clearwater and Salmon Rivers.

Designated critical habitat for Snake River Basin steelhead includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake Rivers as well as specific stream reaches in a number of tributary subbasins. Key statistics associated with the current status of Snake River Basin steelhead are summarized in Tables 8.5.2-1 through 8.5.2-4 of the SCA (NMFS 2008a) and Appendix B1 as found in Cooney (2010).

Limiting Factors and Threats

Limiting factors identify the most important limitations in the biological requirements of the species. Historically, the key limiting factors for the Snake River Basin steelhead include hydropower projects, predation, harvest, hatchery effects, and tributary habitat. Ocean conditions have also affected the status of this DPS. These generally have been poor over at least the last 20 years, improving only in the last few years. Limiting factors are discussed in more detail in the context of critical habitat in this Opinion.

Abundance

Population-specific adult population abundance is generally not available for Snake River Basin steelhead due to difficulties conducting surveys in much of their range. However, to supplement the few population-specific estimates that are available, the Interior Columbia Technical Recovery Team (TRT) used Lower Granite Dam counts of A-run and B-run steelhead and apportioned those to A-run and B-run populations proportional to intrinsic potential habitat (Cooney 2010). The TRT generated 10-year geometric mean abundance estimates for two populations in the Grande Ronde MPG and reported average A-run and average B-run abundance as an indicator for the other populations. Abundance data for individual populations and MPGs for the Snake River Basin steelhead DPS are further discussed in Cooney (2010).

Figure 3 shows the 1975 to most recent abundance and 5-year trend averages for the aggregate of all steelhead populations above Lower Granite Dam. The yearly returns have been increasing since 1975, with peaks in 1986, 1989, and 1992, and very strong peaks in 2001 and 2009. The 2009 adult return was substantially higher than any return during the 1975 to 2009 period. The 5-year trend average has also been steadily increasing, with a general increase beginning about 1980, and then a stronger increase beginning in 2001. Natural-origin adults have experienced a similar increase in yearly returns.

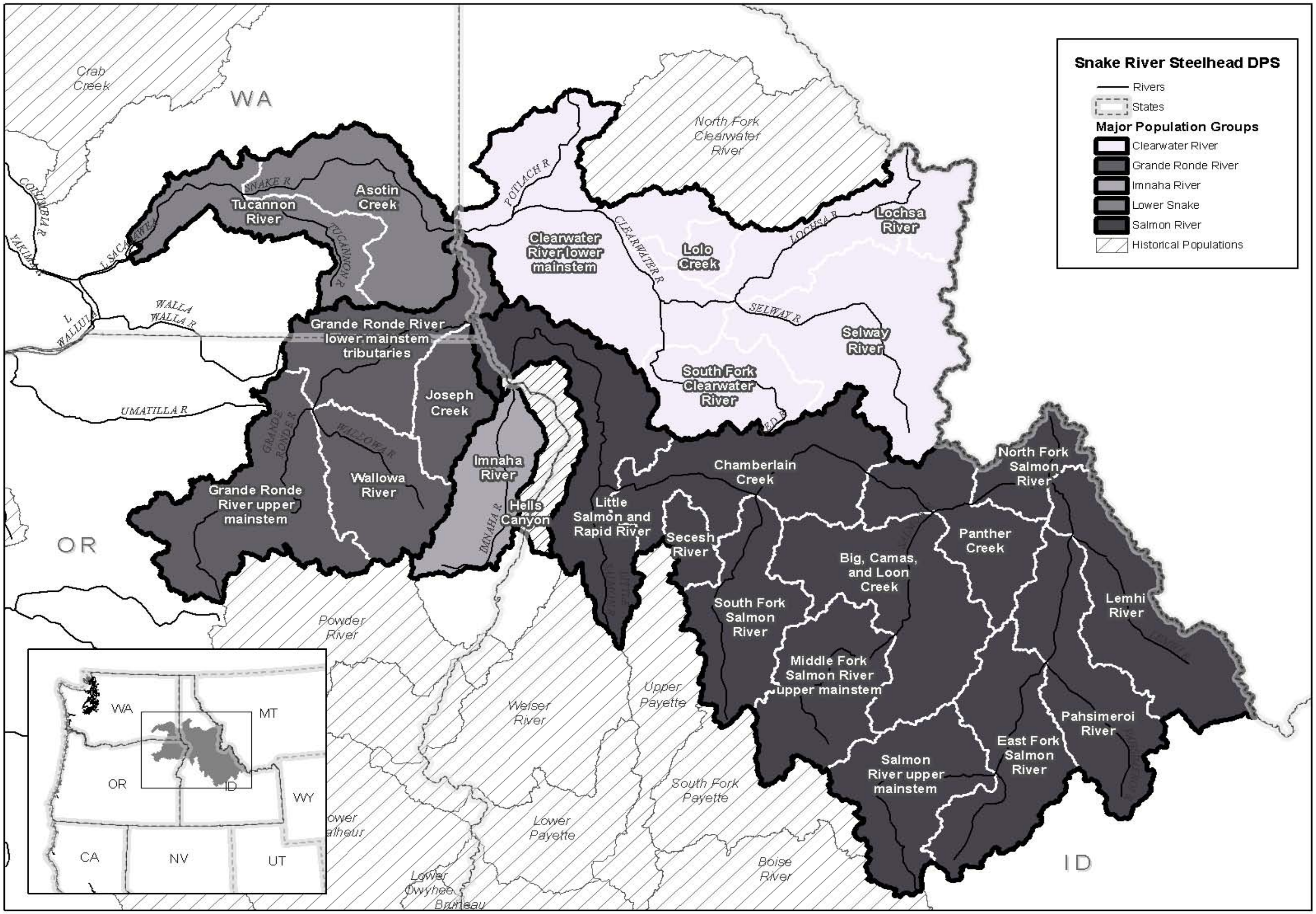


Figure 2. Map showing locations of MPGs and individual populations of Snake River steelhead DPS

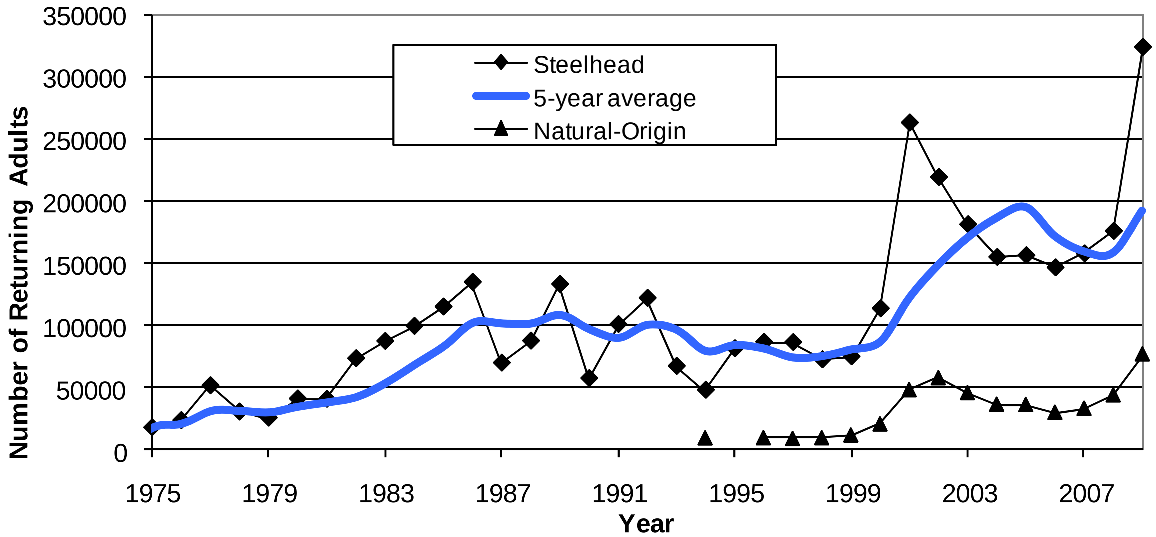


Figure 3. Snake River Basin Steelhead DPS Abundance and 5-Year Average at Lower Granite Dam

Productivity

The population growth rate, or lambda (λ), was used by McClure et al. (2003) and Cooney (2003) to determine whether the Snake River Basin steelhead DPS is increasing in numbers (λ >1) or decreasing (λ <1). Lambda, when measured over multiple generations, is a key component of population viability analysis; values less than one signal that a species is heading toward extinction.

On average for over 20 full brood year returns (~1980 to 1999 brood years, including adult returns through ~2004), A-run Snake River Basin steelhead populations have replaced themselves (SCA, Table 8.5.2-1) when only natural production is considered (i.e., average recruit/spawner (R/S) has been >1.0), while B-run steelhead have not. Adult returns from 2005 to 2009 have continued to show higher return trends. In order to ensure that the distribution of productivity estimates among MPGs is clearly stated, the SCA (Table 8.5.2-1) displays the average A-run and B-run Snake River Basin steelhead productivities applied to each individual population. In general, R/S productivity was relatively high during the early 1980s, low during the late 1980s and 1990s, and high again in recent brood years (brood year R/S estimates in TRT Current Status Summaries (Cooney 2010). The 10-year average of all adult steelhead passing Lower Granite Dam from 2000 to 2009 is 188,715 adults while the 10-year average for natural-origin steelhead for the same period is 42,576 adults (FPC 2009). The latest 10-year averages have increased significantly by higher returns since 2001, and particularly by the 2009 run, which had 323,388 total steelhead and 76,121 natural-origin steelhead crossing Lower Granite Dam.

In summary, the base period trend in abundance has been stable or increasing for both A-run and B-run populations, as indicated by the population growth rate and BRT trend (SCA, Table 8.5.2-1). The one exception is the Upper Grande Ronde population, which has a lambda slightly less than 1.0 (0.99) when estimated under the assumption that effectiveness of hatchery-origin and natural-origin spawners is equal. For B-run Snake River Basin steelhead populations, however, natural survival rates are not sufficient for spawners to replace themselves each generation, as indicated by average R/S estimates <1.0, even though abundance has been increasing.

The current status summaries (Cooney 2010) characterize the long-term (100 year) extinction risk, calculated from productivity and natural origin abundance estimates of populations for R/S productivity estimates, as "High" (>25% 100-year extinction risk) for all eight B-run populations and three (of 16) A-run populations. The TRT (Cooney 2010) defines the quasi-extinction threshold (QET) for 100-year extinction risk as fewer than 50 spawners in four consecutive years in these analyses (QET=50). Most A-run populations are characterized as having "moderate" risk (6% to 25% 100-year extinction risk). One A-run population in the Grande Ronde MPG (Joseph Creek) is characterized as having a "very low" risk of long-term extinction (<1% risk).

Ocean productivity and climate cycles also appear to play key roles in population trends (Tolimieri and Levin 2004, Mantua *et al.* 1997). For example, large-scale climatic regimes, such as El Niño, appear to affect changes in ocean productivity and influence local environmental rainfall patterns that can result in drought and fluctuating flows. Snake River Basin anadromous fish are affected by climate-based environmental cycles; thus, the survival and recovery of these species may depend on their ability to persist through periods of low natural survival rates. The effects of possible climate change are unknown; however, the present trends in population have been improving and should help preclude extinction of wild-origin Snake River salmon and steelhead.

Spatial Structure

The TRT characterizes the spatial structure risk of nearly all Snake River Basin steelhead populations as "very low" or "low" (SCA, Table 8.5.2-2), with the exception of Panther Creek which has a "high" risk due largely to past mining operations.

Diversity

The TRT characterizes the diversity risk of all Snake River Basin steelhead populations as "low" or "moderate" (SCA, Table 8.5.2-2).

2.1.1.4.1a. Snake River Basin Steelhead MPGs Status and Trends. The two MPGs within the Snake River Basin steelhead DPS that the LOP directly withdraws water from are the Lower Snake River MPG and the Clearwater River MPG; those two MPGs are discussed below. Information for the other three Snake River Basin steelhead MPGs is found in the status summary as updated in Cooney (2010).

Lower Snake River MPG

The Lower Snake River MPG contains two populations, one must achieve a viable status (5% or less risk of extinction over a 100 year period) and the other must achieve a highly viable status (1% or less risk of extinction over a 100 year period) for the MPG to achieve its recovery goal. Both the Tucannon River and Asotin Creek populations are currently rated as "high" risk (greater than 25% risk of extinction over a 100 year period). The Lower Snake River MPG does not currently meet MPG-level viability criteria. Table 6 shows the VSP risk matrix for independent steelhead populations in the Lower Snake River Basin steelhead MPG (Cooney 2010).

Table 6. VSP risk matrix for independent steelhead populations in the **Lower Snake River Basin** steelhead MPG.

		Spatial Structure/Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
Abundance/ Productivity Risk	**Very Low** (<1%)	HV	HV	V	M
	Low (1-5%)	V	V	V	M
	Moderate (6 – 25%)	M	M	M	HR
	High (>25%)	HR	HR	HR Tucannon River; Asotin Creek	HR

Key: HV – Highly Viable; V – Viable; M – Maintained; HR – High Risk. Shaded cells do not meet viability criteria.
Note – Minimum abundance and productivity values represent levels needed to achieve a 95% probability of persistence over 100 years.

Clearwater River MPG

The Clearwater River MPG contains five extant populations and one extirpated population. The TRT viability criteria recommend that three populations achieve a viable status (5% risk) and one of the populations achieve a highly viable status (1% risk). The Lower Mainstem Population (which includes the Sweetwater and Lapwai drainages and the Lower Clearwater River) must achieve a viable status (5% risk) because it is the only large population in the MPG. It is currently rated a rated as "maintained" (a population with an extinction risk between 6% and 25% over 100 years).

Populations in the Clearwater River MPG were characterized at either "Low" or "Moderate" risk for spatial structure and diversity criteria, a result of the large geographic size of most populations and similar effects operating across the MPG. The spatial structure and diversity risk is sufficiently low for any population to achieve viable status (5% risk), and three populations could potentially achieve highly viable status (1% risk). The composite risk ratings for spatial structure and diversity and viability assessments for the individual populations are summarized in the Clearwater River MPG in Cooney (2010). Table 7 shows the VSP risk matrix for the steelhead populations in the Clearwater River MPG. The Clearwater River MPG does not currently meet MPG-level recovery goal. (Cooney 2010).

Historically, steelhead populations in most of the Clearwater drainage were adversely affected by a partial barrier dam that existed in the mainstem Clearwater River at Lewiston, Idaho, from 1927 to 1973 (Cramer et al. 1998). Another dam existed in the South Fork Clearwater River, near Harpster, Idaho, which was a complete barrier to migratory fish from 1910 to 1935 (Cramer et al. 1998). The effects of present-day dams in the Snake and Columbia Rivers, historic effects of the Harpster and Lewiston dams, and numerous habitat alterations likely have lingering effects on genetic characteristics and productivity of steelhead in the Clearwater River Basin.

Table 7. VSP risk matrix for independent steelhead populations in the Clearwater River steelhead MPG.

		Spatial Structure/Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
Abundance/ Productivity Risk	**Very Low** (<1%)	HV	HV	V	M
	Low (1-5%)	V	V	V	M
	Moderate (6 – 25%)	M	M Lower Mainstem	M	HR
	High (>25%)	HR	HR Lochsa; Selway	HR S. Fork Clearwater; Lolo Creek	HR

Key: HV – Highly Viable; V – Viable; M – Maintained; HR – High Risk. Shaded cells do not meet viability criteria.
Note – Minimum abundance and productivity values represent levels needed to achieve a 95% probability of persistence over 100 years.

There is little available information on historic fish abundance in the Lapwai Creek drainage. Based on the channel morphology, anecdotal accounts of numerous steelhead killed in a flash flood (Lewiston Morning Tribune, April 24 and 25, 1986), and operation of a Tribal steelhead snag fishery in Mission Creek until about 30 years ago (Johnson and Stangl 2000), the Lapwai Creek drainage likely produced larger numbers of anadromous fish in the past. Johnson and Stangl (2000) describe Mission Creek, which is upstream of and slightly smaller than Sweetwater Creek, as providing spawning and rearing habitat for steelhead from its mouth upstream to a natural falls at stream mile 8.7. They also note that it historically was a major spawning area for anadromous fish. Recent studies by the Tribe (e.g. Chandler 2004; Chandler and Richardson 2006) document the presence of steelhead in Upper Lapwai, Mission, Webb, and Sweetwater Creeks, and their studies also document the presence of *O. mykiss* in the stream sections above the Sweetwater Dam.

Table 8 shows that minimum summer bypass flows were consciously provided starting in 2004, and then only in Sweetwater Creek until 2009. Prior to that, flows in either creek occurred only when the LOP was not operating, when there was an amount of inflow below the diversion dams to supply flows, or when there was such an abundant supply of water that the LOP did not capture it all. Yet, despite discontinuous flows and the streambeds periodically going dry in Webb and Sweetwater Creeks, Snake River Basin steelhead continued to persist in the Lapwai Creek watershed.

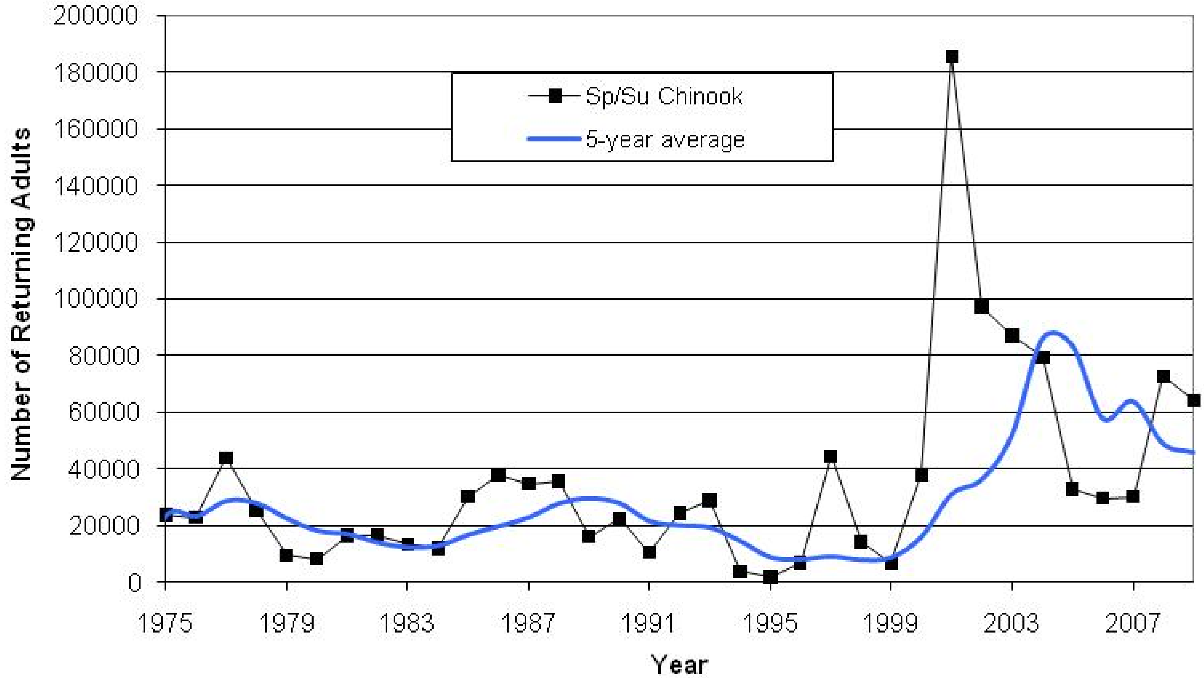
Table 8. Minimum Summer Bypass Flows for Webb and Sweetwater Creeks from approximately 1916 through the present proposed action.

Years	Minimum Summer Bypass Flows (cfs)		Total Minimum Bypass Flows (cfs)
	Webb Creek @ dam	Sweetwater @ dam	
~ 1916 to 2003	0	0	0
2004[1]	0	See Note 1	-
2005[2]	0	See Note 2	-
2006	0	1.0	1.0
2007[3]	0	1.2	1.2
2008	0	2.0	2.0
2009	0.4	2.2	2.6
2010	1.0	2.5	3.5

[1] For 2004, this was a voluntary release beginning 8/12/04 resulting in highly variable flows ranging from 0.13 to 3.1 cfs in August and 0.21 to 8.9 cfs in September. (http://waterdata.usgs.gov/id/nwis/)
[2] For 2005, this was a voluntary release resulting in highly variable flows ranging from 0.04 to 2.6 cfs in July, 0.43 to 2.1 cfs in August and 0.16 to 4.7 cfs in September. (http://waterdata.usgs.gov/id/nwis/)
[3] For 2007, an additional 0.2 cfs was provided to Sweetwater Creek because of water savings from canal lining. Also, the consistency of flows improved due to gate automation at the Sweetwater diversion dam.

2.1.1.4.2. Snake River Spring/Summer Chinook Salmon Status and Trends. Historically, the Snake River drainage is thought to have produced more than 1.5 million adult spring/summer Chinook salmon in some years during the late 1800s (Matthews and Waples 1991). By the 1950s, the abundance of spring/summer Chinook had declined to an annual average of 125,000 adults, and continued to decline through the 1970s. Returns were variable through the 1980s, but declined further in the 1990s. In 1995, only 1,797 spring/summer adults returned. Returns at Lower Granite Dam (hatchery and wild fish combined) dramatically increased after 2000, with 185,693 adults returning in 2001. The large increase in 2001 was due primarily to hatchery returns, with only 10% of the returns from fish of natural origin. Large returns in recent years may be a result of cyclic ocean and climatic conditions favorable to anadromous fish, as described above for steelhead. Figure 4 shows the number of spring/summer Chinook salmon crossing Lower Granite Dam from 1975 through 2009.

Figure 4. Number of spring/summer Chinook salmon crossing Lower Granite Dam from 1975 to 2009.



The causes of oscillations are uncertain, but may be due to a combination of factors, including unfavorable ocean conditions and an increase in predation by marine mammals (Varanasi 2005). Various Federal and state agencies are taking measures to help control predation effects and populations of seals, sea lions, and fish-eating birds, but speculating on the long-term results of such efforts would be premature. Over the long term, population size is affected by a variety of factors, including harvest; increased predation in riverine and estuarine environments altered by Snake and Columbia River Dams; increased smolt mortality from poor downstream passage conditions; competition with hatchery fish; and widespread alteration of spawning and rearing habitats. Spawning and rearing habitats are commonly impaired in places from factors such as agricultural tilling, water withdrawals, sediment from unpaved roads, timber harvest, grazing, mining, and alteration of floodplains and riparian vegetation. Climate change is also recognized as a possible factor in Snake River salmon declines (Scheuerell and Williams 2005, Tolimieri and Levin 2004).

The general trend in adult salmon returns from 1975 to 1999 was a gradual population decline with episodic oscillations. McClure *et al.* (2003) estimated the mean population growth rate from 1965 through 2000 for spring/summer Chinook salmon to be from 0.93 to 0.97, depending on the amount of error from hatchery fish counted as wild fish. A population growth rate slightly less than one is characteristic of a gradual decline in population size, where the population will eventually become extinct unless factors causing the decline are remedied. However, since the year 2000 and since McClure's (2003) work, there have been a number of years with higher spring/summer Chinook returns, and the 5-year average (2005-2009) has risen to 45,895 adults over Lower Granite Dam. The SCA (NMFS 2008a) states that abundance has been stable or increasing on average over the last 20 years.

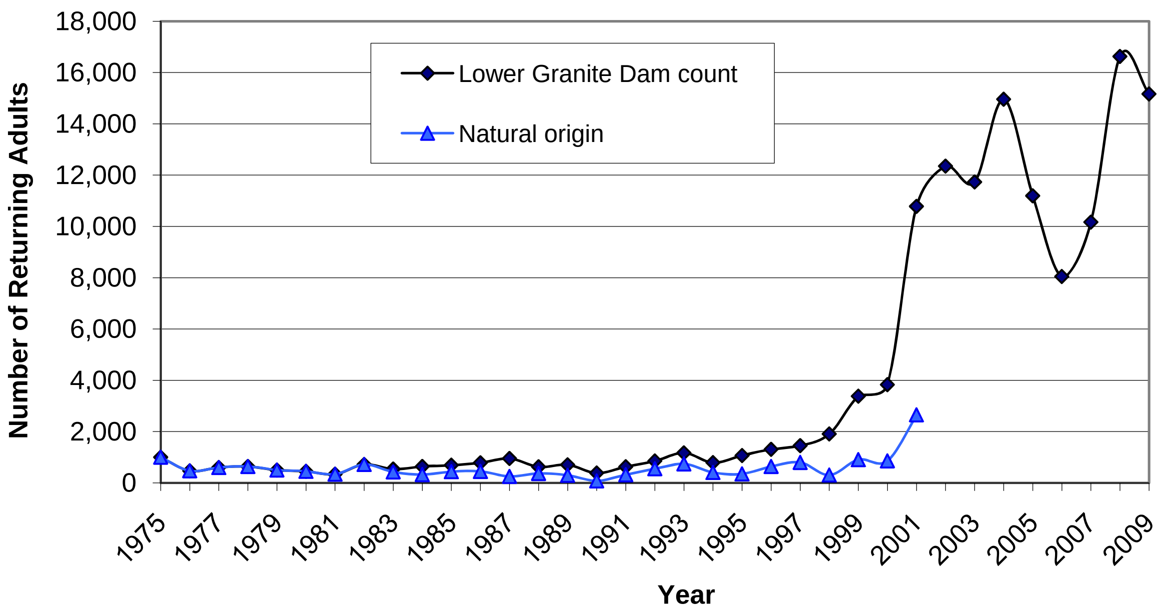
The forecast for 2010 is for a dramatic increase to 470,000 spring/summer Chinook salmon to the Columbia River, which would be the largest return since 1938. The Technical Advisory Committee used seven models that generated a range of predicted run sizes from 366,000 to 528,000 adults. The number of jack Chinook salmon that returned in 2009 was four times greater than any before. Jack salmon are immature, precocious males that return after just 1 or 2 years in the ocean and their return numbers have been used, in the past, to model overall returns.

2.1.1.4.3. Snake River Fall Chinook Salmon Status and Trends. Snake River fall Chinook salmon spawning and rearing occurs only in larger, mainstem rivers, such as the Salmon, Snake, and Clearwater Rivers. Historically, the primary fall-run Chinook salmon spawning areas were located on the upper mainstem Snake River (Connor *et al*. 2005). A series of Snake River mainstem dams blocks access to the Upper Snake River, which has significantly reduced spawning and rearing habitat for Snake River fall-run Chinook salmon. Swan Falls Dam, constructed in 1901, was the first barrier to upstream migration in the Snake River, followed by the Hells Canyon Complex beginning with Brownlee Dam in 1958, Oxbow Dam in 1961, and Hells Canyon Dam in 1967. Currently, natural spawning is limited to the Snake River from the upper end of Lower Granite Reservoir to Hells Canyon Dam; the lower reaches of the Imnaha, Grande Ronde, Clearwater, Salmon, and Tucannon Rivers; and small areas in the tailraces of the Lower Snake River hydroelectric dams (Good *et al*. 2005). The vast majority of spawning today occurs upstream of Lower Granite Dam, with the largest concentration of spawning sites in the Clearwater River, downstream from Lolo Creek, and in the Salmon River upstream to the confluence with the Little Salmon River.

As a consequence of losing access to historic spawning and rearing sites in the Upper Snake River, fall Chinook salmon now reside in waters that are generally cooler than the majority of historic spawning areas. In addition, alteration of the Lower Snake River by hydroelectric dams has created a series of low-velocity pools in the Snake River that did not exist historically. Both of these habitat alterations have created obstacles to fall Chinook survival. Prior to alteration of the Snake River Basin by dams, fall Chinook salmon exhibited a largely ocean-type life history, where they migrated downstream and reared in the mainstem Snake River during their first year. Today, fall Chinook salmon in the Snake River Basin exhibit one of two life histories that Connor *et al*. (2005) have called ocean-type and reservoir-type. The reservoir-type life history is one where juveniles overwinter in the pools created by the dams, prior to migrating out of the Snake River. The reservoir-type life history is likely a response to early development in cooler temperatures, which prevents juveniles from reaching a suitable size to migrate out of the Snake River.

The current condition of Snake River fall Chinook is described in Good *et al.* (2005) and TRT (2003). The Snake River fall Chinook salmon ESU does not meet the ESU-level viability criteria (the non-negligible risk of extinction over 100-year time period), based on current abundance and productivity information, but recent numbers are approaching the delisting criteria. This ESU has been reduced to a single remnant population with a narrow range of available habitat. The overall adult abundance has been increasing significantly beginning in 2000 (Figure 5). The 10-year average (2000 to 2009) over Lower Granite Dam has risen to 11,486 compared to the previous decade (1990 to 1999) average of 1,295. Fall Chinook redd counts have risen from only 46 redds counted in 1991 to modern-day record counts of 1,819 in 2008 and 1,895 in 2009 for the mainstem Snake River between Asotin, Washington, and Hells Canyon Dam (CBB 2009).

Figure 5. Numbers of fall Chinook salmon crossing Lower Granite Dam from 1975 to 2009.



Hatchery fish seem to be faring better than wild fish, and productivity may be sustained largely by a system of small artificial rearing facilities in the Lower Snake River Basin. Hatcheries affect ESU genetics due to three major components: (1) Natural origin fish (which may be progeny of hatchery fish), (2) returns of Snake River fish from the Lyons Ferry Hatchery program, and (3) strays from hatchery programs outside the Snake River. Phenotypic characteristics have shifted in apparent response to environmental changes from hydroelectric dams (Connor *et al.* 2005).

2.1.1.4.4. Snake River Sockeye Salmon Status and Trends. The Snake River sockeye salmon ESU includes all anadromous and residual sockeye from the Snake River Basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program. The Snake River sockeye salmon ESU is comprised of a single MPG and single population that spawns and rears in Redfish, Pettit, and Alturas lakes in the Sawtooth Valley. This population is the last remaining in a group of what were likely to have been independent populations occupying the Sawtooth Valley lakes. The Snake River sockeye ESU was listed as endangered in 1991 and this was reaffirmed in 2005.

The designated critical habitat for Snake River sockeye salmon includes all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas lakes (including their inlet and outlet creeks); Alturas Lake Creek; and that portion of Valley Creek between Stanley and Lake Creek and the Salmon River.

Sockeye salmon were historically numerous in many areas of the Snake River Basin. However, intense commercial harvest of sockeye along with other salmon species beginning in the mid-1880s; the existence of Sunbeam Dam as a migration barrier between 1910 and the early 1930s; the eradication of sockeye from Sawtooth Valley lakes in the 1950s and 1960s; the development of mainstem hydropower projects on the Lower Snake and Columbia Rivers in the 1970s and 1980s; and poor ocean conditions in 1977 through the late 1990s probably combined to reduce the stock to a very small remnant population.

This species has a very high risk of extinction. Between 1991 and 1998, all 16 of the natural origin adult sockeye salmon that returned to the weir at Redfish Lake were incorporated into the Redfish Lake Captive Broodstock Program for Redfish and the other Sawtooth Valley lakes. The program has used multiple rearing sites to minimize chances of catastrophic loss of broodstock and has produced several hundred thousand eggs and juveniles, as well as several hundred adults, for release. The program has been successful in its goals of preserving important lineages of Redfish Lake sockeye salmon for genetic variability and in preventing extinction in the near term.

By the time Snake River sockeye were listed in 1991, the species had declined to the point that there was no longer a self-sustaining, naturally-spawning anadromous sockeye population. It is not yet clear whether the existing population retains sufficient genetic diversity to successfully adapt to the range of variable conditions that occur within its natural habitat. The broodstock program reduces the risk of domestication by using a spread-the-risk strategy by outplanting prespawning adults and fertilized eyed eggs, as well as juveniles raised in the hatchery.

A variety of human-caused and natural factors have contributed to the decline of Snake River sockeye salmon over the past century and have decreased the conservation value of essential features and PCEs of their designated critical habitat. Factors affecting the conservation value of critical habitat include passage barriers (especially high summer temperatures) in the mainstem Lower Snake and Salmon rivers, passage mortality at the mainstem Federal Columbia River Power System (FCRPS) dams, and high sediment loads in the upper reaches of the mainstem Salmon River.

Key factors limiting the function and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Juvenile and adult passage mortality *[hydropower projects in the mainstem Lower Snake and Columbia Rivers]*

- Juvenile and adult mortality in the lower Snake River above Lower Granite Dam and in the mainstem Salmon River *[water withdrawals, temperature, and degraded riparian conditions]*

The TRT has designated this species as very high risk. The extremely low number of natural spawners and reliance on the captive broodstock program illustrates the high degree of risk faced by this population. Although residual sockeye salmon have been identified in Redfish and Pettit lakes, adults produced through the captive propagation program support most of the ESU. Sockeye salmon returned in comparatively large numbers in 2008 and 2009. Figure 6 shows the numbers of sockeye salmon crossing Lower Granite Dam from 1975 to 2009.

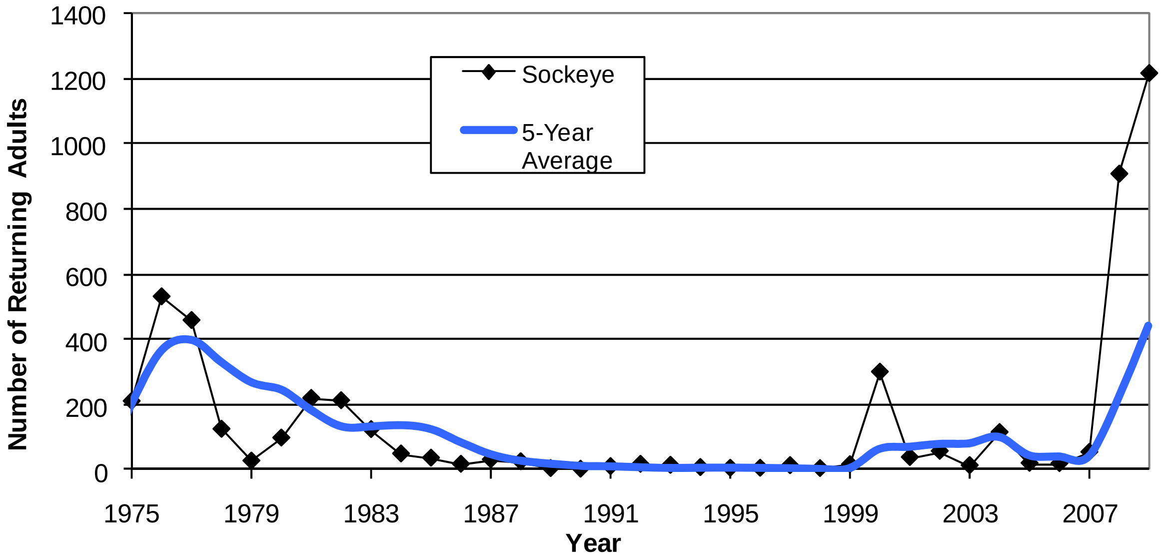


Figure 6. Numbers of sockeye salmon crossing Lower Granite Dam from 1975 to 2009.

2.1.1.4.5. Other Columbia River salmon and steelhead ESUs and DPSs. The action area downstream of the mouths of Captain John Creek and Lapwai Creek includes additional salmon and steelhead populations within the Snake River. It also includes other steelhead DPSs and salmon ESUs in the Columbia River. The status of the species for these populations is included in the SCA (NMFS 2008a). Additionally, flow modifications that result from the LOP were considered in the SCA for all Columbia River anadromous fish. The status section and effects analysis from the SCA were reviewed and no additional information was required to update these sections.

2.1.1.4.6. Summary of Snake River Salmon and Steelhead Status and Trends. In summary, habitat loss and modification are believed to be major factors determining the status of salmonid populations. Conservation and recovery of Pacific Northwest salmon and steelhead depend on having diverse habitats with connections among those habitats. The salmonid life cycle involves adults maturing in the ocean, migrating back to their home streams and spawning, embryos incubating, fry emerging, juveniles growing, and smolts migrating to the estuary to acclimate to saltwater and moving out into the ocean. Each phase may require use of and access to distinct habitats. Loss of habitat reduces the diversity in salmon and steelhead life histories, which influences the ability of these fish to adapt to natural and man-made change. Salmon and steelhead need freshwater habitat that includes:

- Cool, clean water;
- Appropriate water depth, quantity and flow velocities;
- Upland and riparian (stream bank) vegetation to stabilize soil and provide shade;
- Clean gravel for spawning and egg-rearing;
- Large woody debris to provide resting and hiding places;
- Adequate food; and
- Varied channel forms.

Overall, the extinction risk for Snake River salmon and steelhead remains high, but abundance numbers for all four species described in this Opinion have risen significantly over the past decade. Such increases need to be sustained for several generations to diminish the extinction risk and to withstand severe downturns in population size from climate anomalies or other natural events.

2.1.1.5. Status of Critical Habitat

NMFS reviews the status of designated critical habitat affected by the proposed action by examining the condition and trends of primary constituent elements (PCEs) throughout the designated area (Table 9). The PCEs consist of the physical and biological features identified as essential to the conservation of the listed species in the documents that designate critical habitat (see Table 2).

Table 9. Types of sites and essential physical and biological features designated as PCEs, and the species life stage each PCE supports.

Site	Essential Physical and Biological Features	ESA-listed Species Life Stage
Snake River Basin Steelhead[a]		
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity & floodplain connectivity to form and maintain physical habitat conditions	Juvenile growth and mobility
	Water quality and forage[b]	Juvenile development
	Natural cover[c]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[c]	Juvenile and adult mobility and survival
Snake River Spring/summer and Fall Chinook Salmon		
Spawning & Juvenile Rearing	Spawning gravel, water quality and quantity, cover/shelter, food, riparian vegetation, and space	Juvenile and adult.
Migration	Substrate, water quality and quantity, water temperature, water velocity, cover/shelter, food[d], riparian vegetation, space, safe passage	Juvenile and adult.
Snake River Sockeye Salmon		
Spawning & Juvenile Rearing	Spawning gravel, water quality and quantity, water temperature, food, riparian vegetation, and access	Juvenile and adult.
Migration	Substrate, water quality and quantity, water temperature, water velocity, cover/shelter, food[d], riparian vegetation, space, safe passage	Juvenile and adult.

a Additional PCEs pertaining to estuarine, nearshore, and offshore marine areas have also been described for Snake River Basin steelhead. These PCEs will not be affected by the proposed action and have therefore not been described in this Opinion.
b Forage includes aquatic invertebrate and fish species that support growth and maturation.
c Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
d Food applies to juvenile migration only.

Snake River salmon and steelhead have experienced long-term declines in population size since the 1870s, and the present population sizes remain low in comparison to historical estimates. However, salmon and steelhead populations have been on a general increase since about 2000. Steep population declines occurred with construction of hydropower dams in the Snake River. In addition to effects of dams, population declines are attributed to the combined effects of activities that include harvest, hatchery fish, habitat loss and alterations, predator effects, and climatic conditions. Habitat loss from impassable hydropower dams, and streams dried in whole or in part by water withdrawals, sediment, and artificial passage barriers account for most of the losses of freshwater habitat for Snake River salmon and steelhead (Lee et al. 1997). Effects of forestry, mining, roads, urbanization, and agriculture have reduced the quality of much of the remaining salmon and steelhead habitat outside roadless areas (Lee et al. 1997; McIntosh et al. 1994).

Hydropower dams associated with the FCRPS have eliminated access to roughly 600 miles of streams historically accessible to salmon and steelhead. The FCRPS storage dams have eliminated mainstem rearing habitat, and have altered the natural flow regime of the Snake and Columbia Rivers, decreased spring and summer flows, increased fall and winter flows, and altered natural thermal patterns. The eight Snake and Columbia River Dams kill or injure a portion of the smolts passing through the migration corridor area, and the dams create artificial conditions favorable to salmon and steelhead predators, such as terns, sea lions, seals, and northern pikeminnow. The low velocity movement of water through the reservoirs behind the dams slows the smolts' journey to the ocean and enhances the survival of predatory fish (Independent Scientific Group 1996, NRC 1996). Changes in the operation and modifications to the FCRPS dams in the last decade have reduced adverse effects of the dams; however, the dams continue to kill or harm a sizable number of steelhead smolts. In-river mortality through the FCRPS, estimated by Williams et al. (2005) from 1997 to 2003, ranged from 28% to 58% for Snake River spring/summer Chinook and 4% to 50% for Snake River Basin steelhead.

In many Columbia River watersheds, land management and development activities have: (1) Reduced connectivity (i.e., the flow of energy, organisms, and materials) between streams, riparian areas, floodplains, and uplands; (2) elevated fine sediment yields, degrading spawning and rearing habitat; (3) reduced large woody material that traps sediment, stabilizes streambanks, and helps form pools; (4) reduced vegetative canopy that minimizes solar heating of streams; (5) caused streams to become straighter, wider, and shallower, thereby reducing rearing habitat and increasing water temperature fluctuations; (6) altered peak flow volume and timing, leading to channel changes and potentially altering fish migration behavior; and (7) altered floodplain function, water tables and base flows[2] (Henjum et al. 1994; McIntosh et al. 1994; Rhodes et al. 1994; Wissmar et al. 1994; NRC 1996; Spence et al. 1996; and Lee et al. 1997; Ecovista et al. 2003). Ecovista et al. (2003) found all seven of these problems in the Lapwai Creek drainage, and in the Middle Fork and South Fork, and mainstem of the Clearwater River drainage.

Climate change is likely to have negative implications for the conservation value of designated critical habitats in the Pacific Northwest (CIG 2004; Scheuerell and Williams 2005; Zabel et al. 2006; Independent Scientific Advisory Board [ISAB] 2007). Average annual Northwest air temperatures have increased by approximately 1ºC since 1900, or about 50% more than the global average warming over the same period (ISAB 2007). The latest climate models project a warming of 0.1 ºC to 0.6 ºC per decade over the next century. According to the ISAB, these effects may have the following physical impacts within the next 40 or so years:

- Warmer air temperatures will result in a shift to more winter/spring rain and runoff, rather than snow that is stored until the spring/summer melt season.

[2] Base flow is stream discharge sustained only by groundwater, and none of the discharge is from surface runoff.

- With a shift to more rain and less snow, the snowpacks will diminish in those areas that typically accumulate and store water until the spring freshet.

- With a smaller snowpack, these watersheds will see their runoff diminished and exhausted earlier in the season, resulting in lower streamflows in the June through September period.

- River flows in general and peak river flows are likely to increase during the winter due to more precipitation falling as rain rather than snow.

- Water temperatures will continue to rise, especially during the summer months when lower streamflow and warmer air temperatures will contribute to the warming regional waters.

These changes will vary across the landscape. Areas with elevations high enough to maintain temperatures well below freezing for most of the winter and early spring would be less affected. Low-lying areas that historically have received scant precipitation contribute little to total streamflow and are likely to be more affected. These long-term effects may include, but are not limited to, depletion of cold water habitat, variation in quality and quantity of tributary rearing habitat, alterations to migration patterns, accelerated embryo development, premature emergence of fry, and increased competition among species.

2.1.1.5.1. Status of Snake River Basin Steelhead DPS Critical Habitat (as excerpted from SCA, Chapter 8. Designated critical habitat for the Snake River Basin steelhead DPS includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake Rivers as well as specific stream reaches in the following subbasins: Hells Canyon, Imnaha River, Lower Snake/Asotin, Upper Grande Ronde River, Wallowa River, Lower Grande Ronde, Lower Snake/Tucannon, Lower Snake River, Upper Salmon, Pahsimeroi, Middle Salmon-Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon-Chamberlain, South Fork Salmon, Lower Salmon, Little Salmon, Upper Selway, Lower Selway, Lochsa, Middle Fork Clearwater, South Fork Clearwater, and Clearwater (NMFS 2005b). There are 289 watersheds within the range of this DPS. Based on the quality and quantity of the PCEs (Table 4.2-2, SCA), 14 watersheds received a low rating, 44 received a medium rating, and 231 received a high rating of conservation value to the DPS. The Lower Snake/Columbia River rearing/migration corridor downstream of the spawning range is considered to have a high conservation value and is the only habitat area designated in 15 of the high value watersheds identified above. This corridor connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a unique and essential area for juveniles and adults making the physiological transition between life in freshwater and marine habitats. Of the 8,225 miles of habitat areas eligible for designation, 8,049 miles of stream are designated critical habitat.

Many factors, both human-caused and natural, have contributed to the decline of salmon and steelhead over the past century, as well as affecting the conservation value of designated critical habitat. The condition of PCEs in spawning and rearing areas and juvenile and adult migration corridors is described below.

Spawning and Rearing Areas

This species spawns in tributaries to the Snake River in southeast Washington, northeast Oregon, and Idaho. Adults enter fresh water from June to October and spawn the following spring from March to June (Thurow 1987). Emergence occurs by early June in low elevation streams and as late as mid-July at higher elevations. Snake River Basin steelhead usually rear in the natal tributaries for 2 to 3 years before beginning their seaward migration.

The following are the major factors that limit the functioning and thus the conservation value of habitat used by Snake River Basin steelhead for these purposes (i.e., spawning and juvenile rearing areas with spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, and space):

- Degraded tributary channel morphology *[bank hardening for roads or other development; livestock on soft riparian soils and streambanks]*

- Physical passage barriers *[culverts; pushup dams; low flows]*

- Excess sediment in gravel *[roads; agricultural and silvicultural practices; livestock on soft riparian soils and streambanks; recreation]*

- Degraded riparian condition *[grazing]*

- Reduced tributary stream flow, which limits usable stream area and alters channel morphology by reducing the likelihood of scouring flows *[water withdrawals]*

- Degraded tributary water quality including elevated summer temperatures *[water withdrawals; groundwater depletion; degraded riparian condition]*

In recent years, the FCRPS Action Agencies, in cooperation with numerous non-Federal partners, have implemented actions to address limiting factors and threats for this DPS in spawning and rearing areas. Some projects provided immediate benefits and some will result in long-term benefits with survival improvements accruing into the future. These include acquiring water to increase streamflow, installing or improving fish screens at irrigation facilities to prevent entrainment, removing passage barriers and improving access, improving mainstem and channel habitat, and protecting and enhancing riparian areas to improve water quality and other habitat conditions. Some projects provided immediate benefits and some will result in long-term benefits with improvements in PCE function accruing into the future.

Juvenile and Adult Migration Corridors

Factors limiting the functioning and conservation value of PCEs in juvenile and adult migration corridors (i.e., affecting safe passage) are:

- Tributary barriers *[push-up dams, culverts, water withdrawals that dewater streams, unscreened water diversions that entrain juveniles]*
- Juvenile and adult passage mortality *[hydropower projects in the mainstem Lower Snake and Columbia Rivers]*
- Temperature barriers *[timing of adult entry into and migration through the Lower Snake River in late summer and early fall is delayed because of elevated mainstem temperatures]*
- Juvenile mortality due to habitat changes in the estuary that have increased the number of avian predators *[Caspian terns and double-crested cormorants]*

In the mainstem FCRPS corridor, action agencies have improved safe passage for juvenile steelhead with the construction and operation of surface bypass routes at Lower Granite, Ice Harbor, and Bonneville Dams and other configuration improvements listed in section 7.3.1.1 in Corps et al. (2007). The safe passage of juvenile steelhead through the Columbia River estuary improved beginning in 1999 when Caspian terns were relocated from Rice to East Sand Island. The doublecrested cormorant colony has grown since that time. For steelhead, with a stream-type juvenile life history, projects that have protected or restored riparian areas and breached or lowered dikes and levees in the tidally influenced zone of the estuary (between Bonneville Dam and approximately river mile 40 have improved the functioning of the juvenile migration corridor. The FCRPS Action Agencies recently implemented 18 estuary habitat projects that removed passage barriers, providing access to good quality habitat (see Section 7.3.1.3 in Corps et al. 2007).

Areas for Growth and Development to Adulthood

Although Snake River Basin steelhead spend part of their first year in the ocean in the Columbia River plume, NMFS designated critical habitat no farther west than the mouth of the Columbia River (NMFS 2005b). Therefore, the effects on PCEs in these areas were not considered further.

2.1.1.5.2. Status of Snake River Basin Steelhead MPG's Critical Habitat. The two MPGs within the Snake River Basin steelhead DPS that the LOP directly withdraws water from are the Lower Snake River MPG and the Clearwater River MPG, and those two MPGs are discussed below. Information for the other three Snake River Basin steelhead MPGs is found in the status summary as updated in Cooney (2010).

Lower Snake River MPG

The two populations within the Lower Snake River Basin steelhead MPG include the Asotin Creek and Tucannon River populations. The major tributaries in the Asotin Creek population include the North Fork and South Fork Asotin, George, Pintler, and Lick Creeks in the Asotin Creek drainage; Stember and Page Creeks, and Pow Wah Kee Gulch of the Alpowa Creek drainage; and Tenmile, Tammany, Steptoe, and Almota Creeks that drain directly into the Snake River. The TRT identified two major spawning areas (Asotin and Alpowa) and five minor spawning areas (Almota, Steptoe, Tenmile, Tammany, and Tenmile Canyon) (Cooney 2010).

The Tucannon River population is found downstream of Lower Granite Dam. The major tributaries in the Tucannon River population include Penawawa Creek, Pataha Creek, and the Tucannon River. The TRT identified one major spawning area (Tucannon) and two minor spawning areas (Penawawa and Pataha) (Cooney 2010).

The LOP withdraws water from Captain John Creek only during the spring when flows are high in the Snake River. The canal capacity is listed as 6.3 cfs in Table 3, but there are no data available on actual use. According to the BOR (BA, page 3-3), the Captain John diversion typically provides water for only a few weeks and seldom operates at full capacity. The LOP will not have any impact on the tributaries mentioned above for the Asotin Creek and Tucannon River populations, and therefore, should have not have any discernable effect on the status of the Lower Snake River MPG. Information for the Lower Snake River MPG is found in the status summary as updated in Cooney (2010).

Clearwater River MPG

The Clearwater River MPG has five existing populations, including Lower Mainstem Clearwater River, South Fork Clearwater River, Lolo Creek, Lochsa River, and Selway River. Dworshak Dam blocked the North Fork Clearwater River population. For the sake of brevity, the Clearwater River MPG has a total of 20 major spawning areas and 20 minor spawning areas. For individual details on all of the spawning areas, please see Cooney (2010). Within the Lower Mainstem Clearwater River population, the TRT identified six major spawning areas (Potlatch, Lower South Fork Clearwater tributaries, Big Canyon, Lapwai, Clear, and Lawyer) and five minor spawning areas (Orofino, Jim Ford, Cottonwood, Bedrock, and Lindsay) (Cooney 2010). Spawning is distributed widely across the population and occurs in all major and minor spawning areas. All major tributaries and numerous small tributaries are currently utilized (Cooney 2010).

Johnson and Stangl (2000) indicate steelhead appear to use all accessible tributaries in the area occupied by the Lower Mainstem Clearwater population (Lower Mainstem Population) whenever the tributaries are large enough to support spawning or rearing, but fish numbers are relatively low in most tributaries, with a few exceptions. Portions of the Potlatch River and Big Canyon Creek basins, Upper Lapwai Creek, and Mission Creek, have relatively high steelhead abundance that is indicative of a productive stream. Areas of steelhead production in the Lower Mainstem Population occur throughout the upper Potlatch River drainage; Big Canyon, Lapwai, Clear, and Maggie Creeks drainages; and secondarily from the remaining drainages in the Lower Clearwater River. Johnson and Stangl (2000) recognized Potlatch River, Big Canyon, Lapwai, and Lawyer Creeks as drainages with high potential for habitat restoration to benefit steelhead production in the mainstem Clearwater River drainage (after Lolo Creek, which is a separate population). Clear Creek and Maggie Creeks drainages were identified as likely the most important for steelhead spawning and rearing in the Middle Fork Clearwater River subbasin. Johnson and Stangl (2000) identified Johns Creek and Mill Creek as the only streams in the South Fork Clearwater River drainage that provide habitat refugia for steelhead. In published fish and habitat inventories (*e.g.* Johnson 1985, Fuller et al. 1984, Kucera and Johnson 1986, Chandler 2004, Bowersox and Brindza 2006), common problems limiting fish production in the lower Clearwater River Basin include high summer water temperatures, low summer discharge, flashy response to runoff, and moderate to severely degraded channels. The exceptions to this tend to be in forested headwaters, such as those in the Potlatch River, Clear Creek, Mission Creek, and Big Canyon Creek.

Among the habitat alterations in the freshwater life stages, water withdrawals collectively cause some of the more severe habitat losses in the range of Snake River salmon and steelhead, and they account for a significant portion of habitat losses and mortality for salmon and steelhead in the Snake River Basin. Water withdrawals are one of the few types of Federal actions in the Snake River Basin where salmon and steelhead productivity may be quickly improved by addressing water withdrawal effects. Prior to 2006, the LOP diverted most, if not all, of the flows in Sweetwater and Webb Creeks and left disconnected pools and/or entire stream sections dry. Reduced Sweetwater Creek flows also reduced the flow entering Lapwai Creek and reduced its habitat potential. Since 2006, however, the LOP has provided minimum flows suitable to maintain stream connectivity in Sweetwater Creek, but no flow was provided for Webb Creek until 2009.

The TRT identified the Potlatch River as one of six major spawning areas within the Lower Mainstem Clearwater River population. An IDFG fisheries inventory report stated that in the lower tributaries of the Potlatch River, the change in the stream hydrograph probably caused significant impacts to fish populations and habitat (Schriever and Nelson 1999). A later IDFG report stated the Potlatch watershed had undergone significant amounts of change in the last 150 years, and land-use practices had altered the aquatic habitat and the flow dynamics (Bowersox et al. 2007). These changes resulted in extreme flow variation, high summer water temperatures, lack of riparian habitat, high sediment loads, and low instream structure (Bowersox and Brindza 2006). Nonetheless, the IDFG goes on to state that despite the altered condition of the aquatic habitat, it does support an important population of wild steelhead (Bowersox et al. 2007). Flows in the lower mainstem Potlatch River become very low in the drier parts of the year.

In addition, the IDFG (using Pacific Coastal Salmon Recovery Funds) documented substantial numbers of juvenile and adult steelhead in Bear Creek, an upper watershed tributary of the Potlatch River. The Potlatch River Steelhead Monitoring and Evaluation project started in 2005 to assess steelhead production and productivity in relation to large-scale habitat restoration occurring within the drainage. The monitoring effort provides a measure of success to agencies initiating habitat restoration projects within the drainage. The Latah County Soil and Water Conservation District has begun significant restoration efforts on the agricultural lands associated with the Lower Potlatch River drainage. In 2007, the IDFG estimated 177 adult spawners above weir locations on Big Bear and Little Bear Creeks and estimated that 9,187 juvenile steelhead/rainbow trout emigrated from the Bear Creek system (Bowersox 2008).

The TRT identified Lapwai Creek as a major spawning area within the Lower Mainstem Clearwater River population. Chandler and Richardson (2005) found water temperatures at all four of their Lapwai Creek sampling sites to exceed temperature criteria for juvenile salmonid rearing. They also noted habitat alterations from channel confinement, residential development, cattle and horse grazing, irrigation diversions, fish passage barriers, and agricultural activity. However, Chandler and Richardson (2005) found steelhead/*O.mykiss* in three of four sites sampled in Lapwai Creek. In Mission Creek, a main tributary of Lapwai Creek, Chandler and Richardson (2005) noted habitat alterations from areas of channel confinement, riparian grazing, high water temperatures, low summer discharges, and some logging activity. Despite the noted habitat alterations, Chandler and Richardson (2005) found steelhead/*O.mykiss* in all four sites sampled in Mission Creek. In Sweetwater Creek, the primary tributary of Lapwai Creek, Chandler and Richardson (2005) noted habitat alterations from areas of residential development, riparian grazing, agricultural impacts, high water temperatures, and irrigation diversions. Despite the noted habitat alterations, Chandler and Richardson (2005) found steelhead/*O.mykiss* in two of four sites sampled in Sweetwater Creek.

The TRT also identified Big Canyon Creek as a major spawning area within the Lower Mainstem Clearwater River population. Chandler and Richardson (2005) found water temperatures at all four of their Big Canyon Creek sampling sites to exceed temperature criteria for juvenile salmonid rearing, with one stream section dewatered for a distance of ~9.5 miles. They also noted habitat alterations from areas of low channel stability, residential development, channel confinement, grazing, and agricultural activity. However, Chandler and Richardson (2005) found steelhead/*O.mykiss* in all four sites sampled in Big Canyon Creek. Chandler and Richardson (2005) also found steelhead/*O.mykiss* present in all four sites sampled in Little Canyon Creek, the main tributary to Big Canyon Creek.

Habitat within the Lapwai Creek watershed, including Sweetwater and Webb Creeks, has been affected by channel and floodplain alterations, fish passage barriers, water withdrawals, accelerated rates of runoff, and sediment. However, as shown in Table 8 of this Opinion, the amount of flow in Sweetwater and Webb Creeks has increased beginning with the 2006 Opinion, and flows will further increase with the implementation of BOR's 2010 proposed action. At a bypass flow of 1 cfs at the Sweetwater Dam, the BOR reported pools ranging from 20 to 39 inches deep and riffles from 4 to 6 inches deep (BOR 2007b). For Lapwai Creek, the BOR reported pools ranging from 24 to 50 inches deep and riffles generally from 4 to 8 inches deep in Lapwai Creek, at a Sweetwater Dam bypass flow of 2.18 cfs (BOR 2009).

2.1.2. Environmental Baseline

The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone Formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The effects of future actions over which the Federal agency has discretionary involvement or control are analyzed as effects of the action.

The action area includes the drainages of Captain John Creek in the Snake River drainage, and Sweetwater Creek, Webb Creek, and Lapwai Creek downstream from Sweetwater Creek in the Clearwater River drainage. The action area also includes the mainstem Snake and Clearwater Rivers downstream of these tributaries and the Columbia River at its confluence with the Snake River downstream to the Pacific Ocean.

Diversions from the project area have been ongoing as early as 1916, and the BOR has been under contract with LOID since 1947. The LOP diverts water from Captain John Creek and from three points in the Sweetwater Creek drainage: (1) Lake Waha feeder that diverts water from the West Fork Sweetwater Creek into Lake Waha; (2) Webb Creek diversion that routes water through a canal into a tributary of the East Fork Sweetwater Creek; and (3) the mainstem of Sweetwater Creek where water is transferred out of the basin into Mann Lake.

The BOR's contract with LOID provides for BOR to deliver up to 2.2 af of water annually for each acre of irrigated land (3,838 acres, for 8,444 af of water). The BOR holds water rights with the Idaho Department of Water Resources to divert 87.8 cfs at the Sweetwater Canal, which allows diversion of far more than 8,444 af of water, if it were available and if the facilities could accommodate a larger amount. In a letter dated August 20, 2004, the BOR indicated the average volume of water delivered to LOID for the previous 12 years was 1.4 af per acre (which is 5,373 af, or 64% of the volume contracted for delivery by BOR). However, the amount of water diverted annually at Sweetwater diversion dam has averaged 8,695 af in 25 years of records from 1973 through 2000. Diversions from the Sweetwater Canal have averaged 6,970 af from 2003 through 2008 (calculations from BA, pages B-74 through B-79). Decreases in the amount of water diverted in the most recent decade compared to the long-term record since 1973 may reflect a shrinking water supply due to an apparent shift in climatic conditions toward lower snow packs and hot, dry summers. According to Morehead (2004), roughly 32% of the water entering Sweetwater Canal was lost to seepage and evaporation. Water lost from the Sweetwater Canal does not appear to reenter Sweetwater Creek in any measurable amount.

The Captain John Creek drainage is approximately 20 to 25 square miles, and flows into the mainstem of the Snake River. The lower reaches of the drainage provide juvenile rearing habitat for spring/summer Chinook salmon, and spawning and rearing habitat for steelhead (Johnson and Stangl 2000). A natural falls in Captain John Creek prevents upstream fish migration approximately 6 miles from the mouth, and the diversion dam is approximately 2 to 3 miles upstream from the falls. The dam diverts water from an ephemeral tributary to Captain John Creek during spring runoff. The diversion dam operates for a relatively short period of operation and captures a small percentage of surface flows from fish-bearing streams below the waterfall.

The Sweetwater and Webb watersheds are largely private, state, and Tribal forest lands, with a small number of residential properties, and agricultural lands used primarily for grazing at higher elevations, and crops at lower elevations. A significant amount of timber harvest has occurred in the drainage in recent decades, which has likely contributed to changes in the hydrology. Timber harvest alters hydrology by opening forested canopies and through alteration of soil and drainage features from skid trails, landings, and permanent or temporary roads. Timber harvest has different and sometimes opposite effects on the hydrologic dynamics of snowpack and rainfall. The effects vary depending on the climatic setting and likelihood of rain-on-snow events (Ziemer and Lisle 1998). While hydrologic alterations from timber harvest are widely acknowledged in scientific literature, the effects are difficult to predict. Jones (2000) states that "it is difficult to derive general predictions of forestry treatment effects because runoff responses vary by geographic setting, type of runoff event, road configuration, and time since treatment." In a system dominated by rainfall, Ziemer and Lisle (1998) concluded that removal of trees in the Pacific Coastal region tended to increase base streamflow in summer, but these summertime effects tend to disappear within several years. Ziemer and Lisle (1998) also observed that "logging and road building can increase rates and volumes of storm flows," which would tend to have the opposite effect on summer base flows. Because the hydrologic effects of timber harvest are highly variable and complex, the effects of timber harvest in the action area are unknown. It is likely that climatic changes discussed above are the largest factor in changes to the hydrology in the action area, and climatic changes have interacted with forestry effects to create watershed conditions where today, spring runoff occurs earlier and faster and summer base flows are lower than they were in previous decades.

The Sweetwater Creek watershed (including Webb Creek) drains the north face of Craig Mountain, which receives more than 23 inches of precipitation annually, with the majority of precipitation historically occurring as snow. Records from Cottonwood, Idaho, indicate that winter precipitation has shifted in recent decades from predominantly winter snow toward a higher percentage of rainfall in winter (unpublished data from the U.S. Geological Survey (USGS) precipitation gauge at Cottonwood, Idaho), which is characteristic of changing precipitation patterns in the Pacific Northwest, described by Mote et al. (2004). The consequences of this shift have increased the likelihood of streambeds drying in summer from earlier snowmelt and timing of peak flows, smaller peak flows, and lower base flows in summer (Regonda et al. 2005). LOID personnel have observed a shift in the hydrograph in recent decades, to an earlier runoff season with a less pronounced peak and shorter duration (K. Casey, LOID, pers. comm.). During the 2006 connectivity survey in Sweetwater Creek, the BOR found nine pump diversions, none of which had screens in place for juvenile fish protection (BOR 2007a). An unusually large spring (Twenty One Ranch spring) exists in the headwaters of Sweetwater Creek, which would naturally buffer variation in stream flows if not for the Sweetwater diversion dam downstream of the spring.

The BOR completed an inventory of fish habitat upstream of the Sweetwater dam in 2007 (BOR 2007c). This survey found a total of 4.1 miles of potentially suitable habitat that would support steelhead. Although the dam itself is included within the environmental baseline, water collection from West Fork Sweetwater Creek is included within the proposed action. Habitat effects would occur downstream of the Lake Waha feeder canal and downstream of Lake Waha and the Twenty One Ranch spring.

LOID received a grant in 2005 from BOR to reduce leakage from the canal system. After the 2006 irrigation season, LOID constructed 1800 feet of canal lining by placing a geotextile composite liner on shaped earth and covering it with shotcrete. LOID estimated that this lining resulted in a water savings of 179 af, or 0.6 cfs water saving per day, with 50% of this estimate added to the summertime minimum streamflow during the 2007 irrigation season.

The environmental baseline from the Snake and Clearwater Rivers through the Columbia River has been modified by the use of water for irrigation and the construction of dams as described in the SCA. These changes have reduced the overall flow volumes and altered hydrographs so that a lower proportion of water flows downstream in spring and early summer (SCA, NMFS 2008a). Diversion of water for irrigation by LOID is not a new action and so the effects of the proposed action are expected to be effectively the same as described in the baseline flows in the SCA.

2.1.2.1. The Twenty One Ranch Spring and its Effect on Stream Flows

Lake Waha and the Twenty One Ranch spring are significant sources of natural stream flows in Sweetwater Creek. Summer base flows in the mid and upper reaches of Sweetwater Creek are determined largely by the discharge from the Twenty One Ranch Spring, which is hydrologically connected to Lake Waha. The hydrology of Lake Waha and the Twenty One Ranch spring have been altered for decades, following the installation of a pump in Lake Waha in 1916 and installation of a diversion dam in a tributary to the West Fork of Sweetwater Creek, which is used to divert water into the lake for storage. Today, water is diverted into the lake and pumped out of the lake by the LOP.

Lake Waha is a unique geological feature where an ancient slope failure filled the canyon of the upper West Fork of Sweetwater Creek with rock and soil several hundred feet high. The slope failure dammed the West Fork Sweetwater Creek and created Lake Waha. The lake has no natural surface outlet, but water seeps out of the lake through the slide debris, and emerges down slope at the Twenty One Ranch spring (also referred to as “Sweetwater Spring” and “Big Spring”).

The precise nature of stream flow alterations in Sweetwater Creek are not known since there are no measurements of unregulated stream flows in Sweetwater and Webb Creeks prior to use of these streams for irrigation. Additional uncertainty in Sweetwater Creek arises from unusual seasonal stream flow patterns that are influenced by springs fed by Lake Waha. Lake Waha is the source of water for the Twenty One Ranch Spring, and higher water levels in the lake appear to cause higher rates of discharge from the spring (NMFS 2006 Opinion). Water levels in Lake Waha have been manipulated since 1916 by adding water through the Lake Waha feeder canal and pumping water out of the lake. Since the fluctuation in water levels in Lake Waha is increased by adding and removing water from the lake, flows from the Twenty One Ranch Spring have probably become more variable than natural. Discharges from the spring are probably lowest in later summer and fall, particularly in drier years, after larger volumes of water have been withdrawn from Lake Waha.

In its natural state, the Twenty One Ranch Spring likely provided higher, but variable flows in Sweetwater Creek during the summer. Data on discharge from the Twenty One Ranch spring are scant and variable, but they show that the spring provided larger amounts of discharge during summer and early fall when lower flows typically occur in Sweetwater Creek.

Because of the unique hydrologic characteristics of the Twenty One Ranch Spring, the biological value of Sweetwater Creek for steelhead was likely high in relation to other streams, especially due to the amount of summer discharge. Besides providing a larger surface flow during the critical summer period, the water from the Twenty One Ranch spring provides nearly optimal temperatures for steelhead year-round. Water temperatures at the spring outlet ranges from 8.3°C to 10.6°C, with an average of 10.0°C (NPT 1994). The natural longitudinal temperature profile of Sweetwater Creek is unknown; however, a discharge of 3 cfs or more from the spring would likely provide cooler water temperatures during the hotter and drier parts of summer for at least several miles downstream. Where steelhead occur 3 miles downstream below the Sweetwater diversion dam, the spring likely had a diminished effect on water temperatures, since water temperatures begin to equilibrate with air temperature over this distance. Infiltration of the surface flow would likely contribute to cooler spots throughout the stream wherever hyporheic flows emerged from the gravels. During the winter, the spring would provide a buffer against freezing temperatures.

2.1.2.2. Stream Flows in the Absence of LOP Operation

There are no available records of stream flows in Sweetwater and Webb Creeks that exist before water was diverted from the Sweetwater and Webb Creeks, but sufficient data exists to estimate flows in the absence of the LOP. In this section, and in the remainder of this Opinion, references to “unregulated flow” refers to stream flows in the absence of the LOP. Unregulated flows were modeled by BOR using measured inflows and outflows at various parts of the LOP system, and water availability based on the conditions observed from 2003 through 2008. The NPT and Entrix (2009a) expanded the model to include a longer period of record that is wetter on average than the period modeled by BOR, and the extended model by Entrix is used to represent average unregulated flows. Unregulated flows provide an important benchmark for analyzing aggregate effects of the action, and they represent the best estimate of stream flows likely to occur in Sweetwater and Webb Creek in the absence of the LOP. The model of unregulated flows does not account for potential changes in stream flows from the Twenty One Ranch Spring due to weather or effects of the action, nor does it account for additional water losses that may occur from water users other than BOR. Existing claims by third parties would enable water users to divert much of the minimum flow in summer if it were not protected by the Idaho water supply bank. Water claims in the Lapwai drainage are also partly subject to the SRBA, which could dictate how water would be allocated to various users. The amount of water actually used by parties other than BOR is entirely unknown, but the use of the water supply bank under the State of Idaho will protect the minimum flows provided by the LOP from being withdrawn by other water users in Sweetwater and Webb Creeks.

2.1.2.3. Stream Flows and Habitat Under Past LOP Operations

Prior to the 2006 LOP Opinion, LOID was allowed unrestricted withdrawal of water from Sweetwater, Webb, and Captain John Creeks, up to the limit of the contracted water volume or water right, physical limitations of the facilities, and water availability. From 2006 on, the Sweetwater dam bypass target flow of 1 cfs provided connectivity in Sweetwater Creek, although no flow was provided for Webb Creek until 2009. Whenever NMFS uses language about past LOP operations in this Opinion, NMFS is referring to LOP operations prior to 2006.

The LOP facilities and their operations altered flows and fish habitat conditions in Sweetwater, Webb, Captain John Creek, and Lapwai Creek. The diversion dam in Webb Creek is located at stream mile 9.6 and upstream from an impassable waterfall at stream mile 9.2 with a vertical drop of approximately 25 feet. A smaller waterfall approximately 3.3 feet high is located at stream mile 7.3 and is classified as an upstream passage barrier for resident fish species and juvenile anadromous salmonids (Chandler 2004). Chandler (2004) found that residential development along the lower 15 miles was minimal, livestock and grazing impacts were notable, and logging activity was evident above mile 10. Chandler (2004) found the overall habitat composition of Webb Creek from the mouth upstream to the dam was 7.8% pools, 8.5% glides, and 83.7% riffles, along with a substrate composition of 49% cobble, 26% coarse gravel, 14% boulder, 7% gravel, and only 2% sand and silt.

The Sweetwater Creek diversion dam is a complete or nearly complete barrier to upstream migration of adult steelhead and a downstream barrier during much of the irrigation season. Occasional windows of downstream passage opportunities during the irrigation season exist following summer storms when runoff exceeds the canal capacity. The Sweetwater dam eliminates access to roughly one mile of the mainstem of Sweetwater Creek and more than 24 miles of perennial headwater streams in the East and West Forks of Sweetwater Creek. The BOR completed a fish habitat survey above the Sweetwater dam in 2007 and they found a total of 4.1 miles of potentially suitable steelhead spawning and early rearing habitat. Parr densities upstream of the dam were predicted to be moderate to low based on unconsolidated rock lithology and habitat quality (BOR 2007c). The Tribe conducted electrofishing and habitat surveys above the Sweetwater dam and found that the Sweetwater dam precludes passage to 11 miles of stream that presently supports *O. mykiss* (Chandler and Parot 2003; Chandler and Richardson 2006).

The timing and volume of water storage, release, and transfer have varied widely from year to year, depending on precipitation, air temperature, runoff, and customer demand. Based on water records in the BA, water typically accumulates in Soldiers Meadow Reservoir from November through late June or early July, and decreases from July to November. The LOP facilities are not operated when low temperatures might cause build-up of ice in the canals or pipes, which could cause the canals to breach. Water has been released from Soldiers Meadow Reservoir in all months other than January, but water was not typically released from December through March. The diversion dams in Sweetwater and Webb Creeks were operated year-round on occasion, but since 1990, water has not been diverted in December and January, with the exception of 2 years when flows in Sweetwater Creek were diverted year-round. The Captain John Creek diversion dam feeding Soldiers Meadow Reservoir operates for several months in the spring when the ephemeral channel has flowing water.

Since the BOR did not require LOID to provide minimal flows in Sweetwater and Webb Creeks prior to the 2006 Opinion, stream flows below the diversion dams were dictated by the influx of ground water and the availability of surface water in excess of the physical limitations of the facilities when the dams were in operation. The maximum rates of water diversion are roughly 32 cfs from Sweetwater Creek, 20 cfs from Webb Creek, an unknown smaller amount from Captain John Creek, and an estimated 1 to 3 cfs through the diversion into Lake Waha, based on upstream drainage area and the size of the culvert. In 2004 and 2005, LOID voluntarily agreed to provide minimum instream flows below the Sweetwater diversion dam, but the flows were highly variable and probably did little to improve fish habitat conditions in those two years (See notes 1 and 2, Table 8).

Anecdotal accounts of past LOP operations suggest that the LOP eliminated most of the rearing habitat accessible to steelhead in Sweetwater and Webb Creeks, and to a lesser degree, in Lapwai Creek below the confluence with Sweetwater Creek, by drying portions of the streambeds in summer. When the LOP diverted water during the summer, stream flows in the lower 6 miles of Lapwai Creek, from the Sweetwater Creek confluence to its mouth, were likely reduced by roughly one-third. Lapwai Creek was predominantly dry below the confluence of Sweetwater Creek in the summers of 2002 and 2003. Water diversions in Sweetwater and Webb Creeks have caused the streams to become dry for up to several miles below the dams, followed by several more miles of alternating stretches of surface and subsurface flows in summer, and occasionally, in early fall. Murphy and Metsker (1962) reported the streambed of Sweetwater Creek was dry for a distance of 4 miles below the diversion dam in the summer. The precise duration, extent, timing, and severity of channel drying from past operations each year is unknown, but would vary with spring runoff and summer precipitation patterns.

When the LOP diverted all surface flows, usable fish habitat below the diversion dams was found only in disconnected pools and short stream segments where groundwater reaches the channel surface. In areas that retained water in summer, the LOP likely reduced habitat quality by creating discontinuous pools with little or no flow, no cover, lack of drifting invertebrates for food (Rader and Belish 1999), inadequate depth, high temperatures, low oxygen, and higher metabolic wastes (e.g. Lake 2003). During periods of discontinuous surface flows, a low number of juvenile *O. mykiss* probably survived in those pools that were large enough to provide cover, food, and water quality. Fish stranded in pools without suitable water volume were likely killed outright by the LOP. On August 3, 2004, the Tribe reported to NMFS that Tribal biologists observed dead and dying juvenile *O. mykiss* stranded in shallow pools in Sweetwater Creek where the water had evaporated (D. Johnson, Tribe, pers. comm.). From July 6 to August 19, 2004, the Tribe conducted fisheries surveys in Webb Creek and Little Canyon Creek. Chandler (2004) found that Webb Creek was entirely diverted by the LOID diversion and that the stream was dewatered downstream of the Webb diversion dam for a distance of over 1.5 miles, at which point, minimal hyporheic flows began. Despite the fact that all flow at the

Webb Dam was diverted at that time, the survey found *O. mykiss* present at all 12 sites sampled except for the one site where the stream was dewatered, and found three age classes present in the stream.

Under past LOP operations, there was likely a threshold response in the quantity and quality of habitat. Habitat conditions were likely poor when the combined natural surface flows in Sweetwater and Webb Creeks at the diversion dams were less than the canal capacity (~32 cfs) and all surface flows were diverted. When the natural discharge exceeded canal capacity, surface flows likely remained in Sweetwater and Webb Creeks, although flows and habitat conditions were likely to have been highly variable. Because the combined rates of natural surface flows in Sweetwater and Webb Creeks have generally been less than 32 cfs in at least part of the summer (Table 6, NMFS 2006 Opinion), the LOP likely caused stream drying and habitat loss in most years.

Stream flows observed from 2003 through fall of 2005 in Sweetwater and Webb Creeks encompass a relatively wide range of variation in flow (from wet to dry conditions), but do not capture the extremes. Stream flows gauged in Sweetwater and Webb Creeks from 2003 through 2005 are representative of typical flows that have likely occurred in the past under conditions ranging from dry to moderately wet summers. The weather in 2003 was relatively wet in spring followed by a very dry summer. In 2004, the weather was relatively warm and dry in spring, followed by a moderately wet summer. Stream flows measured in Lapwai Creek, at the stream gauge near Lapwai, Idaho, from June through September 2003, indicate that the summer of 2003 was the 27th lowest flow (or driest) recorded out of 30 years of records (1975 through 2004), and stream flows measured in 2004 during the summer were the 11th highest (or wettest) out of 30 years. Because of these characteristics, the 2003 and 2004 stream gauge data serve as benchmarks for flows that would exist under the environmental baseline with on-going operation of the LOP at past diversion rates.

In 2003, all available surface water was diverted for irrigation use during the summer, while in 2004 and 2005, approximately 1 cfs was allowed to pass over the Sweetwater Dam from June to September, although at times, the actual flow measured was less than 1 cfs. In 2003, flows at the mouth of Webb Creek ranged from 0 to 0.1 cfs from July through September, which left the majority of its streambed dry during the latter part of the summer. In Sweetwater Creek, at the gauge site below the diversion dam, the streambed was completely dry in September of 2003, but otherwise maintained flows ranging from 0.7 to 0.8 cfs from July through October. At the mouth of Sweetwater Creek, flows ranged from 0.7 to 2.4 cfs from July through October, indicating the stream gains flows from groundwater downstream of the diversion dam and additional discharge from Webb Creek. The discharge rates observed in Sweetwater Creek in 2003 created discontinuous flows that alternated between the surface and subsurface of the streambed, leaving isolated pools and areas of dry streambed below the Sweetwater Creek diversion dam.

In 2004 and 2005, when LOID voluntarily provided some surface flows at the Sweetwater Dam, stream flows measured at the mouth of Sweetwater Creek were higher than the combined flows from Webb Creek and below the Sweetwater diversion dam. At these low flows, Sweetwater

Creek retained surface flows immediately below the dam and at the mouth. Sweetwater Creek appears to gain surface flows several miles below the dam, since flows have been observed in Sweetwater Creek below the dam at times when the dam captured all available surface water.

With the issuance of the 2006 LOP Opinion, the LOID provided 1 cfs of summertime flows past the Sweetwater Creek Dam and 0 cfs past the Webb Creek Dam for 2006 and 2007. Under the 2008 stipulated agreement with the Tribe, the LOP operations included an average daily flow of 2 cfs at the Sweetwater Dam whenever the LOP was diverting water between June 1 and October 31, 2008, and 2.2 cfs between June 1 and October 31, 2009. The agreement did not provide for supplying any water past the Webb Creek Dam for 2008, but did commit BOR to providing 0.4 cfs for 2009. Although some silting issues and mechanical problems occurred, the LOP was generally at or above these target bypass flows. The BOR and LOID worked at providing solutions to the problems encountered and installed an automatic alarm system in 2007 so that LOID could respond sooner if the system was not delivering the stipulated bypass flow. Since installation of the automation system, BOR reported only two days (of 197) in 2007 and four days (of 153) in 2008 when flows fell below the allowable target bypass flow for Sweetwater Creek below the diversion dam (BOR 2008; BOR 2009).

It is likely that water temperatures have been affected by past operation of the LOP. Water temperatures in streams are strongly influenced by the amount of discharge, which buffers temperatures from daily extremes in air temperature in direct proportion to the amount of flow (Poole and Berman 2001). Due to flow reductions caused by the LOP, water temperatures below the diversion dams are likely elevated in most summers from conditions that would have occurred in the absence of the water diversion. Average daily water temperatures in Sweetwater and Webb Creeks have approached the lethal limit for steelhead in summer. Maximum daily average water temperatures reported in the LOP BA from June 30, through September 19, 1999, in Sweetwater Creek, ranged from 14^{o}C to 17^{o}C, upstream of the diversion dam, and 17^{o}C to 22^{o}C below the diversion dam. The reported temperatures are warmer than the optimal range for steelhead rearing (10^{o}C to 12.8^{o}C) and cooler than the upper lethal limit of 24^{o}C reported by Bell (1986). The relatively warm water temperatures increase respiration rates and metabolic demands of salmonids, which can become a physiological stressor if food or oxygen are in short supply (e.g. Brett 1971). In conjunction with disconnected surface flows caused by past operation of the LOP, it is likely that elevated temperatures have increased the mortality of juvenile salmonids rearing from the combined effect of high metabolic demand and reduced food availability in stream reaches that lack continuous surface flows.

Water temperatures in Sweetwater Creek above the diversion dam appear to be cooler than temperatures typically found in most tributaries in the Lower Clearwater River Basin, based on a comparison to various stream temperature averages in Table 10. Maximum daily average temperatures measured in selected tributaries of the Clearwater River Basin (Donato 2002), range from 19.6^{o}C to 24.9^{o}C. Stream temperatures in Lawyer Creek (site #2), Potlatch River, and Grasshopper Creek exceed the lethal limit for steelhead. Seven-day maximum average temperatures at the USGS stream gauge near Orofino, Idaho, in the Clearwater River upstream from Orofino Creek, exceed 24^{o}C to 25^{o}C during August (period of record 1931 to 1998). In tributaries to the Potlatch River (East Fork, Little Bear Creek, Bear Creek, Big Bear Creek, and

Corral Creek), which are among the higher elevations in the Lower Mainstem Population area, the maximum daily average temperatures ranged from 17°C to 20.5°C in the summer of 2000 (LSWCD 2004).

At times when surface flows became discontinuous, water temperatures likely varied widely among pools and wetted areas, depending on the amount of intergravel flows that existed at each site. In stagnant areas, water temperatures in summer likely exceeded lethal limits for steelhead when the average ambient air temperature exceeded 22°C (the lethal limit for steelhead) for several consecutive days or when the wetted areas were not shaded from direct sunlight. Temperatures exceeding 22°C for several consecutive days were likely to occur in most summers, since daytime temperatures often exceeded 37°C, and water temperatures reported in many similar streams nearby (Table 10) were 22°C or higher. In disconnected pools with intergravel flows, water temperatures likely varied in proportion to the relative amount of groundwater influence. Where rates of intergravel flow or groundwater influx were relatively high, isolated pools likely had a narrow range of daily temperature fluctuation with temperatures similar to the groundwater temperature. Where waters were stagnant or pools had low rates of intergravel flows, isolated pools likely had a wide range of daily temperature fluctuation, proportional to the range of daily air temperatures, and average temperatures that were higher than the groundwater temperature.

Table 10. Mean maximum daily average temperatures (°C) measured in tributaries to the Lower Clearwater River, from Donato (2002).

Stream	Temp. (°C)		Stream	Temp. (°C)
Bedrock Cr.	20.4		Jim Ford Cr.	21.8
Big Bear Cr.	22.8		Lawyer Cr. #1	21.3
Big Canyon Cr.	21.7		Lawyer Cr. #2	24.9
Corral Cr.	22.9		Mission Cr.	21.9
Cottonwood Cr. (3rd order)	21.7		Potlatch R. (3 sites)	23.8 to 26.0
Cottonwood Cr. (4th order)	22.9		E. F. Potlatch R.	21.3
Grasshopper Cr.	24.2		Rock Cr.	19.6

The temperature variability among sites and mean water temperatures in isolated pools are unknown, but are likely similar to patterns observed elsewhere in the Lower Clearwater River Basin. Kucera and Johnson (1986) reported a wide range of summer water temperatures in several Clearwater River tributaries among pools in the same stream that were sometimes separated by relatively short distances. Some sampling locations contained pools with temperatures much cooler or much warmer than nearby pools, presumably due to the relative abundance of phreatic (springs) and hyporheic (shallow subsurface stream flow) flows in the pools. Since Sweetwater and Webb Creeks appear to gain surface flows in certain stream reaches, it is likely that at least some of the pools that remain in summer are fed by relatively cool water, and are buffered from air temperatures to some degree. It is also likely that the degree of groundwater influence has varied from year to year, depending on weather patterns. The effect of the LOP on water temperatures outside of summer are not documented, but can be logically inferred. When the LOP has been operated in winter, it likely lowered average water temperatures and increased the variation in water temperatures through the effects of reduced flow. Groundwater influences have likely moderated water temperatures in those places where pools have a large influx of phreatic or hyporheic flows.

Past LOP operations likely precluded or reduced steelhead reproduction in many years. Steelhead incubation requires flows sufficient to keep eggs moist, provide oxygen, and flush metabolic wastes. The amount of flow needed for incubation depends on the particle size distribution of the gravels, with coarser particles providing less flow resistance than smaller particles, such as sand. The likelihood of egg and alevin survival depends on the local hydraulic conditions where each redd is located. If flows are abruptly dropped below 1 cfs in Sweetwater or Webb Creeks, redds located in suboptimal locations are likely to become dry.

Survival of eggs and alevins is dependent upon intergravel flows affected by water velocity and the hydraulic characteristics of the redd (Chapman, 1988; Young et al. 1990). Reduced interstitial flows in the gravels increases egg mortality by reducing oxygen or providing inadequate flushing of metabolic wastes (Chapman, 1988; Young et al. 1990). In addition, alevins may not be able to emerge from the streambed with insufficient flow (Phillips and Koski 1969; Chapman 1988; Young et al. 1990). Steelhead eggs are capable of normal development in dewatered redds, as long as the gravels retain suitable moisture (Reiser and White 1983). However, alevins cannot survive in moist gravel once they develop gills (Becker et al. 1982), and fry require adequate stream flows to swim out of the redds and reach rearing areas. Past LOP operations have abruptly reduced stream flows in Sweetwater and Webb Creeks in the months of April, May, and June, depending on the water year. Flow reductions in April occurred when adult steelhead were likely in the midst of spawning; flow reductions in June occurred before steelhead incubation was completed or fry emerged from the redds, and flow reductions in July likely exposed fry to risks of stranding.

2.1.2.4. Channel-Forming Processes

The past operations and maintenance of the LOP have influenced the channel forming processes in the Lapwai drainage. Channel form is governed primarily by the relative amounts of sediment supply and stream flows, along with any external constraints such as bedrock, woody debris, riparian vegetation, and floodplain characteristics. A channel is more or less in equilibrium when the average amount of sediment delivered to the stream is equal to the average amount of sediment transported out of the stream over the course of several years. When sediment input exceeds transport capacity, sediment will accumulate in the channel and along stream banks (aggradation); conversely, when transport capacity exceeds sediment supply, the stream banks and/or stream bottom will begin to erode (degradation) and cause channel incision.

A significant portion of Sweetwater Creek below the diversion dam appears to have been intentionally straightened or channelized by excavation or construction of levees. Straightening a channel increases its slope, which accelerates the stream flow. Increased channel slope, along with increased channel confinement, exponentially increases the transport energy in the channel, and is a common cause of channel incision. Once a channel is incised in this manner, the levees typically prevent a channel from making natural adjustments and the channel remains in a perpetual dysfunctional state.

Most of the Sweetwater Creek channel below the diversion dam is incised to varying degrees. The channel cross-section diagrams in BOR (2009) indicate that the upper reaches of Sweetwater Creek, nearest to the diversion dam, are recovering from past incision, while reaches closer to the mouth tend to be actively incising. Webb Creek, however, has only a few locations where straightened or channelized reaches occur. The channel cross-section diagrams indicate that most of the Lower Webb Creek channel appears to be adjusted to the prevailing sediment and water regimes, and the stream generally has a functional floodplain. A few areas show signs of minor aggradation or degradation, but these appear to be mostly localized adjustments that occur from scour, sediment deposition, and meander development rather than changes in the overall channel elevation.

2.1.2.5. Steelhead Baseline

The Sweetwater Creek drainage, including Webb Creek, is approximately 84 square miles, which is roughly 30% of the Lapwai Creek drainage, but less than 1% of the area occupied by the Snake River Basin steelhead DPS. The StreamNet (2004) database estimates potential steelhead smolt production in the Lapwai drainage to be 5,000 smolts, which would be 2% of the Lower Mainstem Population, if all streams, including the Lapwai drainage, were producing fish near their potential. Steelhead in the Lower Clearwater River Basin are believed to be predominantly A-run fish (NPT and IDFG 1990) of natural origin, with little influence from hatchery introgression (TRT 2003). Based on tissue samples from natural and hatchery steelhead, Waples (1995) concluded that steelhead in the Lower Clearwater River showed no evidence of substantial genetic introgression by steelhead from the Dworshak Hatchery, in spite of widespread outplanting in the area. The Lower Clearwater River and its tributaries are among the few areas in the Snake River Basin with predominantly wild fish production and limited hatchery influence (TRT 2003).

Known inventories of steelhead in the Lapwai drainage come from electrofishing data from Sweetwater Creek by Kucera et al. (1983), Kucera and Johnson (1986), Fuller et al. (1984), and numerous Chandler reports (e.g. Chandler and Richardson 2006). Fish densities in the Lower Clearwater River Basin (See Table 8, NMFS 2006) have been inventoried sporadically since the 1980s. This inventory data shows Sweetwater and Webb Creeks support steelhead at densities similar to much smaller streams that have limited natural potential, such as Butcher, Corral, and Big Creeks, or severely degraded streams of similar or larger size, such as Lawyers Creek and Cottonwood Creek (tributary to the South Fork Clearwater River). Kucera et al. (1983) noted that fish densities in Sweetwater Creek were the 11th lowest out of 12 streams sampled in the Nez Perce Indian Reservation, and Fuller et al. (1984) ranked Sweetwater Creek the lowest of 17 streams in the reservation based on biomass and density. Densities of juvenile steelhead in Sweetwater and Webb Creeks are roughly 10 and 50 times lower, respectively, than the average density of juvenile steelhead of all the streams summarized (Table 8, NMFS 2006). Because the density data are not derived from random or stratified samples suitable for statistical analysis, the fish density values provide only a qualitative indicator of the magnitude of effect that the LOP may have on fish mortality.

Past flow reductions by the LOP in summer likely limited *O. mykiss* abundance in Sweetwater and Webb Creeks in all but the wettest years. Lake (2003) cites numerous examples of studies where invertebrate and fish populations were eliminated or greatly reduced by droughts, including a study by Davies et al. (1988), which found that recruitment of brown trout and steelhead in small headwater streams was severely limited in drought years. Fish densities reported by Chandler and Richardson (2005) in Sweetwater and Webb Creeks were 2 to 3 orders of magnitude lower than fish densities observed by Kucera and Johnson (1986) in nearby streams of similar size; however, more recent surveys in the Lower Clearwater River Basin show that steelhead densities in Sweetwater and Webb Creeks are intermediate to other streams (Figure 14). Although many factors besides stream flow affect fish densities, inadequate stream flows are likely to be an important factor causing low steelhead densities observed in Sweetwater and Webb Creeks below the diversion dams, but high stream temperatures and degraded channel conditions are also important factors contributing to the lower densities. The number of steelhead that can survive periods of low flows and partly dry channels is directly related to pool quality and availability, and wetted areas that function as refugia (*see* Magoulick and Kobza 2003). High temperatures force steelhead to rely on pools, and pools in Sweetwater Creek are reduced in number and size by channel alterations and by reductions in stream flow.

Chandler and Richardson (2005) electroshocked 11 sites in Sweetwater Creek and three sites in Webb Creek (below the diversion dams) in the summer of 2003, and found *O. mykiss* at all sites, with sizes ranging from 44 to 189 mm fork length. They also found *O. mykiss* above the diversion dams in Sweetwater and Webb Creeks. The relatively low numbers of fish observed are not known conclusively to be a result of LOP effects; however, a report attached to the inventory data (Kucera et al. 1983) attributes the low fish densities in Sweetwater Creek to low flows, sediment, and high temperature. Based on the body of scientific literature cited in this Opinion regarding effects of low stream flows, there is little doubt that few fish can survive several months in isolated pools with near-lethal temperatures, and little to no cover or food.

The ability to move in a stream is critical for steelhead survival. Juvenile steelhead in their first year, occupy shallow, low velocity areas in side channels and along channel margins to escape high velocities and predators (Everest and Chapman 1972). They progressively move toward deeper water as they grow in size (Bjornn and Rieser 1991). Juvenile salmonids require three general types of habitat and the ability to move freely among the habitat types. The three habitat types, described by Schlosser and Angermier (1995), and Fausch et al. (2002), include: (1) A mosaic of feeding areas such as pools, riffles, and stream margins; (2) transitory cover used when feeding; and (3) refugia from harsh conditions (e.g. extreme temperatures or low flow). The variety of habitats available to steelhead diminishes as stream flows decrease, which is likely to force steelhead to reside in lower quality habitats. When low flow causes portions of a stream to become dry, or discontinuous, juvenile steelhead cannot move between habitat types. Fish stranded in disconnected pools or wetted areas are likely to become separated from one or more habitat types needed for feeding, cover, or refugia. Separation from food causes reduced growth or death by starvation; separation from cover increases mortality from predators; and separation from refugia reduces growth rates or kills fish from temperature stress.

Juvenile steelhead that survive the summer in isolated pools and wetted areas are exposed to conditions that reduce their growth and vigor. Fish stranded in pools with low flows or stagnant water are likely to be exposed to high concentrations of wastes and toxic materials, and low levels of oxygen (Lake 2003). High temperatures are also likely to occur in isolated pools with low volume or low intergravel flow; however, those pools that receive a relatively large amount of water from intergravel flows may have temperatures in some parts of the pools that are much lower than the pool as a whole. Nielsen et al. (1994) documented the use of thermally stratified pools as refugia by steelhead and other salmonids. The fact that juvenile *O. mykiss* occupy the Lapwai drainage and other LCR tributaries where temperatures exceed those considered lethal, highlights the importance of thermal refugia for survival. When water temperatures approach the upper lethal limit, but are not lethal outright, high temperatures can cause delayed mortality and reduced growth rates through behavioral effects such as: (1) Changes in the timing of migration; (2) reduced ability to maintain feeding stations and to capture enough food to grow; (3) increased susceptibility to disease, predation, and competition; and (4) dietary demands that may exceed available food resources (Brett 1956; McCullough 1999; Reeves et al. 1987). Food, in particular, is likely to become scarce or non-existent in disconnected pools and wetted areas, since invertebrate drift on which juvenile steelhead feed, cannot occur without flowing water, and invertebrate production in an isolated pool is likely to be quickly depleted.

Steelhead that are weak or small in size when reaching the ocean have a low probability of surviving their first year in the ocean, due to higher vulnerability to predation or exhaustion (Beamish and Mahnken 2001; Sogard 1997; Holtby et al. 1990). Poor growth conditions in fresh water result in under-sized smolts with lower survival rates to the adult stage (Beamish and Mahnken 2001; Holtby et al. 1990; Miyakoshi et al. 2001; Sogard 1997). Consequently, the conditions found in small, isolated pools are not likely to produce large, healthy fish, and steelhead that survive the summer in isolated pools are unlikely to survive once they reach the ocean.

NMFS knows of no published surveys of steelhead spawning or steelhead redd counts in Sweetwater or Webb Creeks. The Cottonwood BLM has records of adult steelhead spawning in numerous Clearwater River tributaries, including Big Canyon, Little Canyon, Sally Ann, Three Mile, and Bedrock Creeks (C. Johnson, pers. comm.). The StreamNet (2004) fish distribution data indicates that Sweetwater, Lapwai, and Mission Creeks support steelhead spawning and rearing. There are anecdotal accounts of adult steelhead spawning in Lapwai Creek, above and below Sweetwater Creek, including photographs of adult pairs constructing redds on March 5, 2003, and April 14, 2003, by Tribal fisheries biologists (E. Taylor, pers. comm.). There are no conclusive data that indicate whether juvenile *O. mykiss* in Sweetwater and Webb Creeks are offspring of resident or anadromous fish, or a combination of both, but there appears to be few mature resident fish in the streams. Snake River Basin steelhead typically reach reproductive maturity from 2 to 4 years of age, and steelhead smolts rarely remain in fresh water after 3 years (Simpson and Wallace 1982).

Chandler and Richardson (2005) found no *O. mykiss* greater than 2 years of age below the diversion dams in Sweetwater and Webb Creeks; however, they observed one *O. mykiss* believed to be greater than 2 years of age in Sweetwater Creek above the diversion dam. *O. mykiss* are known to move progressively into deeper waters as they increase in size (*e.g.* Bjornn and Reiser 1991). The lack of mature *O. mykiss* in Sweetwater and Webb Creeks below the dams could be caused by a lack of deep pools from straightened channels, streamside dikes, and reduced flow. However, the BOR (2007b) reported pools ranging from 20 to 39 inches deep in Sweetwater Creek at a bypass flow of 1 cfs at the Sweetwater dam; the BOR (2009) similarly reported pools ranging from 24 to 50 inches deep in Lapwai Creek at a Sweetwater dam bypass flow of 2.18 cfs.

The historic role of the Sweetwater and Lapwai Creeks area in its contribution to steelhead abundance in the Lapwai Creek drainage is likely to have been changed by the LOP. The supply of abundant, cold water from the Twenty One Ranch spring in summer is likely to have been diverted and Sweetwater and Lapwai Creeks, below the confluence with Sweetwater Creek, were unable to serve as an important refuge in times of low flows and hot weather when other nearby streams might be dry. Steelhead and other salmonids rely on thermal refugia to survive periods of drought (Lake 2003, Matthews and Berg 1997). Flows from the spring likely maintained suitable temperatures throughout portions of the entire stream during much of the summer, which would have provided favorable growth conditions. Salmonid densities and distributions are closely tied to the availability of thermal refugia, as found by Torgersen et al. (1999) in Northeastern Oregon. Thermal refugia often occur in scattered patches in a stream (Torgersen et al. 1999), and likely create source-sink dynamics where fish that survive in patches of thermal refugia repopulate areas where fish perish from temperature extremes (Magoulick and Kobza 2003). In the past, Sweetwater Creek was likely a unique “source” of steelhead in the Lapwai Creek basin in times of low flows, which was lost when the LOP dried the streams in summer.

2.1.2.6. Environmental Baseline Summary

Fish habitat in Sweetwater, Webb, and Lapwai Creeks has been degraded by roads, limestone mining, conversion of forests to crop production, commercial timber harvest, cattle grazing, residential housing, horse farms, water withdrawals by the LOP and other smaller diversions, and fish passage barriers. The collective result of habitat degradation in the Lapwai Creek drainage is an aquatic landscape characterized by inadequate stream flows, excessive temperatures, structural impediments, degraded riparian corridors, simplified and reduced instream habitat, and excessive erosion (Ecovista et al. 2003). Lapwai Creek has also been extensively altered by past efforts to move and channelize the stream by the Idaho Transportation Department, landowners, and the Clearwater Shortline Railway Company. Flows from the Twenty One Ranch spring have likely been reduced compared to discharge rates prior to use of Lake Waha by the LOP, due to a combination of extended drought conditions and use of the lake as a source of irrigation water.

In Sweetwater Creek, the diversion dam blocks upstream fish passage. When the diversion dam in Sweetwater Creek is in operation, all or nearly all of the available surface flows have typically been diverted out of Sweetwater Creek from late summer through early fall, leaving only scattered pools and alternating stretches of surface and subsurface flows in many years. The reduction in stream flows from the diversion dams and draw-down of Lake Waha has changed

Sweetwater Creek from a unique, low-elevation stream with cool water and high flows in summer, to a system that is largely dewatered in summer with warm water temperatures that approach the upper limit for steelhead.

The LOP has had similar effects on stream flows in Webb and Lapwai Creeks. The Webb Creek diversion dam is located upstream of an impassable natural fish barrier. Streamflow reductions in Webb Creek often dewatered the stream, and no flows were provided for Webb Creek until 2009. Past LOP operations seriously lowered flows in Lapwai Creek, but beginning with 2006, bypass flows at Sweetwater diversion have added to the flow in Lapwai Creek. The BOR did document stream connectivity in Lapwai Creek in 2007 below the confluence with Sweetwater Creek.

The Lower Mainstem Population is among the few remaining indigenous stocks of A-run steelhead that are not influenced genetically by hatchery fish. Steelhead abundance in the Lapwai Creek drainage is relatively high compared to the Lower Mainstem Population as a whole in spite of severe habitat alterations in portions of the drainage. The Lapwai Creek drainage has high potential for steelhead production if degraded habitat were restored, and it is an important source of A-run steelhead production.

2.1.3. Effects of the Action

'Effects of the action' means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). The effects of the action under consideration include the direct, indirect, and cumulative effects of the proposed operation and maintenance of the LOP on the Snake River Basin steelhead DPS, Snake River spring/summer Chinook salmon, fall Chinook salmon, and critical habitat for these species. An abbreviated analysis is provided for the effects of the LOP on Snake River spring/summer and fall Chinook salmon, which occur outside the Lapwai Creek drainage and in areas where the proposed action has minor effects. The Opinion is focused primarily on Snake River Basin steelhead in the Lapwai Creek drainage where the flow alterations have their greatest effect.

The proposed action has both direct and indirect effects, but no known effects of interrelated or interdependent actions. Interrelated actions "are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR 402.02). Future Federal actions that have not undergone section 7 consultation are not considered in this Opinion.

NMFS' fundamental determination in conducting ESA section 7(a)(2) formal consultation is to determine whether a proposed action is or is not likely to jeopardize listed species, or destroy or adversely modify designated critical habitat. To make those determinations, NMFS assesses the status of the species and critical habitat, the environmental baseline in the action area, and the cumulative effects. The status information provides an overall assessment of the risks that listed species presently face for their long-term survival and conservation. The environmental baseline provides a more focused look at factors in the action area that bear on that risk. In effect, the species' status and the environmental baseline are "snapshots" of a species' health at a specified point in time, and the environmental conditions in the action area, respectively. The cumulative effects discussion provides a forward-looking assessment of certain reasonably likely future actions that will eventually bear on that risk.

In contrast to status, baseline, and cumulative effects information, the effects of the action are the environmental changes caused specifically by the proposed action. In the context established by status, environmental baseline, and cumulative effects assessments, the effects analysis examines how environmental changes caused by the proposed action bear on, and exacerbate or ameliorate existing risk to the species and their critical habitat. The determinations based on these analysis do not rest on whether critical habitat and listed species in the action area become better or worse under the proposed action. The jeopardy analysis turns on whether and to what extent the effects of the proposed action on fish in the action area influence the existing prospects for species survival and conservation. Similarly, but distinctly, the adverse modification analysis turns on whether and to what extent the effects of the proposed action on PCEs of critical habitat in the action area influence the conservation role or value of the designated critical habitat.

The most important effect of the proposed action is the modification of the natural flow regime in the Lapwai Creek drainage. As described in the Environmental Baseline, past operation of the LOP removed more water from the action area than would the proposed future operations. Those past operations have contributed to the status of the listed species and critical habitat in the action area. To determine how the proposed action is likely to affect listed species and critical habitat in the action area, the effects analysis consists of five parts: (1) Stream flows that will occur under the BOR's proposed action; (2) environmental consequences resulting from environmental baseline conditions, the proposed action, and cumulative effects; (3) individual fish response to the environmental conditions likely to occur under the proposed action; (4) functional condition of PCEs in the action area and the consequences of those conditions on the conservation prospects of the critical habitat designation; and (5) population-level consequences of the biological and environmental effects.

Changes in stream flows are assessed by examining the difference between the flow regime that is likely to occur under the proposed action with the regime that is estimated, based on models and available information, to exist in the absence of flow regulation by the LOP. The difference between these two flow regimes provides insights on the degree to which the project affects the species and habitat within Sweetwater, Webb, and Lower Lapwai Creeks. With this analytical approach, the effects analysis integrates effects of the proposed action with environmental changes that have occurred prior to 2010, including past operation of the LOP.

Having analyzed the effects of the proposed action on stream flows, NMFS then examines the consequences of those effects on fish habitat, as that habitat exists currently as described in the Environmental Baseline. Environmental consequences of the action are examined by considering changes to habitat features such as depth and velocity, as well as changes in other habitat components such as channel morphology, temperature, and substrate that are related to stream flow. For the critical habitat analysis, NMFS assesses how these environmental effects bear on the functional condition of the PCEs of critical habitat in the action area.

After describing the modifications to the flow regime that the proposed action is likely to cause and the resulting effects to fish habitat, NMFS assesses the extent to which these habitat changes affect individual fish, and individual effects are then used to infer how fish abundance would be affected in the action area. Unlike habitat effects that can be quantified from measurements or estimates of stream flow, effects of the action on fish abundance are inferred from general principles established in scientific literature. The general effects of environmental conditions on the growth and survival of individual fish are well established, and whether a particular circumstance is favorable or unfavorable to fish can be reliably predicted. Quantitative predictions of changes in fish abundance that are likely to be caused by the action cannot be reliably predicted from available information. Identical changes to depth and velocity in one particular stream will not always affect fish to the same extent in another stream since numerous habitat characteristics that vary among different streams may either amplify or dampen the effects of changes in flow. Fish respond to the integrated effects of all environmental and biological features in a stream (Murphy and Meehan 1991), and each streams has many unique characteristics that integrate stream and watershed characteristics at multiple scales (Fausch et al 2002). In light of this fact, quantitative models used in the analysis to predict steelhead abundance are viewed as general indicators of effect rather than actual quantitative predictions, since the relationship between stream flows and fish abundance in the Sweetwater, Webb, and Lower Lapwai Creeks has not been established and there are no means available to objectively determine the accuracy or reliability of the estimates.

To conduct the jeopardy analysis, NMFS analyzes the extent that changes in fish abundance in the action area affect the status of the population groups to which those fish belong, and whether such changes to the status, if any, appreciably reduce the prospects for survival and recovery of the DPS which is comprised of those populations. This analysis relies heavily on the status of the species since the risks faced by the DPS are not determined solely by habitat conditions or steelhead abundance and productivity in the action area. The prospects for survival and recovery of a DPS depend largely on factors that influence population status such as how well the species is distributed in its remaining habitat, the overall abundance, and the trends in abundance that exist under the environmental baseline. The jeopardy analysis is based on investigating the extent that any of the factors affecting population status are changed by the proposed action.

The critical habitat analysis begins with the same assessment of habitat change in the action area described above. But in contrast to the species analysis, the critical habitat analysis focuses on the conservation value of critical habitat and the action's effects on the functional condition of PCEs in the action area, rather than on fish. After analyzing action area effects, NMFS assesses the conservation role of the affected PCEs in the watersheds in which the action area lies, and in turn the conservation role of the watershed relative to the entire geographic designation of critical habitat. To make the adverse modification determination, NMFS finally assesses whether changes in PCE function at the local scale would appreciably diminish the ability of critical habitat to serve its intended conservation role or diminish the conservation value of critical habitat.

NMFS considers the effects of the proposed action on the potential for recovery in both the jeopardy and the adverse modification analysis. The ESA regulations define "jeopardize the continued existence of" as “engag[ing] in an action that would reasonably be expected, directly or indirectly to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing the reproduction, numbers, or distribution of that species." Recovery plans provide criteria that describe what "recovery" looks like. The criteria describing the characteristics of recovered species also provide metrics that are useful for evaluating the effects of human actions on listed species. While there is no final recovery plan for the Snake River Basin Steelhead DPS, the TRT, comprised of biologists from universities, state and Federal agencies, and the Columbia River Intertribal Fisheries Commission, has produced an analysis of the recovery needs for listed salmon and steelhead in the Snake River and mid-Columbia River Basins. The TRT’s viability assessment and interim recovery goals (until a recovery plan is adopted by NMFS) are the basis for the discussion of recovery in this Opinion, and this the best available science regarding recovery. NMFS' critical habitat analysis determines whether the proposed action will destroy or adversely modify designated or proposed critical habitat for ESA-listed species by examining any expected changes in the conservation value of the essential features of that critical habitat. To determine whether the proposed action is likely to jeopardize the continued existence of the DPS or to destroy or adversely modify its critical habitat, NMFS adds the effects of the action to the environmental baseline in the action area and any cumulative effects in the action area, and considers the aggregate effect in light of the status of the species or critical habitat. Thus, the jeopardy and adverse modification analysis considers the changes to the condition of the species and critical habitat in the context of their status given past actions, and the likely effects of other actions in the future.

Key Data Sources and Limitations

Observations and measurements made within the Sweetwater, Webb, and Lapwai Creeks drainages include both biological and physical data, consisting of stream gage measurements; fish and habitat inventories done by the Tribe and the University of Idaho (UI); physical habitat inventories by the BOR; water temperature logs; and cross-sectional measurements of depth, velocity, and substrate conditions at 65 locations in the action area. Although there is a considerable amount of information from the Sweetwater, Webb, and Lapwai Creeks, there are gaps in important information such as the natural hydrology of the Lapwai Creek Drainage and the statistical relationship between stream flows and fish abundance in these streams.

The LOP has operated annually for more than 60 years prior to the proposed action and, as a result, records of natural stream flows, elevations in Lake Waha, and hydrological processes in Sweetwater and Webb Creeks are not available. Stream gage measurements in Sweetwater and Webb Creeks have only been available since 2002, and, while these measurements have a high degree of accuracy, the period of record is too brief to represent the full range, frequency, and timing of flows that are likely to occur in these streams. The available stream gage records also appear to reflect relatively dry conditions, compared to previous decades, so data from other stream gages were used to estimate unregulated flows that would be more characteristic of the long-term average. Since knowledge of natural stream flows and hydrology is based on a limited set of data, the physical and biological effects of stream flow alteration resulting from the proposed action are inferred partly from modeling that relies on certain assumptions or extrapolation from other stream systems that are not identical to Sweetwater, Webb, and Lapwai Creeks. Because stream flow records are limited and weather is not entirely predictable, the frequency of opportunity-based flows and their incremental increases in discharge cannot be reliably predicted over a 10-year period. The opportunity-based flows are an important feature of the action that minimizes the hydrologic alterations, but they are not certain to occur with any particular frequency. Opportunity-based flows are not presumed to occur, and their general effects are described only briefly. The effects analysis is based on the assumption that only the minimum flows and flows in excess of the canal capacity are reasonably certain to occur on an annual basis. The effects analysis presumes that minimum flows will be provided as proposed (including certain allowances for mechanical failures and other causes for shortages that are specified in the proposed action) and stream flows in excess of the canal capacities will occur on an annual basis, as they have in recent dry years.

Biological inventories in Sweetwater, Webb, and Lapwai Creeks provide snapshots of juvenile fish densities and distribution from various years, but there are no reported estimates of the numbers of adult steelhead that annually return to the Lapwai Creek drainage, and there is limited information on summer survival rates of juveniles in the action area. Steelhead redds are often nearly impossible to count due to the coincident timing of steelhead spawning and spring runoff that creates flooding and extreme turbidity; therefore, no inventories of steelhead spawning are available. Pairs of spawning steelhead have been documented in Lapwai Creek near the mouth of Sweetwater Creek, which establishes steelhead spawning in the Lapwai Creek Drainage. Fish inventories have also found newly-hatched steelhead throughout the majority of fish-bearing segments of Sweetwater and Webb Creeks, in locations that suggest that the juveniles were hatched from redds in these streams since juveniles could not have swum upstream to reach these locations. There is no practical means to distinguish juvenile fish as resident or anadromous during field surveys, but resident *O. mykiss* that are large enough to reproduce do not appear to be in sufficient abundance to explain the number and distribution of juvenile *O. mykiss* in Sweetwater and Webb Creeks. Given these circumstances, NMFS assumes in this analysis that juvenile *O. mykiss* up to 3 years in age that have been observed in Sweetwater and Webb Creeks are largely offspring of anadromous fish and their densities are representative of steelhead abundance.

There is uncertainty about the variability, frequency, timing, and volume of natural stream flows; the number of steelhead that spawn in the action area; and the survival rates of juvenile steelhead; therefore, most biological effects are assessed with statistical models or inference from published scientific literature rather than direct observation. The effects analysis relies on predictions of future effects of the action in the stream system by drawing largely on general knowledge of hydrology and biology, in addition to site-specific information from the action area. By necessity, some of the analysis is based on unproven, but well-informed scientific assumptions. In particular, there is considerable uncertainty about the accuracy of the models used to evaluate changes in habitat and fish abundance in response to changes in stream flows. The models used for this purpose are state-of-the-art, but the results partly depend on the choice of assumptions used in the model. There are no means to verify the results of the fish population model, no objective means to determine whether the assumptions are valid for this particular setting, or if the model results are realistic. However, there is sufficient published scientific literature to understand the strengths and weaknesses of the various models, scientific concepts, and assumptions used in the analysis. Modeled results are used in this analysis as qualitative indicators of effects in conjunction with published scientific information and inventory data to arrive at a weight-of-evidence analysis.

Part of the uncertainty stems from incomplete data, which requires use of lower-quality data and less-reliable inferences to fill the data gaps. In some cases, data are contradictory or inconsistent, with no objective means to resolve contradictions; however, the pertinence, accuracy, and reliability of the data sources vary, and some information sources are given greater deference than others. When data sources are inconsistent or contradictory, deference is given to data with the greatest accuracy, reliability, and pertinence to steelhead and habitat conditions in Sweetwater, Webb, and Lapwai Creeks. Data accuracy, reliability and pertinence are generally weighted in this order, from highest to lowest: (1) Observations made in Sweetwater, Webb, and Lapwai Creeks; (2) models based on data and mathematical relationships developed in Sweetwater, Webb, and Lapwai Creeks; (3) inferences drawn from peer-reviewed scientific literature; and (4) inferences drawn from observations from other stream systems or general models.

2.1.3.1. Habitat Effects of the Action

The proposed action affects anadromous fish and their habitat primarily through the consequences of stream flow alterations. The LOP also has minor effects on sediment transport in the stream channels below the Sweetwater Creek diversion dam. The LOP withdraws the vast majority of its water from Sweetwater and Webb Creeks, which significantly affects stream flows and fish habitat conditions in the lower reaches of Sweetwater, Webb, and Lapwai Creeks. In these stream segments, base flows during the summer and early fall are largely dependent on the amount of water provided by LOID. From November through February, stream flows in Sweetwater Creek are affected by the capture of water in Soldiers Meadow Reservoir. Outside the Lapwai Creek drainage, the effects of the action are less significant. In the analysis that follows, habitat effects analysis are described for Captain John, Lindsay, Sweetwater, Webb, and Lapwai Creeks, and downstream effects in the Clearwater, Snake, and Columbia Rivers, but the primary focus of the analysis is on Sweetwater, Webb, and Lapwai Creeks.

The effects analysis evaluates the effects of water diversion and storage, and minimum flows that are likely to occur under the proposed action. Since the proposed action is a change in on-going operations, it causes many of the same effects as past operations described under the environmental baseline, and the distinction between baseline conditions and effects of the action is not readily discernable. As a consequence, the effects analysis uses “unregulated” flows as a point of reference for describing effects of the action rather than strictly analyzing changes to the environmental baseline. Unregulated flows are estimates of conditions that would likely to exist in the absence of the LOP. Unregulated flows provide an essential point of reference that is necessary to understand how the proposed action affects the environment. Unregulated flows are not a description of the environmental baseline since the baseline also includes characteristics unrelated to stream flows and present effects of Federal actions (present LOP operations).

Unregulated flows are estimated from measurements of stream flows and volumes of water flowing into and out of reservoirs and canals. Unregulated flows were modeled by BOR from stream gage data that are available from 2003 through 2008. Average stream flows from 2003 through 2008 are relatively dry compared to previous years. The Tribe and Entrix (2009) extended the range of unregulated flow estimates to include a wider range of weather conditions from 1980 through 2009 by using correlation between the Lapwai Creek and Lolo Creek stream gages. The BOR model, based entirely on data measured in the LOP system, is more accurate than estimates made from the Lolo Creek stream gage, but the period of record used by BOR is not likely representative of the long-term average. The dataset used by the Tribe and Entrix is not as accurate as the BOR model, but it is likely to be more representative of the long-term average, which is wetter on average than the period from 2003 through 2008. The extended dataset from the Tribe and Entrix is used in this Opinion to represent unregulated flows since the amount of flow alteration may be underestimated by data from the shorter period of record used by BOR.

When a new action changes an on-going operation such as the LOP, the changes themselves may be beneficial or detrimental to listed fish when compared to past operations, but the aggregate effect does not necessarily change accordingly. When a baseline has been degraded by an on-going action, entirely beneficial changes to the action could cause favorable or unfavorable conditions for listed fish, depending on the circumstances. The relevant issue at hand in this biological opinion is the degree to which the environmental and biological conditions in the action area affect the survival and recovery of listed fish as a result of the proposed action, and not simply an analysis of changes made to previous operations. This is a circumstance that is unique to consultations on on-going activities where environmental baseline conditions are substantially influenced by discretionary actions of a Federal agency. The proposed action improves stream flows in Sweetwater and Webb Creeks during the summer irrigation season, relative to the baseline, which have likely been a significant source of mortality. The proposed action may also withdraw a greater amount of water from Sweetwater Creek on annual basis than has occurred in the recent past, which could create greater impacts on stream flows during the spring runoff period compared to the baseline. Although summer stream flows are improved under the proposed action compared to the baseline, they are not restored to levels that would occur in the absence of the LOP. The effects of water withdrawals and stream flows under the proposed action are described below.

The LOP affects stream flows whenever unregulated flows are captured by Soldiers Meadow Reservoir or stream flows anywhere in the system diverted out of a stream. The LOP diverts water from the headwaters of the Captain John Creek drainage, upper West Fork of Sweetwater Creek, and the mainstems of Webb and Sweetwater Creeks. From 2003 through 2008, the average amount of water diverted through the Sweetwater Canal has averaged 6,972 af of water, with the majority of water coming from Sweetwater and Webb Creeks and a minor amount coming from the Captain John Creek drainage. Water is stored in Soldiers Meadow Reservoir and Lake Waha, which are located in the Webb and Sweetwater Creek drainages, respectively, and Reservoir A (Mann Lake), which is located in the Lindsay Creek drainage. Soldiers Meadow Reservoir collects water from Upper Webb Creek, whenever streams above the reservoir are flowing, and the reservoir collects water diverted from the Captain John Creek drainage for several weeks during the spring runoff period. Water diverted from the West Fork of Sweetwater Creek is collected in Lake Waha, which is a natural lake that is used as reservoir. Lake Waha naturally captures stream flows from the Lake Creek drainage. Lake Waha has no surface outlet for the water, but water drains out of the lake through subsurface flows that emerge at the Twenty One Ranch Spring. The LOP draws water from Lake Waha with a pump that pipes water into an unnamed tributary of the West Fork of Sweetwater Creek.

Reservoir A is the lowest-elevation reservoir in the LOP system, and all water used by LOID is drawn from Reservoir A. Storage capacity in Reservoir A has often been a significant constraint on the amount of water than can be used by LOID. Reservoir A is located in the Lindsay Creek watershed, but the water in the reservoir comes almost entirely from the Sweetwater canal. An insignificant amount of intermittent surface flows from Lindsay Creek are captured in Reservoir A. The majority of water stored each year is collected between late February and mid June. Together, the LOP reservoirs have an active storage capacity of roughly 8,000 to 9,000 af, based on the maximum capacities of Soldiers Meadow Reservoir and Mann Lake and the average volume of water stored in Lake Waha from 2005 through 2008. However, the maximum storage capacity is seldom reached in these reservoirs. The storage and use statistics under past operations cited in the BA indicate that the average volume of water storage at the beginning of each season has generally been less than the average volume of water that is diverted out of Sweetwater Creek. Consequently, the LOP has relied partly on capturing surface flows from Sweetwater and Webb Creeks throughout the irrigation season. Hydrologic effects of the LOP are constrained by water availability and the capacities of canals and reservoirs. Once reservoirs fill, or when stream flows exceed the capacities the diversion canals, water in excess of the capacities remains in the streams.

Four different flow scenarios occur at different times each year under the proposed action: (1) Flows that are largely unimpaired when the LOP is not diverting water; (2) minimum flows whenever the LOP is diverting water and base flows are less than the capacities of the diversion canals in Webb or Sweetwater Creeks; (3) opportunity-based flows that are higher than the minimum flows when sufficient water is stored in reservoirs; and (4) stream flows during the operating season that are higher than the minimum or opportunity-based flows whenever the capacities of the diversion canals are exceeded and stream flows are beyond LOP control.

The effects analysis is based only on stream flows that are reasonably certain to occur on an annual basis and which are affected by the LOP operations. Flows that are reasonably certain to occur consist of the proposed minimum flows and flows in excess of diversion canal capacities. Flows in excess of LOP capacities are likely to occur annually since spring runoff events are characteristic of the regional climate and watershed with mountainous topography.

As explained previously, there are gaps in the data concerning instream flows in Sweetwater, Webb, and Lapwai Creeks. The following assumptions are used in the effects analysis to address uncertainties in stream flows:

- Stream flows observed in the Lapwai Creek Drainage during the past decade are generally drier than the long-term average.

- Stream flows in Webb Creek when the LOP is not diverting water are captured by Soldiers Meadow Reservoir, but likely resemble unimpaired flows. Soldiers Meadow Reservoir captures an unknown amount of water from Upper Webb Creek year-round, but the drainage area is relatively small and the streams captured by the reservoir typically do not flow year-round. When the LOP is not diverting water (November through January), stream flows captured by Soldiers Meadow Reservoir are likely to be insignificant since the small streams are usually dry or nearly so at the beginning of November, and the ground is typically frozen and snow covered through this period.

- Stream flows in Sweetwater Creek when the LOP is not diverting water are indirectly influenced by manipulation of the water levels in Lake Waha, but the actual effect is unknown. Elevations in the lake vary naturally with the amount of inflow, so the "natural" elevation is not fixed. There are no accurate records of natural inflows and volumes of water diverted into lake; consequently there is no way to know what the elevation of the lake would be in the absence of LOP effects. Estimates of "unimpaired" flows in Sweetwater Creek used in this Opinion may differ from the actual unimpaired flows due to unknown effects of the action on Lake Waha. Effects of the lake elevation on stream flows are most significant in summer and least significant in winter.

- Opportunity-based flows provide a mechanism that contributes toward a more natural range of annual flow variation, but no assumption is made that opportunity-based flows would necessarily occur during the 10-year operating period. This assumption helps minimize the likelihood of overestimating actual flows that will occur under the proposed action. Year-to-year variation in flow is an important aspect of a natural flow regime, but there is not enough certainty in future operations and weather conditions to evaluate the likelihood of these higher flows in a 10-year period.

- No more than 32 cfs (highest value reported in the BA) will be diverted through the Sweetwater Canal and no more than 20 cfs will be diverted through the Webb Creek Canal, since the facilities are physically incapable of diverting more than this amount in their present configuration and there no proposed changes to these capacities.

- Stream flows in excess of the canal capacities are reasonably certain to occur annually during the 10-year operating period since the capacities of the diversion canals in Webb and Sweetwater Creeks are considerably less than peak flows during the spring runoff period, rain-on-snow events, and intense thunderstorms, and this general weather pattern is unlikely to change during this period. There is an annual pattern of snow accumulation in the winter, a transitional period of rain and snow in the fall and spring, and a dry summer period with occasional rainstorms. Although there is considerable variation in weather from year to year and a long-term trend toward less snow and more rain during winter, this general pattern occurs annually throughout the Clearwater River Basin, and there is no year on record where the region lacked winter snow accumulation followed by a period of snowmelt and elevated stream flows. Stream gage records from Sweetwater and Webb Creeks represent a period that has been drier than average; therefore, the frequency and magnitude of high flow events during the next 10 years are likely to be at least as high as the period of record.

- Streamflows in the 2008 and 2009 irrigation seasons represent conditions under flows that are less than the proposed action, but much closer to the proposed action than previous operations. The data from this period provides insight to environmental conditions that are likely to exist under the proposed action, but the effects of the action are not identical to the effects of 2008 and 2009 operations.

- Stream flows downstream from the LOP diversion dams in Sweetwater and Webb Creeks are assumed to reach the mouths of these streams in amounts similar to volume released at the dams. Flows at the mouth may vary slightly from the amounts released at the diversion dams through natural groundwater gains that vary naturally or from water withdrawals from property owners in the drainage. Discounting the natural inflow provides a conservative estimate of effects that errors in favor of the species. Minimum flows provided to Sweetwater and Webb Creeks are legally protected from withdrawal by junior water-rights holders, and there are no water rights senior to BOR.

A. Hydrologic Effects of the Action in the Lapwai Creek Drainage

The proposed action will increase summer flows in Sweetwater and Webb Creeks compared to past operations, and to achieve this, a larger amount of water must be withdrawn and stored at other times of the year. Compared to past operations, the LOP will withdraw more water from Sweetwater Creek during the spring and early summer to make available more water for Sweetwater and Webb Creeks from mid-summer through the end of the irrigation season. The LOP is able to withdraw more water under the proposed action since the storage capacity of Reservoir A is increased by 480 af. The LOP may be capable of storing more water to meet minimum flows during the summer and to provide a similar amount of water to LOID as has occurred in the past. Additional water withdrawals would come primarily from Sweetwater Creek since the only significant opportunity for additional water storage is through use of the added capacity in Reservoir A and diverting a larger amount of water through the Sweetwater Canal. Lake Waha and Soldiers Meadow Reservoir generally capture as much water as circumstances allow, and there no means to significantly increase the storage in these reservoirs.

Effects of the Action on the Twenty One Ranch Spring

Unregulated flows in Sweetwater Creek are influenced significantly by discharge from the Twenty One Ranch Spring which is located in the West Fork of Sweetwater Creek. The precise nature of unregulated flows in Sweetwater Creek (Figure 7) are poorly understood due to the lack of stream flow measurements prior to use of the drainage for irrigation and uncertainty over natural hydrologic patterns from the unusually high, but variable discharge from the Twenty One Ranch Spring. The spring is fed by Lake Waha and discharge rates from the spring are positively influenced by the amount of water in the lake. Water has been diverted into the lake and pumped out of the lake for more than 40 years, so natural water elevations in the lake and natural discharge from the spring are unknown.

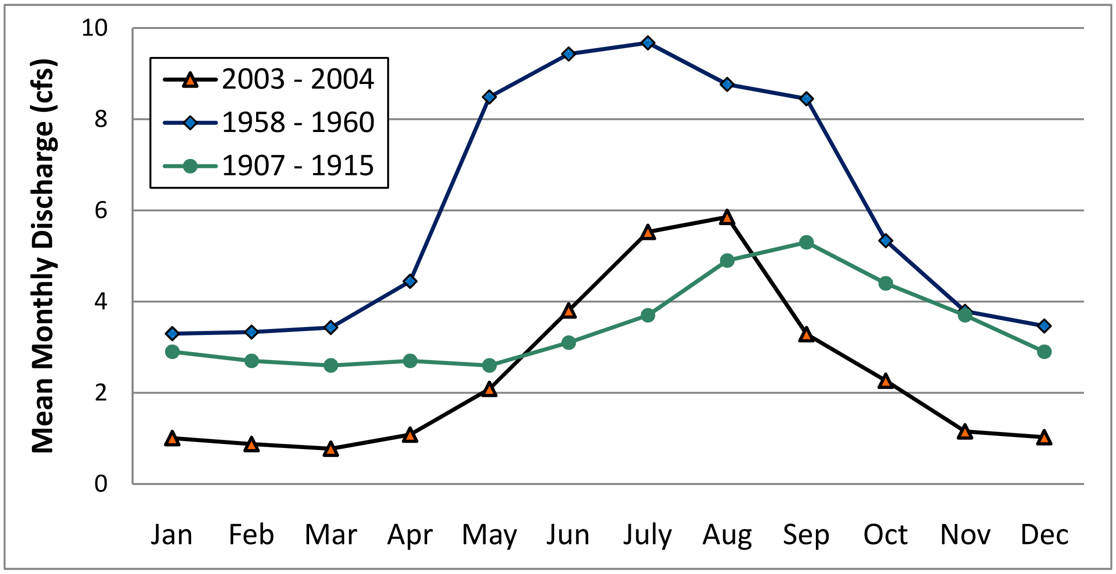


Figure 7. Discharge from the Twenty One Ranch Spring below Lake Waha. Data reported after 1915 are affected by the LOP. Data from 1958 through 1960 and mid-2003 through 2004 are from USGS stream gages.

In its natural state, the Twenty One Ranch Spring likely provided high, but variable flows in Sweetwater Creek during the summer, depending on the volume of water in the lake. Water elevations in the lake and discharge from the spring likely varied from year to year with changes in precipitation and runoff into the lake. Data on discharge from the Twenty One Ranch spring prior to the LOP (Figure 7) are scant and variable, but they show that under natural conditions in several years (prior to 1916), discharge ranged from 2.5 cfs to 6 cfs during summer and early fall. There is no way to know if these flow rates are characteristic of unregulated flows that might occur today. Data from 1958 through 1960 show that discharge from the springs can potentially be even higher than the flows observed from 1905 through 1915 if lake levels are raised. However, natural patterns in elevation of the water surface in Lake Waha are unknown. Lake Waha was receiving water diverted from the West Fork of Sweetwater Creek from 1958 through 1960 and there are no records available to determine whether the higher flows at this time were due to manipulation of water levels in Lake Waha, or if the flows were largely a natural phenomenon.

From November through January, stream flows in Sweetwater Creek may be affected indirectly by changes in the water elevation in Lake Waha through its effect on the Twenty One Ranch spring; however, the nature of the effect is uncertain. Stream flow records for the Twenty One Ranch Spring show that discharge from the spring during fall and winter has diminished from earlier decades (Figure 7). Weather conditions, LOP operations, and changes in lake bed permeability from sediment deposition are likely all factors causing differences in discharge, but there is insufficient information to determine the relative effect of each factor. Since stream flows in Sweetwater Creek during winter likely depend, to a large extent, on discharge from the Twenty One Ranch Spring, the LOP would affect winter stream flows if the water surface elevation in Lake Waha is changed by the LOP. If the LOP were to cause water levels to drop below or raise above "natural" elevations, stream flows in winter would be diminished or increased, respectively. It seems plausible that the LOP has reduced flows from the Twenty One Ranch Spring but, since natural inflows and outflows to Lake Waha are unknown, there is no direct information available to estimate "natural" water elevations nor to determine the effect of the action on winter outflows from the spring, which is a significant portion of the flow in Upper Sweetwater Creek during the Winter.

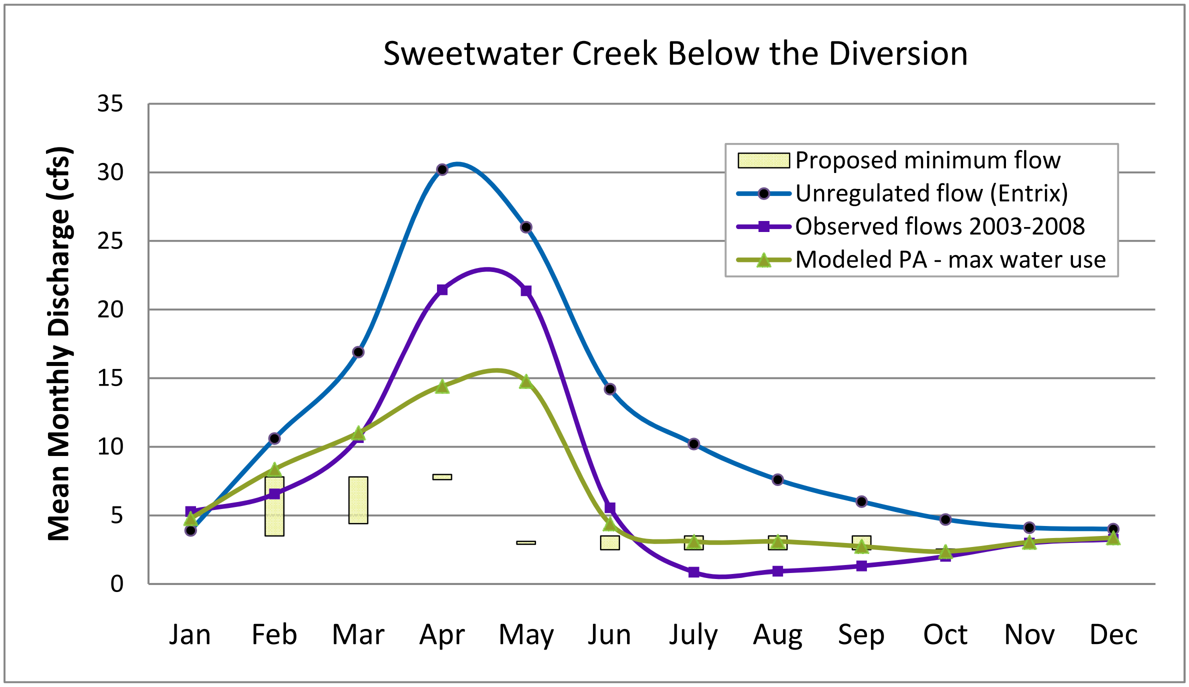
Effects of Minimum flows

The minimum flows in the proposed action are the primary source of stream flows in Sweetwater and Webb Creeks from mid-June through October. In Sweetwater Creek, the diversion dam is downstream from the Twenty One Ranch Spring and discharge from the spring no longer has a significant effect on stream flows below the dam when water is diverted. From February through October, whenever the streamflow above the Sweetwater diversion dam is less than the operational capacity of the diversion canal (roughly 30 cfs), water in excess of the proposed minimum flows can be diverted into Reservoir A as long as the reservoir is not already filled. Operation in this manner largely negates the effects of the Twenty One Ranch Spring whenever water is diverted from Sweetwater Creek. Although the Twenty One Ranch Spring has no significant effect on stream flows below the diversion dam when water is being diverted, discharge from the spring likely had a significant effect on unregulated flows during the summer, and knowledge of the spring's effect on flows is necessary to assess the hydrologic alterations caused by the proposed action.

Compared to flows in 2009, the proposed action increases minimum stream flow in Sweetwater Creek from June through October by 0.3 cfs at the Sweetwater dam, and additional 0.6 cfs in Webb Creek, but the proposed minimum flows, at times, would remain lower than unregulated flows by more than 50%. The LOP annually diverts or stores approximately 47% of the average annual water volume in Sweetwater Creek. The proposed action would provide a relatively constant rate of flow to Sweetwater Creek during summer and early fall. Stream flows would be fixed at 2.5 cfs at the dam to roughly to 3.5 cfs at the mouth, rather than a continual gradation of flows ranging from 2.5 cfs to 6 cfs, or more, as occurred under unregulated flows (Figure 8). The proposed action also shifts the hydrograph in Sweetwater Creek from an unregulated system with peak flows occurring in April and gradually tapering off from June through December, to a system with lower peak flows that occur a few weeks later and then rapidly drop in June (Figure 8). Overall, the proposed action retains flows that are within the range that occurred in the absence of the LOP, but stream flows from February through October would generally resemble flows that would have occurred only in drier years.

In Webb Creek, the LOP annually diverts or stores approximately 60% of the average annual water volume. The natural hydrology of Webb Creek differs from Sweetwater Creek since it is not influenced by the Twenty One Ranch Spring. The falling arm of the unregulated annual hydrograph drops more sharply from the peak flows in April to base flows in July (Figure 8); consequently, the stream does not naturally have the robust summer flows seen in Sweetwater Creek. The proposed action provides minimum flows that are greater than the baseline from July through October, and similar to the baseline in the remainder of the year. Compared to unregulated flows, the proposed action provides minimum flows that are higher than or equal to unregulated flows from August through October and, in the remainder of the year, minimum flows are less than unregulated flows. The timing of peak flows in Webb Creek under the proposed action would be unchanged from the baseline and remain similar to the timing of peak unregulated flows.

The overall effect of the hydrologic alterations caused by the LOP can be seen in Figure 9. The proposed action maintains summer flows in Sweetwater Creek that are characteristic of dry conditions during the majority of years; it might occasionally provide flows that are characteristic of more average flow conditions whenever “opportunity-based” flows are provided (but these flows are uncertain to occur); large floods would still occur on a regular basis; and the action would continue to eliminate sustained flows ranging from 3.5 to 7 cfs that might otherwise occur in Sweetwater Creek during the summer in some years. In Webb Creek, large floods would still occur on a regular basis; flows during the spring runoff period would continue to be reduced as they have in the past; summer flows would be characteristic of flows seen in wetter years; and extreme low flows that might occur naturally would be eliminated.



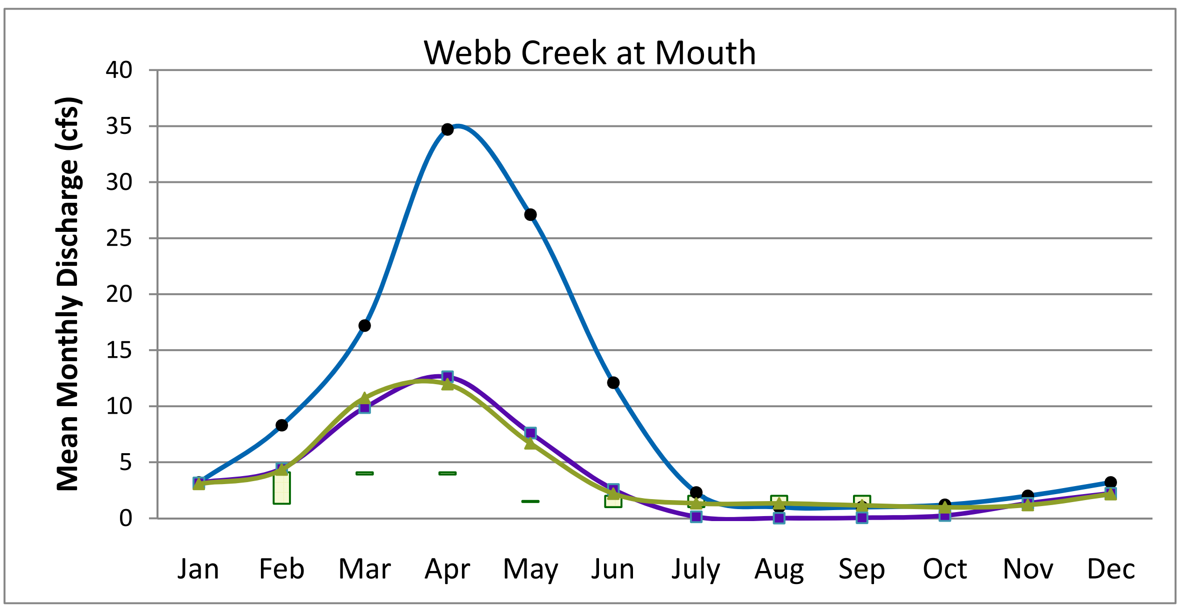
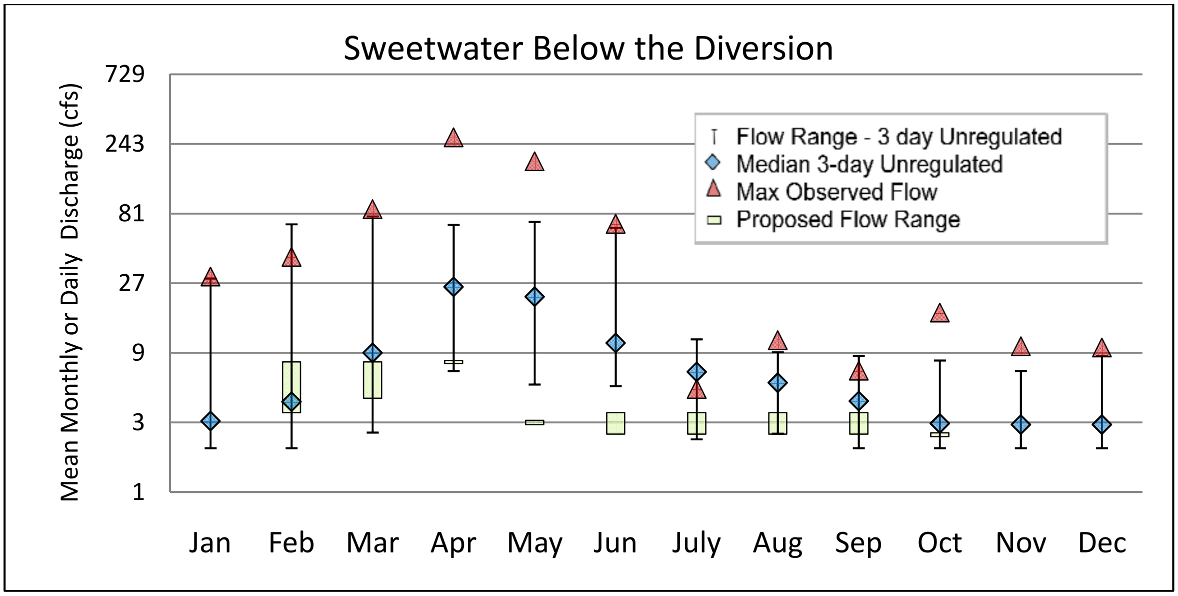


Figure 8. Mean monthly discharges for Sweetwater Creek below the diversion and Webb Creek at the mouth. Shown for the proposed minimum flow, unregulated flow (Nez Perce Tribe and Entrix 2009), observed flows from 2003 to 2008, and the modeled proposed action with the maximum water use.



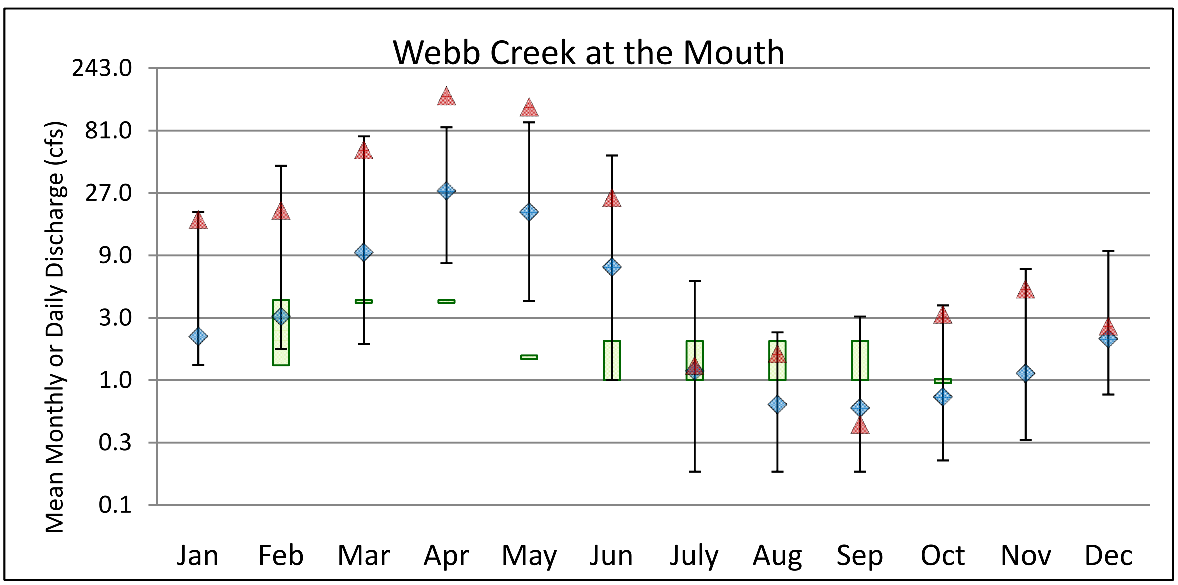


Figure 9. Unregulated flows are represented by range of the 3-day moving average of mean daily flows and median monthly flows predicted by BOR, and modified by adjusting negative model values to zero and by holding minimum flows at 2.5 cfs in Sweetwater Creek to account for the Twenty One Ranch Spring. Maximum observed flows are the highest daily average flows recorded by stream gages for each month, from 2003 through 2009. The proposed action is represented by boxes showing the range of flows that would occur under the proposed action. Minimum flows in the months of February and March are the lesser of the lowest inflows observed from 2003 through 2009 or the minimum bypass flow. The vertical axis is plotted on a logarithmic scale.

Effects on Flows in excess of System capabilities

The LOP cannot prevent large flood events from occurring because snow melt and precipitation events regularly produce stream flows that exceed the capacities of the diversion canals in Sweetwater and Webb Creeks. Any flow in excess of the diversion structures remains in the streams. High flow events that exceed the capacities of the LOP diversion canals are reasonably certain to occur annually under the proposed action since the physical limitations of the LOP are not changed by the proposed action.

Stream gage records from 2003 through 2008, show that stream flows exceeded the Sweetwater Canal capacity of 30 cfs roughly 25 to 30 days each year between February and June, and exceeded the Webb Canal capacity of 20 cfs approximately 19 days per year during the same period. Mean monthly flows under past operations, with no required minimum flows or with minimum flows less than the proposed action, were larger than the proposed action from March through June. The maximum flows observed between 2003 and 2009 during the spring are several orders of magnitude higher than the proposed minimum flows (Figure 9). Flows in excess of the canal capacities will continue under the proposed action, as weather allows.

In addition to physical limitations, inefficiencies in past LOP operations have apparently limited the hydrologic effects of the LOP during the spring runoff period. Since 2006, when minimum flows were first established, stream flows in Sweetwater and Webb Creeks have often exceeded minimum flows during the spring runoff period at times when the Webb and Sweetwater Canals were running at less than full capacity. Operational efficiency, as measured by LOID's ability to capture water in excess of the proposed minimum flows, would be maximized by providing only two distinct flows: (1) Flows in excess of canal capacity or (2) flows equal to the proposed minimum, but actual flows since automated gates have been installed have typically been somewhere between these two flow rates.

Under past operations, LOID has generally diverted as much water as system operations, weather, and available stream flows allowed. This happened until 2006 when minimum flows were first established. Since 2006, minimum flow requirements have varied. Minimum flows at the Sweetwater Creek diversion dam ranged from 5 cfs to 10 cfs from February through June and 1 cfs to 2.0 cfs from June through October. Minimum flows in Webb Creek have ranged from 0 cfs to 1.2 cfs from June through October, with no specified minimum at other times of the year. Stream gage records from 2003 through 2008 show that stream flows measured below the Sweetwater Creek diversion dam exceeded 10 cfs from February through June an average of 50 days per year, and from July through October, stream flows exceeded 2.0 cfs an average of 33 days per year.

If operational efficiencies were increased under the proposed action, daily stream flows in Sweetwater and Webb Creeks during the spring runoff period would become less variable and more consistently resemble the proposed minimum flows. Increased storage capacity in Reservoir A is likely to increase opportunities for diverting more water from Sweetwater Creek, but LOID's ability to capitalize on the additional storage is not certain. Water diversions from Sweetwater Creek have seldom been constrained by the physical capacities of Reservoir A or the Sweetwater Canal during the spring runoff period, so increased storage capacity may have little effect on future stream flows during the spring. However, the modeled stream flows in Sweetwater Creek under the proposed action show a significant reduction in the mean monthly flows from March through May, compared to previous operations, and the predicted increase in water diversion can occur only though increasing operational efficiency. Only the proposed minimum flows and flows exceeding the canal capacity are reasonably certain to occur, and stream flows greater than the minimum, but less than the Sweetwater Creek canal capacity, are not certain to occur as they have in the past. Stream flows in Webb Creek are likely to continue as they have in the past since there is no opportunity to significantly increase operational efficiency in Webb Creek.

Effects on Flows when the LOP is not Diverting Water

The LOP is likely to affect stream flows indirectly during the months of November through January, when the LOP is not diverting water. During the winter, Soldiers Meadow Reservoir captures and stores all stream flows above the reservoir, and discharge from the Twenty One Ranch Spring is affected by water elevation in Lake Waha at the end of the irrigation season. Stream flows during winter are reduced in virtually all years in Webb Creek by a relatively small amount, and winter flows may either be reduced or increased in Sweetwater Creek. Reductions in stream flow in Sweetwater Creek are more likely to occur than increases, but actual effects of the LOP cannot be predicted.

The magnitude of change in winter stream flows in Webb Creek is likely to be relatively small since the ground is typically frozen and there is little or no surface flow above the reservoir once the ground freezes. The graph of mean monthly discharge (Figure 8) shows that stream flows in Webb Creek from November through January under the proposed action are slightly less than unregulated flows. In Sweetwater Creek, Figure 8 shows a similar effect on winter flows; however, unregulated flows shown in the figure do not reflect potential future effects of raising or lowering water elevations in Lake Waha. Actual effects may be more or less severe than depicted in Figure 8. The graph of flows from the Twenty One Ranch Spring (Figure 7) shows that winter flows from the spring have ranged from 1 cfs to 3.5 cfs.

Discharge from the Twenty One Ranch Spring is likely to vary in proportion to the increase or decrease in water elevation in Lake Waha that exists at the end of the irrigation season. This annual flux is partly natural and partly a consequence of the action, but the two effects cannot be distinguished from one another with available information. Since stream flows in Sweetwater Creek during winter likely depend to some extent on discharge from the Twenty One Ranch Spring, the LOP would affect winter stream flows whenever the water surface elevation in Lake Waha is changed by the LOP. If the LOP were to cause water levels to drop below or raise above “natural” elevations, stream flows in winter would be diminished or increased, respectively. However, since natural inflows and outflows to Lake Waha are unknown, there is no information available to estimate “natural” water elevations nor to determine the actual effect of the action on winter flows.

Effects of Opportunity-Based Flows

"Opportunity-based flows" that are higher than the proposed minimums may occur in occasional years when there is a sufficient volume of water stored in the reservoirs. This provision, when it is triggered, would have a beneficial effect by increasing the amount of stream flow. However, this provision is not certain to occur with any particular frequency during the 10-year operating period and the amount of increase is also uncertain. Effects of opportunity-based flows are given no further consideration in the analysis of habitat effects, other than noting these flows would be a benefit whenever they occur.

Effects of the Action on Channel-Forming Processes

Stream flow alterations can potentially affect channel-forming processes. Channel form is driven by the relative amounts of sediment supply, stream flows, and any external constraints such as bedrock, woody debris, riparian vegetation, and floodplain characteristics. A channel is more or less in equilibrium when the average amount of sediment delivered to the stream is equal to the average amount of sediment transported out of the stream over the course of several years. When there is an imbalance in sediment and water, sediment will either accumulate in the channel and along stream banks if sediment supply exceeds transport capacity, or sediment will begin to erode from the stream bottom if transport capacity exceeds the sediment supply. Each of these circumstances creates distinct channel forms that are easily recognized from the channel cross-section and stream bank characteristics.

Since the LOP has been operating for 60 years, and the streams have been used as a source of irrigation water for nearly a century, there has been considerable time for the channel to adjust to flow alterations caused by the LOP and earlier operations. Since flows regularly exceed the diversion canal capacities, annual floods have continued to shape the stream channels, but flood magnitude is attenuated and smaller floods (flows above bankfull, but less than the Sweetwater and Webb canal capacities) are eliminated. When all other factors are constant, a decrease in stream flows causes a reduction in transport energy and streams are prone to aggradation if the sediment supply exceeds transport energy. Given the flashy nature of stream flows in Sweetwater and Webb Creeks, and numerous segments where the channels are incised, transport energy is often greater than sediment supply, which makes the streams far more sensitive to energy increases than energy decreases. Since the LOP reduces transport energy, the action is not likely to cause a change in channel form, and the existing balance between sediment and transport energy is likely to remain in a state similar to the existing conditions.

The diversion dam in Sweetwater Creek traps sediment, which reduces the volume of sediment below the dam. The sediments trapped by the dam primarily consist of particles ranging in size from silt to gravel up to several inches in diameter, with the majority of sediment composed of small pebbles, coarse sand, and finer particles. Accumulated sediments are periodically removed from the pool above the dam and stored next to the stream. The proposed action includes a gravel management plan to replace gravels removed from the stream with a similar volume of spawning-sized gravels. This provision mitigates for gravel losses and helps to partially offset the apparent imbalance between gravel supply and transport energy, and it would also restore spawning-sized gravels removed from the stream.

At the basin scale, gravel replacement would partly mitigate effects of gravel removal, but there is no practical way to add gravels in a manner that mimics the natural supply. Consequently, gravel replacement may create local areas of channel aggradation and instability at the locations where gravel is replenished, and these effects may persist for several years each time gravel is placed. Spring floods will redistribute the gravels, but short-term, localized impacts on the stream channel are likely to occur, in order to achieve a benefit at the larger spatial scale.

Effects of Stream Flow Alterations on PCEs

The preceding section describes the general changes in stream flow that are likely to occur, but streamflow itself is not a general indicator of habitat conditions. It is the effects of stream flows on water velocity, water depth, temperature, and sediment transport that define habitat elements affecting steelhead and other aquatic organisms. This section describes how changes in streamflow described above affect fish habitat and the PCEs of critical habitat. The PCEs of critical habitat for Snake River Basin steelhead (Table 7) describe environmental features needed for the freshwater life stages of the fish, which include suitable water quality, water quantity, substrate, floodplain connectivity, forage, and natural cover. The suitability of water quality is indicated by characteristics such as temperature, turbidity and suspended sediment, pathogens, and concentrations of pollutants. Suitable water quantities are indicated by physical attributes such as water depth, water velocity, wetted width, and longitudinal connectivity, and the timing of certain flows relative to the life history requirements of steelhead. Other important PCEs including floodplain connectivity, natural cover, and substrate are either unaffected by stream flows or are influenced more significantly by factors other than stream flow. Floodplain connectivity, large rocks and boulders, woody debris, shade, and overhanging vegetation are not affected by the proposed action, but these elements provide a physical template that can either moderate or intensify the effects of flow alterations on the PCEs.

The focus of this section is to characterize the condition of PCEs in Sweetwater, Webb, and Lapwai Creeks under the proposed action. The proposed action increases both area and quality of habitat compared to the baseline, but the action does not fully restore stream flows to provide the higher water depths and velocities that would occur in the absence of the LOP. Under the proposed action, water depth and velocity would become more favorable for steelhead than under the baseline, but stream flow alterations by the LOP would continue to create an artificial constraint on habitat quality. The proposed action retains connected surface flows that allow juvenile fish to move freely; maintains summer stream flows that are comparable to other Lower Clearwater River tributaries that produce steelhead; maintains annual floods; and retains important seasonal patterns in flow variability and timing.

All of the PCEs necessary to sustain steelhead within Sweetwater, Webb, and Lapwai Creeks would be retained in their present state or improved from the baseline, but the quality of PCEs related to stream flow would remain somewhat constrained by the proposed action. In addition, some PCEs are compromised from habitat alterations unrelated to the LOP and their conditions will remain unchanged from the baseline. In particular, stream channels and floodplain alterations have reduced channel complexity in significant portions of Sweetwater, Webb, and Lapwai Creeks. High summer stream temperatures are an intrinsic problem in many Clearwater

River tributaries, including Sweetwater, Webb, and Lapwai Creeks. Some of these problems described previously in the *Environmental Baseline* make portions of Sweetwater, Webb, and Lower Lapwai Creeks marginally suitable for steelhead even if the LOP did not exist. In areas where habitat conditions unrelated to stream flow are limiting steelhead, flow alterations may have no meaningful effect on the PCEs. The effects analysis that follows focuses on those areas where habitat suitability is largely determined by stream flow.

Effects of the Action on Water Quality

Water quality characteristics potentially affected by streamflow alterations include water temperature, suspended sediment and turbidity, and various chemical parameters. The water quality parameter affected by the action that is most important to steelhead is water temperature. Increased amounts of suspended sediment or turbidity are prominent effects of the action when large volumes of water are diverted, or when water is released from Soldiers Meadow Reservoir and water levels are extremely low at the time of release. Turbidity has not been a significant effect of the LOP under past operations, but greater draw down of Soldiers Meadow Reservoir could create adverse conditions from turbidity; however the likelihood of this occurring and the severity of the effect are unknown.

Flow alterations potentially amplify or ameliorate problems with excess nutrients and pathogens that exist in the Sweetwater and Webb Creeks, largely though changes in rates of flushing and dilution that occur at different flows. Pathogens are also favored by warmer temperatures. The proposed action is not the source of nutrient or pathogen problems, and it will not change the sources. The proposed action will improve nutrient and pathogen problems to the extent that they can be ameliorated by modest flow increases, but overall, these types of water quality problems that exist under the baseline are not likely to change significantly due to the proposed action.

Throughout the Lower Clearwater River Basin, summer stream temperatures are a significant determinant of steelhead distributions and habitat suitability. Temperature limitations are particularly severe in the Lapwai Creek Basin, with 80% of the streams rated as temperature-limited by the TRT in Cooney (2010). There is considerable scientific debate over the extent to which temperature limitations are a natural or anthropogenic effect. Daytime air temperatures in the low elevation canyons commonly reach or exceed 100°F, with little cooling effect at night. Average temperatures have increased in recent decades. High water temperatures also limit steelhead distributions in portions of the Lochsa and Selway River Basins that are located in undeveloped in roadless areas. These circumstances indicate that temperature limitations are intrinsic to at least some streams. On the other hand, upland and riparian areas are altered in nearly all the tributary and mainstem drainages in the Lower Clearwater Basin, in a manner that generally increases water temperatures. As a consequence, "natural' temperatures are unknown, which presents a considerable obstacle to assessing water temperature alterations.

Water temperature in the Sweetwater, Webb, and Lapwai Creeks is likely to limit steelhead production and growth during portions of each summer since water temperatures reach the upper limits of steelhead tolerance. The primary determinants of temperatures in small streams are solar insolation, air temperature, exposure to wind, stream morphology, and groundwater influences (Poole and Berman 2001). Of these variables, air temperature is generally most influential driver of water temperatures, while the other variables are factors that cause water temperature to deviate from air temperature. Illustrating this principle, Morrill et al (2005) looked at a diverse set of streams and found that "the majority of streams showed an increase in water temperature of about 0.6°C to 0.8°C for every 1°C increase in air temperature, with very few streams displaying a linear 1:1 air/water temperature trend." These findings indicate that air temperature alone typically explains 60% to 80% of the variance in water temperature and deviations from a simple 1:1 relationship can be viewed as the effect of factors that either buffer streams from the effects of air temperature, or directly add or remove heat.

The amount of discharge in a stream can affect water temperature through its effect on the volume of hyporheic exchange and greater thermal inertia that resists rapid temperature change (*See* Poole and Berman 2001). Although discharge is not one of the primary determinants of water temperature, at extreme low or high flows there is a considerable difference in the heat capacities (thermal inertia) of the water. At extremely low flows, water temperatures rapidly can increase (within minutes) from sunlight and increasing daytime temperatures, and the temperatures cool just as quickly at night. At extremely high flows, it takes exponentially higher energy to change the temperature, so temperature change occurs at a much slower rate and daily temperature fluctuations are much smaller. In the hottest part of summer, higher discharges generally lead to water temperatures that are cooler than the air during the day and warmer than the air at night, with a smaller range of daily temperature fluctuations than would occur at lower flows. In winter, higher discharges make streams less susceptible to rapid drops in temperature that can cause supercooling or formation of anchor ice on the bottom of the stream, both of which are capable of killing large numbers of fish.

The BOR reviewed water temperature data from Sweetwater, Webb, and Lapwai Creeks, and found that water temperatures correlated closely with average air temperatures from June through September (Figures 6-6 to 6-8 in BA). There was a weak inverse relationship with stream flow and air temperature at discharges greater than roughly 5 cfs in Sweetwater Creek (Figure 6-6 in BA). The regression line calculated for discharge and water temperature in Sweetwater Creek indicates that increasing stream flow from approximately 2.0 cfs to 10 cfs in summer would reduce average stream temperatures by roughly 2°C (Figure 6-6 in BA). At flows less than 5 cfs, Sweetwater Creek appears to vary more with air temperature than occurs at higher flows. This may be an artifact of the data in that lesser flows occur primarily from July through September when air temperatures are relatively high, and higher flows occur primarily during the tail end of the spring runoff when air temperatures and water temperatures are generally cooler, so the regression may reflect effects of temporal variance as much as streamflow. The large temperature variation at flows less than 5 cfs indicates that flows in this range have little capacity to buffer stream temperatures from air temperature fluctuations.

The BOR modeled temperature differences caused by flows ranging from 2.5 cfs to 4.5 cfs to estimate effects of the action on water temperature. The temperature model produced questionable results that indicated coolest temperatures would occur at a discharge of 2.0 cfs, highest temperatures at 2.5 cfs and temperatures would decline with flows greater than 2.5 cfs. However, the temperature differences were not greater than the error limits of the model (1.4°C), so, in essence, the temperature model did not predict a difference in average temperatures over this narrow range of flow. The model results appear consistent with actual temperature measurements that showed no relationship between discharge and average temperature at discharges below 5 cfs. The lack of a relationship does not necessarily indicate the lack of an effect. Rather than affecting mean temperatures, flows less than 5 cfs may cause temperatures to respond rapidly to daily air temperature changes, and as a result, temperatures span a wider range than occurs at higher flows.

In wetter years, unregulated flows in Sweetwater Creek could possibly be as much as 5 cfs to 10 cfs higher than the minimum flows in the proposed action due to effects of the Twenty One Ranch Spring. If unregulated flows in Sweetwater Creek were near the upper end of this range, water temperatures would likely be roughly 1°C to 2°C lower than those likely to occur under the proposed action. Summer temperatures in Webb Creek with unregulated flows would likely be similar to those under the proposed action since the action would provide minimum flows equal or greater than unregulated flows from July through October.

The effects of the action on water temperatures in spring and winter are not as significant as summer time effects since the sun has less intensity, water is not being diverted in winter, and flows during spring are at their highest point of the year. When water is not being diverted, Soldiers Meadow Reservoir captures a small amount of streamflow in Webb Creek. Flows in Sweetwater Creek are affected by any differences in discharge from Twenty One Ranch Spring caused by water withdrawals. Temperature effects of the LOP during winter and spring in Webb Creek are likely to be negligible since the unregulated flows in winter are too small to make any difference. The volume of water captured by Soldiers Meadow Reservoir in winter is thought to be relatively small (less than 1 cfs) since the upper end of the basin is generally frozen and snow-covered most of the winter. The effects of the action on winter temperatures in Sweetwater Creek are unknown, but could potentially make the stream more or less susceptible to sub-freezing temperature in winter, depending on the action's effects on the Twenty One Ranch Spring.

In both Webb and Sweetwater Creeks, the action may alter temperatures in the spring by several degrees, but the temperatures would remain within the range of unregulated flows, and within a range that is not detrimental to steelhead. In spring, water temperatures have generally been favorable for juvenile spawning, rearing, and incubation under past operations, primarily because air temperatures typically remain relatively cool during this period and runoff from snow melt and stream flows frequently exceed the minimum flows. Surface water temperatures exceeding 15°C have been observed under recent operations in late May, indicating that eggs deposited in redds constructed late in the spawning season may be exposed to lethal temperatures. However, water temperatures under the gravels are typically 0.5° to 1.5°C cooler in summer, and can be as much as 4°C to 6°C cooler than the surface water (Shepherd et al. 1986), and nearly all egg deposition occurs early enough that most, if not all, eggs would be hatched before water reached 15°C.

Overall, the proposed action appears to have minor effects on average stream temperatures. The greatest effect on daily temperature variability occurs in summer when unimpaired stream flows in Sweetwater Creek would be greater than 5 cfs. At these times, daily fluctuations in temperatures are likely to be larger than normal, and daily maximum temperatures would also be higher than normal. Compared to the baseline, the proposed action is likely to decrease daily temperature variability, which results in modest decreases in the frequency and duration of temperatures greater than 21°C. Compared to the unregulated flows, the action has the opposite effect on variability and temperature variability.

Effects of the Action on Floodplain Connectivity

The proposed action does not have a significant effect on floodplain connectivity since floods occur on an annual basis and the action does not alter channel form or floodplain features. Flood plain connectivity is reduced in portions of Webb, Sweetwater, and Lapwai Creeks due to channel modifications such as straightening, diking, and deepening the stream. The proposed action will not change these conditions.

Effects of the Action Surface Flow Connectivity

The proposed action provides minimum flows in Sweetwater Creek that retain surface flow connectivity when LOID is diverting water. Connectivity in Sweetwater Creek was verified by surveys performed by BOR at flows of roughly 1 cfs, while proposed minimum flows are 2.5 cfs. In Webb Creek, channel cross-sections measured during the IFIM study with flows of 1.2 cfs indicated that surface flows would be connected at this flow rate, but the proposed minimum flows are 1 cfs. Surface flow connectivity at 1 cfs appears likely since the difference in water depth at the two flows is less than one-half inch (water surface elevations measured at flows of 1.2 and 4.3 cfs differed by roughly one-half inch). Although surface connectivity in Webb Creek has not been verified, minimum flows in Webb Creek during late summer are higher than average unregulated flows, meaning that the stream would sometimes naturally drop to levels where surface flows become disconnected, and the proposed action will provide connectivity at times when it would not occur naturally. Overall, minimum flows are likely to provide surface connectivity in Webb Creek that is the same or better than that which occurs in the absence of the LOP, even though it is possible that surface flows may not remain connected at all times under the proposed action.

The proposed action may occasionally disrupt surface flow connectivity due to maintenance activities, mechanical failures of the automated gates that control flow, and unusually large floods which can disrupt surface flow connectivity when they create gravel deposits that are higher than the water level. Flow disruptions from mechanical failures are likely to be uncommon events, with a duration of a day or less. The proposed action includes a provision to mechanically adjust the gates once per day if the automated mechanism is not working. Discontinuities in surface flows from flood deposit are episodic events that are part of natural stream function and the proposed action does not prevent this process from occurring. Discontinuities of this nature generally persist until later flood events scour and redistribute the gravels.

Effects of the Action on Forage

Juvenile salmonids acquire the bulk of their diet from aquatic invertebrates that are captured while drifting in the stream. Terrestrial invertebrates are also eaten when they fall into the water, land on the water surface to deposit eggs, or when they fly near the water surface and are close enough for fish to catch them by leaping out of the water. Changes in stream flows have no effect on the availability of terrestrial insects, but flows can affect the abundance and species composition of aquatic invertebrates, change the vulnerability of invertebrates to predation by fish, and change the energetic balance of costs and benefits to steelhead from capturing prey.

The most significant effects of stream flow alterations on aquatic invertebrates occurs when there is a significant change in the amounts of mesohabitats such as pools, riffles, and runs (Brunke et al 2001), or a significant change in the timing of flows such that high or low flows no longer coincide with the timing of events such as hatching or mating. Flow alterations that maintain general characteristics of the natural flow regime and which do not significantly alter the mesohabitats have only minor effects on invertebrate abundance and diversity (Rader and Belish 1999). Some invertebrate species are sensitive to changes in flow, and qualitative changes in species composition that have occurred under the baseline are likely to continue under the proposed action. The change in baseline stream flows from unregulated flows is large enough to affect some of the more sensitive invertebrates, but the change from the baseline to the proposed action is a relatively minor increase.

In general, mesohabitat diversity is near its maximum at flows near bankfull discharge, and as flows deviate from bankfull flow, marginal pools and riffles become runs, which have depths, velocities, and turbulence intermediate to pools and riffles. Compared to the baseline, the proposed action is not likely to cause significant changes in aquatic invertebrate abundance or diversity because the amount of flow alteration is not enough to significantly change the mesohabitats, nor significantly alter the temporal pattern of the annual hydrograph. During the IFIM study, stream flows spanned the range of proposed and unregulated flows in summer and there was no appreciable change in mesohabitats in flows ranging from roughly 2 cfs to 10 cfs in Sweetwater Creek and from roughly 1 cfs to 4 cfs in Webb Creek. Since mesohabitats did not appreciably change as flows increased from discharge rates similar to the proposed minimum flows to discharge rates similar to unregulated flows, it appears that the action does not significantly alter mesohabitats when compared to the baseline or unregulated flow. Invertebrate abundance and diversity are likely to remain at levels similar to or slightly higher than the baseline, and they are not likely to be significantly different than would occur under unregulated flows.

*Effects of the Action on Natural Cove*r

Natural cover consists of areas where fish can hide from competitors or predators. Cover is provided by elements such as turbulence, shadows, logs, rocks, undercut streambanks, deep water, and overhanging vegetation. The proposed action has little effect on logs, shadows, size or presence of rocks, and overhanging vegetation, since these features are generally present regardless of streamflows. Prominent cover features affected by stream flows are undercut streambanks, deep water, and turbulence. Undercut streambanks are created by lateral scouring during floods. Undercutting generally occurs at flood stages near bankfull or higher, and these events occur at frequencies and magnitudes that are reduced by the LOP, but remain more than sufficient to create undercut streambanks. Turbulence and deep water are cover elements that are controlled primarily by channel form and streambed topography, but to be useful for cover, they also require a certain depth and velocity. The proposed action is not likely to affect channel form or streambed topography, but it is likely to alter the suitability of these features as cover, and this is discussed in more detail below. Similarly, the utility of all cover features are dependent on depth and velocity since fish cannot take advantage of cover if the water is too shallow or if flows are too high. Low velocity does not affect the amount of cover, but it can restrict the use of cover areas to hiding or escape, when at higher velocities, fish may be able to forage and hide at the same time.

The proposed action primarily affects the amount of deep water cover and the utility of cover features located in shallow water. When stream flows are reduced by water withdrawals, deep water areas shrink in size and the utility or accessibility of cover features in shallow areas are also reduced. The proposed action maintains and improves the cover available under the environmental baseline, but the quantity and quality of the cover is reduced compared to unregulated flows.

Biological Consequences of changes in Habitat Quality

Entrix, Inc. (consultants to the Tribe; NPT and Entrix, 2009) and BOR completed analyses of flow effects using different sets of parameters to represent the way steelhead respond to changes in flow using PHABSIM (a physical habitat simulation model based on flow), which is part of a general approach referred to as IFIM. The IFIM is a widely used technique in the United States that requires the modeler to specify the velocities, depths, and several other habitat parameters that are preferred by a particular species, size-class, or life stage. These preferences are compared to actual stream measurements to calculate an index of habitat quality called "weighted usable area" (WUA). This index is often misinterpreted as a measure of the amount of habitat gained or lost due to its name, but it is actually a dimensionless indicator of relative differences in habitat quality. Model results depend substantially on the parameters chosen by the modeler. Unless the relationship between habitat parameters and fish preferences or fish responses have been determined at the site that is being investigated, IFIM practitioners must use data developed elsewhere and decide which model parameters and assumptions best fit the circumstance under investigation. Scientific research informs this decision, but generally provides no single answer.

In modeling the effects of the LOP using IFIM, Entrix and BOR used the same set of physical measurements from channel cross-sections in Sweetwater and Webb Creeks, but they used different parameters to represent steelhead habitat preferences. Since no data on steelhead habitat preferences were available from Sweetwater and Webb Creeks habitat preferences had to be extrapolated from studies in other drainages. In a setting such as the mountainous Western United States where most of the precipitation occurs in winter, natural stream flows are often unfavorable for salmonid production in the summer during extended periods of hot, dry weather. Under these circumstances, any choice of model parameters that favor higher flows would generally be the most beneficial to fish, if the flows were attainable. Choosing the model that provides the greatest flow is not analogous to choosing the best model. The "best" model is one that most closely resembles the relationship between fish and flows in the particular setting that is being investigated, and which produces realistic results that are within the range of flows that actually occur. Unfortunately, there are only rough estimates of unregulated flows in

Sweetwater and Webb Creeks and there are no independent or objective means to determine which particular model parameters and assumptions are most appropriate for evaluating the effects of flow in these streams; therefore, choice of model parameters becomes a matter of opinion and professional judgment.

Because of the subjective nature in choosing model parameters, and some other notable limitations of IFIM (e.g. Castleberry et al 1996; Poff et al 1997), the modeling approach is most appropriate for making relative comparisons among various alternatives. It is not ideally-suited for assessing actual biological effects of a particular action in the absence of actual data relating fish production or survival to a range of flows. Poff et al (1997) point out: *As a predictive tool for ecological management, the IFIM modeling approach has been criticized both in terms of the statistical validity of its physical habitat characterizations (Williams 1996) and the limited realism of its biological assumptions (Castleberry et al. 1996). Field tests of its predictions have yielded mixed results (Morehardt 1986).* In spite of these limitations, this modeling approach maximizes the use of limited data, and it provides a qualitative means of evaluating the effects of stream flows.

The choice of various flow parameters has a large influence on IFIM results because the modeler must specify the specific depths, velocities, and several other parameters that fish prefer, and assign each variable a range of scores that reflect the fish's preference for various conditions. If a modeler assumes that juvenile steelhead prefer habitats with high velocities and deep water, the model will assign the highest quality rating to habitats with deep water and high velocity, and assign the lowest quality rating to habitats with shallow water and low velocity. As such, the model has an intentional statistical bias that is used to discriminate between habitats with different quality. Due to the subjective nature of rating a fishes' preference and scoring the quality of habitat features, apparent differences in habitat quality at different flows can be based as much on the modeler's choice of parameters as actual differences in habitat quality.

It is beyond the scope of this Opinion to evaluate the nuances of the different model parameters used by Entrix and BOR. Both approaches are legitimate ways of characterizing flow effects, and together, the two approaches define a plausible range of environmental effects. In general, the parameters used by Entrix are more likely to err in favor of higher flows that may exceed flows that would occur naturally, and the parameters used by BOR are more likely to err in favor of lower flows that are less than would occur naturally. Recognizing these different biases, the results from the two models are used in this Opinion as the upper and lower bounds of minimum flow estimates.

In the absence of the LOP, the WUA index for Age-1 and older steelhead during the summer ranges from 62% to 94% in Sweetwater Creek, and from 43% to 100% in Webb Creek[3]. Under the proposed action, habitat quality in summer for Age-1 and older juveniles is roughly 62% to 70% of the maximum potential in Sweetwater Creek and 43% to 58% in Webb Creek. These results indicate that natural habitat conditions as a whole in Sweetwater and Webb Creeks are probably not ideally-suited to juvenile steelhead that are Age-1 or older and the proposed action

[3] The range of WUA indices for the proposed minimum flows consists of the lowest and highest index values from the different IFIM modeling approaches used by BOR and Entrix, and which result from minimum flows of 2.5 cfs in Sweetwater Creek and 1.0 cfs in Webb Creek.

further reduces the suitability. Age-1 and older fish might naturally move out of Sweetwater and Webb Creeks in early summer to seek more suitable flows, and, with the proposed action, a large number of fish may be forced to move; or, fish that would have moved anyhow might have to move several weeks earlier. A possible consequence of the proposed action might be that the minimum flows cause marginally suitable areas for Age-1 and Age-2 fish to become unsuitable, forcing some older juveniles to move.

If minimum flows force juveniles to move, the significance is unclear. Steelhead are known to move into larger streams as they mature because smaller streams are generally less suitable. The model results might indicate a detrimental effect of the action or they might simply reflect the natural behavior and physiological requirements of juvenile steelhead. The UI fish data from Sweetwater and Webb Creeks show that older juveniles tend to segregate from the young-of-the-year (YOY) and older juveniles occur in downstream locations in Lapwai Creek where YOY are absent. If older juveniles were absent from both upstream and downstream locations, it would be an indication that proposed action might be eliminating older juveniles all together. Since older juveniles remain in the project vicinity, but have shifted downstream, this is possibly an indication the system is functioning as it should; with older fish occupying larger streams and smaller fish occupying smaller streams. However, it is also possible that the minimum flows in 2008 and 2009 might have reduced the summer carrying capacity for older juveniles in Sweetwater Creek compared to the capacity under unregulated flows. In Webb Creek, the average carrying capacity and suitability for older juveniles would likely be increased compared to unregulated flows.

The natural flows conditions for YOY steelhead in Sweetwater and Webb Creeks appear far more suitable than those for older juveniles. Flows producing 100% WUA are within the range of unregulated flows, and they are not substantially higher than flows provided under the proposed action. The proposed action would provide roughly 80% to 94% of the maximum habitat quality at 2.5 cfs in Upper Sweetwater Creek and it would produce about 70% to 84% in Lower Sweetwater, assuming an additional 1 cfs would be added from Webb Creek and ignoring apparent ground water inflows. In Webb Creek, the proposed action would provide only 60% to 74% of maximum habitat quality, but Figure 8 shows that the proposed action often provides more flow on average than unregulated flows from July through September.

B. Habitat Effects in Lapwai Creek

The effects of the LOP on Flows in Lawpai Creek are the same general nature as the effects in Sweetwater and Webb Creeks, but they are less prominent since roughly two-thirds of the flows in Lapwai Creek come from drainage areas unaffected by the LOP. Detailed channel cross-section measurements and IFIM data are not available for this stream. The proposed action is unlikely to cause significant changes in the habitat conditions described under the environmental baseline from November through April since the proposed action has little effect on flows in winter, and the increase in minimum flows over the baseline in March and April are a small percentage of the flows in Lapwai Creek, based on the Lapwai Creek stream gage. Stream flows in Lower Lapwai Creek (downstream from Sweetwater Creek) have been sufficient for adult fish passage, downstream smolt passage, and winter rearing under the baseline, and conditions under the proposed action would improve slightly. However, the improvement would not be significant.

The proposed action has its largest effect on flows in Lapwai Creek in the months of July through October. In recent years, discharge from Sweetwater Creek has often been the primary source of stream flows in Lapwai Creek immediately downstream from the mouth of Sweetwater Creek due in part to flow depletions upstream in the Lapwai Creek Drainage. Consequently, discharge from Sweetwater Creek is an important component of the summer stream flow in Lower Lapwai Creek. Ever since minimum flows have been provided in Sweetwater and Webb Creeks, flows in Lower Lapwai Creek have improved; however, segments of the stream have still occasionally gone dry. The BOR found that surface flows in Lapwai Creek in September 2008 maintained surface connectivity from confluence with Sweetwater Creek to the mouth. The proposed action will provide minimum flows 1.5 cfs greater than 2008. The proposed action would provide enough water to Lapwai Creek to maintain surface flow connectivity in Lower Lapwai Creek but surface connectivity is not certain to occur at all times due to consumptive water use. There appears to be a significant amount of surface water loss in Lower Lawpai Creek to ground water or consumptive water use, which may potentially dewater segments of Lapwai Creek.

In comparison to unregulated flows, the LOP provides less water to Lapwai Creek, which amplifies the problems of flow depletions in the stream. The difference between average flows at the mouth of Sweetwater Creek under the proposed action and average unregulated flows, from July through October, is roughly 4 cfs. An additional 4 cfs in Lapwai Creek would likely reduce the number of days the stream goes dry, and also reduce the severity of drying where flows remain. If the water were to remain as surface flow it might also retain connectivity throughout the summer; however, the amount water that is likely to remain as surface flow is uncertain since the losses to groundwater are unknown and the water is also subject to withdrawal for consumptive use.

C. Habitat Effects in Captain John Creek, Lindsay Creek, and Mainstem Rivers

The proposed action has minor effects in several places outside the Lapwai Creek Drainage. The LOP affects stream flows in Captain John Creek, Lindsay Creek, and in the mainstem of the Clearwater River downstream from Lapwai Creek, the Snake River downstream from Captain John Creek, and the Columbia River to its mouth.

In the Captain John Creek Drainage, a small portion of the stream flows in Brown's Creek are diverted during the spring runoff period via a small canal that empties into Webb Creek upstream from Soldiers Meadow Reservoir. Brown's Creek at the point of diversion is an ephemeral stream that flows only during the snowmelt period. Since there are no changes to the proposed action affecting Captain John Creek, the effects of the action are the same as effects under the baseline. The area upstream from the diversion is roughly 0.5 square miles, which is less than 4% of the entire Captain John Creek drainage[4]. Based on the drainage area captured by the

[4] The drainage area is less than reported in the 2006 Opinion. A more precise map showing the point of diversion from Captain John Creek was provided by BOR for this Opinion.

diversion canal, stream flows in Captain John Creek would be reduced by roughly 4% for several weeks near the latter end of the spring runoff period. The effects of the LOP are insignificant in the Captain John Creek drainage since the size of the water withdrawal has only minor effects on peak flows in Captain John Creek.

The 4% reduction in flows during the spring runoff period would have negligible effects on channel morphology and minor effects on sediment transport. Bankfull flows that shape channel morphology would be less frequent, but would not likely alter the hydrograph to the extent that channel morphology would change. The shape of the annual hydrograph and range of flows would be similar to natural conditions, while sediment transport capacity would be reduced slightly. The hydrologic alterations are unlikely to adversely affect growth, reproduction, or survival of Snake River spring/summer Chinook salmon or Snake River Basin steelhead in Captain John Creek. Effects of the action in the Captain John Creek drainage would be insignificant and are not evaluated further in this Opinion.

Stream flows in Lindsay Creek are reduced slightly from Reservoir A, which is located in the headwaters of a small tributary to Lindsay Creek, but the flow alterations have no effect on listed fish or their habitat. Lindsay Creek is inaccessible to anadromous fish due to an impassable siphon drain at the mouth of the stream and it is not designated as critical habitat. The siphon conveys water over a levee that was built to maintain sufficient water depths for the Port of Lewiston, near the upper end of the pool created by Lower Granite Reservoir.

Water diverted by the LOP will also affect flow in the Lower Clearwater, Snake and Columbia Rivers since water removed from Lapwai Creek no longer contributes to flows in these larger rivers. The annual volume of water withdrawn by the LOP may increase slightly from the annual volume under the baseline due to increased storage capacity, but the volume would still likely remain with the range of water volumes that have been withdrawn in the past. The primary change to the baseline mainstem stream flows as a result of the proposed action is a minor shift in the timing of flows due to the increased minimum flows in Sweetwater and Webb Creeks during the summer, and possible increase in water withdrawal during the spring. The magnitude of this change would not be discernable in the larger rivers. LOID diverts roughly 7,000 af per year of an estimated 14,400,000 af per year of irrigation water diverted from the Columbia river system. (www.nwcouncil.org/history/irrigation.asp). The aggregate of irrigation diversions in the Columbia River system does have an adverse impact on the various anadromous species that utilize this system. However, the effects of the proposed action on water velocity and water depth in the mainstem rivers are unquantifiable because any natural fluctuations or changes in the operation of the FCRPS would overwhelm any potential effect from the LOP. The effects of water withdrawals, including the LOP, on the mainstem rivers is essentially unchanged from the analysis in the SCA, described previously in Section 2.1.2, Environmental Baseline.

Summary of Habitat Effects

The proposed action increases stream flows over those provided under the environmental baseline, it maintains flows necessary to sustain all freshwater life stages of steelhead in the Sweetwater and Webb Creeks, and it maintains the gross characteristics of the natural hydrograph. The characteristics of the PCEs that were present when critical habitat was designated have improved under the environmental baseline with the addition of minimum flows, and the proposed action would further improve PCEs affected by stream flow.

Compared to unregulated flows, the proposed action generally provides less water in summer than would occur naturally in all but the driest periods, at which time the action provides slightly more water than would occur naturally. The most significant effects of the proposed action in Sweetwater Creek are maintaining summer stream flow conditions that are characteristic of years with below average stream flows, and curtailing sustained flows in excess of 2.5 cfs that might otherwise occur throughout the summer in wetter years. In Webb Creek, the effects are mixed, with significant reduction in flows during the spring, while summer stream flows would be higher than average unregulated flows.

Overall, the proposed minimum flows will create habitat conditions that are better than those in the past, but habitat quality would remain at less than the full potential that might be achieved with unregulated flows. With unregulated flows, habitat quality would still suffer from high stream temperatures and shortage of instream cover during the summer, but higher flows would lessen these effects.

2.1.3.2. Biological Effects of the Action

The biological effects of the action are evaluated by considering how the environmental effects described previously affect growth, reproduction, survival, and abundance of individual fish in the action area. Once fish effects to individual fish are established, NMFS analyzes the extent that these changes in fish abundance in Sweetwater, Webb, and Lower Lapwai Creeks affect the status of the Lower Clearwater River population as a whole, and whether such changes to population status, if any, affect the survival and recovery of the DPS. The analysis of effects on individual fish is organized by life stage, and population effects are discussed for the Lower Mainstem Population and the DPS as a whole.

Key indicators of biological effects used in the analysis include: (1) Adequacy of flows with suitable timing to allow adults to reach spawning areas and deposit eggs; (2) sufficient flows throughout the incubation period such that fry would emerge from the redds; (3) sufficient flows to maintain connectivity and allow juvenile steelhead to move freely; and (4) streamflows that are not appreciably lower than comparable streams within the Lower Mainstem Population at the same time of year.

A. Effects of the action on Adult migration and Spawning

Environmental conditions needed to cue adult salmon and steelhead movement from holding areas to spawning locations are not well-understood, but adult movement from holding areas appears to be based on a combination of innate behavioral traits, stream flows, and temperatures (Quinn 2005). Spawning habitat suitability is determined by stream bed topography, channel gradient, the appropriate size-range of gravels, and stream flows sufficient to provide adequate water depth and enough velocity to force water into the gravels. In relation to stream flows, adult fish require sufficient water depth to reach spawning areas and construct redds. Resting pools in the vicinity of the spawning areas are also important.

Adult steelhead are known to spawn in Lapwai Creek above and below Sweetwater Creek, and are likely to use Sweetwater and Webb Creeks for spawning in years when flows and water temperatures are sufficient to cue adults to move into the streams. Spawning is potentially affected by the LOP any time water is diverted from early March through May. Spawning in the project vicinity likely occurs most commonly from mid-March to the end of April, but spawning could possibly occur as early as mid-February in warm years, or as late as May, in years with colder temperatures and late runoff. Peak flows typically occur in the action area from mid-March to the end of April, but the timing of peak flows is variable, and peaks may occur anywhere from mid-February to mid-May, as indicated by the Lapwai Creek stream gauge.

In their BA, the BOR provided an analysis of the action's effects on steelhead spawning habitat and the timing of flows in relation to the timing of steelhead migration. Their findings are summarized here. The BOR documented that steelhead spawning in the Lower Clearwater River Basin and Asotin Creek might occur any time between early February and the end of April or early May, with the majority of spawning in the Lappwai Creek drainage occurring in March and April. Adult and smolt migration periods coincide with the spring runoff period, which typically tapers off before the LOP reduces flows to levels that would preclude movement of adults. Adult steelhead migration and the suitability of redd sites require minimum water depths of approximately 8 inches (Thompson 1972), which is likely met or exceeded in March and April due to runoff that exceeds canal capacities for several weeks or more each year. However, the timing, magnitude, and duration of the spring runoff period varies from year to year, and suitable flows are not always available naturally until mid-March in some years, or may briefly drop below suitable levels during freezing or dry conditions. The IFIM analysis and model of stream flows under the proposed action showed that the proposed stream flows frequently meet depth and velocity requirements for steelhead to reach spawning areas and to construct redds during March and April when most spawning activity occurs.

Once steelhead reach a spawning area, suitable depths must remain for several consecutive days for them to complete spawning. The IFIM results for the proposed action indicate that available spawning habitat suitability is 50% or higher, 90% of the time during March and April, when most spawning activity occurs. Unregulated flows would provide more reliable windows for spawning by maintaining longer and more frequent periods when suitable flows occur, but both regulated and unregulated flows are driven by the same precipitation and runoff events, so the overall pattern in timing of high flow events are identical. Spawning flows reaching 100% WUA (19 cfs to 20 cfs) have occurred regularly in Sweetwater and Webb Creeks from February through June under past operations, and the proposed action would have identical effects on these higher flows since they are determined by weather and diversion canal capacities, and are not strongly influenced by LOP operation. Stream gage records from 2003 through 2008, show that stream flows in Sweetwater Creek on average exceed 20 cfs more than 34 days each year between February and June, and flows in Webb Creek exceed 20 cfs more than 19 days per year during the same period. Since high stream flows are episodic events both naturally and under the proposed action, spawning behavior may be delayed or temporarily disrupted more frequently than natural due to water withdrawals, but it is not likely to significantly alter the number of steelhead that spawn in the Sweetwater, Webb, and Lapwai Creeks since steelhead can accommodate minor delays and disruptions.

Both early and late spawners at the extreme ends of the range are likely to experience less favorable conditions under the proposed action, which can also occur naturally. Early or late spawners may have to hold in Lapwai Creek or in deep sections of Sweetwater Creek to wait for periods with suitable flows. Early spawners would likely be able to delay spawning until suitable flows occur without significant impacts on spawning success. Fish that spawn as late as May would likely find virtually no spawning opportunities in Webb Creek, and few in Sweetwater Creek. Fish that spawn this late would likely have low egg survival under the proposed action due to high temperatures and low flows that can occur with unregulated flows, and which are made worse by the proposed action. However, only a small percentage of adults, if any, are likely to spawn in May, and steelhead are likely to seek other spawning locations if conditions in Sweetwater or Webb Creek are unsuitable.

The proposed action is likely to have minor effects on spawning activity in Lower Lapwai Creek since stream flows are much higher than Sweetwater or Webb Creeks during the spawning period and roughly two-thirds of the Lapwai Creek drainage area is unaffected by the LOP.

B. Effects of the Action on Egg incubation and fry Emergence

The incubation period for steelhead may begin as early as February, when fish first spawn, and extend to the end of June. The majority of steelhead are likely to emerge from redds no later than June since the majority of spawning occurs relatively early in spring, providing ample time to hatch before water temperatures and stream flows recede. Steelhead eggs require 4 to 7 weeks to hatch and the alevins require another 3 to 7 days to absorb the yolk and become free swimming (Pauley et al. 1986).

The effects of stream flow alterations on steelhead redds and incubation are difficult to predict. Egg incubation requires flows sufficient to keep eggs moist, provide oxygen, and flush metabolic wastes, although steelhead eggs are capable of normal development in dewatered redds, as long as the gravels retain suitable moisture (Reiser and White 1983). The amount of flow needed for incubation depends on a variety of physical features that affect upward and downward movement of water through the gravels (Chapman, 1988; Young et al. 1990). Factors affecting intergravel flow include the particle size distribution of the gravels, streambed topography, thalweg profile, and hydraulic gradients. In the best locations, intergravel flows through a redd are driven by upwelling ground water and this type of redd is more or less impervious to alterations in stream flow, as long as the redd is covered with enough water to allow fish to swim away after emergence. At the other end of the spectrum, redds may also be constructed in locations where discharge and velocity of surface waters are crucial to maintaining suitable flow within the gravels. There is no direct information on the physical characteristic of redds in Sweetwater and Webb Creeks; consequently, the degree to which redds depend on surface flows is unknown, so the effects of flow are evaluated as if all redds were sensitive to changes in discharge and water velocity.

Under the baseline, maximum surface water temperatures in Sweetwater and Webb Creeks regularly exceed lethal incubation temperatures of 15°C to 16°C during portions of May and thereafter, which raises the possibility of excess temperatures in the redds. However, daily mean temperatures are generally below the lethal limit throughout May. Redds with abundant flows from upwelling are likely to have temperatures that are substantially lower than the surface water temperature, while redds that lack significant upwelling are likely to have temperatures closely tied to instantaneous temperatures. The BA shows that stream temperatures in May are closely correlated with air temperature and flows have little effect on stream temperatures during this month. The temperature data from BOR suggests that temperature changes from the proposed action are not likely to have a significant effect on incubation in Sweetwater and Webb Creeks. The total picture of incubation success; however, is not clear. There is insufficient information available to determine if unfavorable conditions in redds exist in Sweetwater, Webb, and Lapwai Creeks under natural flows or the proposed action, or if flow alterations from the proposed action have any meaningful effect at all. If temperatures are in fact elevated in the redds, the eggs might require more intergravel flow than normal to obtain sufficient oxygen to meet the increased metabolic demands. We can only conclude that incubation conditions will improve from the baseline and that at least some incubation has occurred under the baseline.

C. Effects of the Action on Juvenile Rearing

Streamflows directly affect the quality of juvenile rearing habitat. Natural habitat conditions in Lower Clearwater River Basin are relatively harsh for steelhead due to hot and dry summer weather. Because these conditions exist naturally, steelhead have evolved mechanisms for coping with adverse environmental conditions. On the other hand, because natural habitat conditions are sometimes challenging to begin with, steelhead are likely to be sensitive to additional perturbations such as stream flow alterations.

As described previously, the proposed action will improve minimum flows from the baseline, but flows would not be restored to levels that would likely exist in the absence of the LOP. The minimum flows that would be provided by the LOP potentially create an artificial constraint on steelhead production in Sweetwater and Webb Creeks. We have no direct information on the actual relationship between stream flows and steelhead production, growth, or survival in Sweetwater, Webb, and Lapwai Creeks, so the effects of stream flow alterations are inferred from a variety of indicators.

The most simple indicator of effects is surface flow connectivity. Mobility is likely to be crucial to the survival and growth of juveniles in the Lapwai Creek Drainage since water temperatures sometimes approach or exceed the thermal tolerance of juvenile steelhead, and fish are likely to be dependent on pools with cooler temperatures to survive periods with excessive temperatures. Under LOP operations prior to 2006, portions of the stream channels in Sweetwater and Webb Creeks were completely dried during most summers. Under recent and proposed LOP operations, minimum flows are sufficient to maintain continuous surface flows throughout the year during normal operations. The BOR conducted surveys of Sweetwater and Webb Creeks to verify flows at which connectivity is maintained; minimum flows in Sweetwater Creek are more than adequate and minimum flows in Webb Creek are slightly above the threshold where connectivity occurs. Instances may arise where continuous flows are disrupted by mechanical failures of the automated gates, or where floods deposit large amounts of gravel and raise the streambed elevation. Floods capable of creating deposits large enough to disrupt summer flows in Sweetwater and Webb Creeks are uncommon events that occur less than once every one or two decades The frequency of mechanical failures cannot be predicted, but the proposed action requires that gates be adjusted manually once per day during failures; therefore, stream flow disruptions would not persist for more than a day when they occur. Otherwise, fish mobility would be maintained in Lower Sweetwater and Webb Creeks and improved in Lower Lapwai Creek to some extent. The proposed minimum flows would allow steelhead in Sweetwater and Webb Creeks to move out of unfavorable areas to seek cover, thermal refugia, or find more abundant prey, or to avoid competitors. Mobility will also improve in Lapwai Creek, below the confluence with Sweetwater Creek for some distance, but flows may still become disconnected due to water withdrawals by other parties downstream from Sweetwater Creek. It is not certain that surface flows would always remain connected in the absence of the LOP, but unregulated flows would likely reduce the frequency and duration of events where flows are disconnected.

Effects of Flow Rate Adjustments

The proposed action reduces minimum flows in several increments during the months of April, May, and June, as the purpose of minimum flows changes from spawning and incubation to summer rearing. Down-ramping may also occur at the end of the irrigation season if unregulated flows are less than the minimum, and any other time during the irrigation season for maintenance purposes. The proposed reductions in flow rates will occur through a series of gate adjustments to prevent abrupt decreases in stream flows that might strand fish and other aquatic organisms. Stranding is a potential problem when flows drop too quickly for fish to notice the change and move to deeper water. The maximum rate of change under the proposed action is 1 cfs per day, which is less than the average rate of decline in flows observed in Sweetwater and Webb Creek. The average daily change in streamflow on the falling end of the hydrograph, observed from April through June, 2003-2008, was -4.8 cfs per day in Sweetwater Creek at the diversion dam, and -2.2 cfs in Webb Creek. These background rates of change are two to nearly five times greater than the proposed adjustment rate. Stream flows when LOID is not making adjustments have fallen in a single day by 105 cfs in Sweetwater Creek and 37 cfs in Webb Creek, and precipitous declines in flow typically occur several times each year from April through June.

Under the proposed action the maximum rates of adjustment will occur when minimum flows drop from 4 cfs to 3 cfs in Sweetwater Creek, and 2.5 cfs to 1.5 cfs in Webb Creek. These adjustment rates correspond to decreases of 25% and 40%, respectively. Decreases in flow of this magnitude occur in Sweetwater and Webb Creeks roughly 20 times each year from April through June when LOID is not adjusting flows. The proposed action would add one additional day each year where the rate of change would exceed 25% in Sweetwater Creek and 40% in Webb Creek. Steelhead that have previously experienced extreme fluctuations in flow are less likely to become stranded than fish accustomed to a stable flow regime (Hunter 1992). Since the gate adjustments are less than half of the average daily change in flows that occur when LOID is not making adjustments, the flow adjustments will not cause an increase in stranding above the background rate that occurs when LOID is not making adjustments.

Flow adjustments at the end of the irrigation season would occur at a time when unregulated flows are generally higher than the minimum flows; therefore, flows would typically increase, but might occasionally decrease as well. Flow increases of 1 cfs in October pose no risks to steelhead since flow increases do not cause stranding and steelhead have developed sufficient swimming skills by October that a 1 cfs increase in velocity would not wash fish downstream. In years when flows are ramped downward in October, stranding would be unlikely in most years since unregulated flows and the minimum flows at the end of the season would likely be similar. Potentially, unregulated flows in October could be insufficient to maintain connected surface flows, and could be low enough to cause stranding when LOP operations shut down. This situation is not likely to occur, but it cannot be discounted. If unregulated flows were low enough in October to cause stranding when the LOP stopped operations, the mortality that would occur in the absence of the LOP would like be similar or higher than the mortality caused by ramping.

The effects of ramping during the operation season due to maintenance or mechanical failure depend on the timing. If the flow adjustments occur before steelhead develop swimming skills, decreased flows may cause stranding and increased flows might wash newly emerged fish downstream. The amount of stranding or washout potentially caused by flow adjustments, if any, cannot be predicted since there are many possible circumstances, including the possibility that the proposed action might sometimes reduce stranding and washout compared to natural conditions, and only some circumstances might result in mortality.

Biological Effects of Changes in Depth, Critical Velocity and Habitat Quality

The habitat effects section indicated that the proposed action is expected to significantly improve habitat conditions from those that existed in the past when no minimum flows were provided, but stream flows would not be fully restored to the levels that would occur in the absence, of the LOP. The IFIM results based on WUA (discussed earlier) indicate that the proposed minimum flows would provide to Sweetwater Creek at the dam from 80% to 97% of the maximum habitat quality for Age-0 steelhead and roughly 70% to 90% for steelhead Age-1 and above. Flows in Webb Creek would provide 60% to 74% of the maximum habitat quality for Age-0 steelhead and 58% to 79% for Age-1 steelhead. These numbers reflect relative differences in habitat quality, but by themselves, they have no direct relationship with fish production, growth, or survival. In general, the model tells us that summer rearing conditions for Age-0 fish should be more favorable than for Age-1 and older fish under the proposed action, and conditions in Sweetwater Creek would be more favorable than in Webb Creek. The model also tells us that unregulated flows would provide higher quality habitat than the proposed action.

Because IFIM results are qualitative indicators of habitat quality, and not direct predictors of fish response, a statistical relationship must still be established to relate stream flows to fish effects. Toward this effort, Entrix developed a report for the Tribe (Entrix 2009) that analyzes the relationship between steelhead survival and late summer streamflow, and the results of the model are considered in this section. From their analysis, Entrix found a statistical relationship between modeled stream velocities for several tributaries to the Snake or Columbia Rivers and modeled cohort survival rates in these same streams during the months August or September. Using these relationships, Entrix predicted critical summer flows that would be necessary for steelhead to survive in Sweetwater and Webb Creeks, as predicted by the model.

The model rests on several assumptions. One key assumption is that separate steelhead populations exist in Sweetwater, Webb, and Lapwai Creeks, and steelhead survival in these stream are not related to one another. This means that steelhead abundance or survival would not be significantly affected by movements of juvenile steelhead in or out of the streams if this assumption holds true. The other key assumption is that statistical correlations of changes in redd counts with stream flows, from one year to another, are due to effects of flow during the juvenile rearing period and not caused by factors affecting other life stages.

The assumption of separate populations in Sweetwater, Webb, and Lapwai Creeks is not likely to be entirely correct, but there is likely to be some degree of independence of steelhead abundance in these streams. Genetic analyses of steelhead populations often find recognizable differences in genetic markers at spatial scale as small as Webb and Sweetwater Creeks. However, movements among streams are also documented at this scale and one of the key reasons for establishing connected surface flows in this and the previous proposed actions was to allow steelhead to move among different habitats and different streams. Movement among streams is recognized as a crucial factor in steelhead survival and production in tributary systems (see NMFS 2006). Given these two circumstances, there is likely to be some amount of independence and also some amount of fish movement from one stream to another. Survival rates would be higher than predicted by the model if fish in the Sweetwater, Webb, and Lower Lapwai Creeks can move to other streams to find more favorable conditions for growth and survival, and the proposed action would maintain surface connectivity so movements can occur. The second assumption regarding the correlation between stream flows, redds counts, and juvenile rearing success is likely to be true to some extent, but the relationship is confounded by mortality in other life stages, so there is an unknown amount of error introduced by using redd counts rather than counts of juvenile fish (which are not available for this purpose).

The concept of a relationship between flow and salmonid growth and survival on which the model is built is well-supported in principle by scientific studies, but no general mathematical relationship between flows and salmonid survival or production has been found in literature reviewed by NMFS, and no such studies were cited in the Entrix (2009) report. Although stream flows are known to be an important factor for salmonid growth and survival, there are many additional factors affecting the survival rates of a cohort, and the validity of a model predicting a critical velocity for survival is untested.

To consider the validity and accuracy of this critical flow model, it is crucial to distinguish the difference between a model developed from measured velocities and actual fish observations in the stream affected by the proposed action, with a model developed from modeled velocities and modeled fish survival using data from other basins. The critical velocity analysis from Entrix (2009) is the latter approach; no actual fish were counted and no actual velocity measurements were used to develop the model. There is nothing inherently wrong with this approach, but there is considerable potential for error, the amount of error cannot be assessed, and the results can be unrealistic. The critical flow model developed by Entrix is questionable until it is validated and tested to determine its accuracy. The results of the model are considered along with other information indicating effects of stream flow alterations on steelhead abundance.

The source of the fish data used to develop the critical flow model for the Wallowa River, and Skitake, Mill, and Beaver Creeks is from McClure et al. (2003), which consists of hypothetical age structures and modeled estimates of redds per mile, made with varying amounts of accuracy and different methods in different years. The fish data from Asotin Creek prior to 2005 are also estimates of redds per mile. With only redd count data available, there is no direct way to determine juvenile survival rates. The only survival estimates that can be made solely from redd counts are survival rates for an entire cohort through its entire lifecycle, which includes mortality during upstream and downstream migration, in the ocean, and the freshwater life stages. Entrix (2009) uses statistical inference to determine what portion of cohort survival is explained by stream flows in August or September. Since this inference is not based on actual stream flow measurements or actual juvenile fish data, and the age structure is hypothetical, there is no statistical probability associated with the model; and therefore, no way to assess the error or statistical significance of the relationship between flow and juvenile survival.

Velocities in the critical flow analysis were estimated from discharge without knowing the actual relationship between discharge and velocity in the streams where flow was measured. In view of the careful attention needed to estimate velocities in Sweetwater and Webb Creeks in the IFIM study by BOR (2009), a single velocity that is estimated from average discharge at a single point for an entire river drainage that includes multiple tributaries is hardly comparable, and likely to have a considerable amount of error.

In comparing the critical flow analysis from Entrix (2009) to estimates of unimpaired flows and flows observed in Sweetwater and Webb Creeks, the critical velocity results do not appear to be realistic. Average unregulated flows estimated by NPT and Entrix (2009) for the months of August and September are 2.6 cfs and 3.6 cfs, respectively, in Lower Sweetwater Creek, and 1.0 cfs and 1.2 cfs, respectively, in Webb Creek. The critical flow model by Entrix (2009) predicts that minimum flows in August or September that are needed for long-term survival in these streams are 5.85 cfs in Sweetwater Creek and 4.9 cfs in Webb Creek. Both of these critical flows are significantly higher than the estimates of average unregulated flows in August or September. Estimates of unregulated flows from 2003 through 2008 predicted zero occurrences of flows as high as 4.9 cfs in Webb Creek during the months of August or September. Based on a coarse estimate flow frequencies from the Lapwai Creek stream gage data (NMFS 2006 Opinion, Appendix B), flows of 4.9 cfs would not occur more frequently than 1 to 3 times in a 20 year interval. If the lower bounds of the model are used, critical flow needed for long-term survival in Webb Creek is 2.35 cfs, which is nearly twice as high as the average unregulated flows in either month, while the lower bound for Sweetwater Creek (2.64 cfs) is roughly the same as the average unimpaired flow in August, but less than average unimpaired flows in September.

If the critical flow model is correct, Sweetwater and Webb Creeks are unsuitable for steelhead even in their natural state. According to the critical flow model, unimpaired flows in Sweetwater and Webb Creeks are not sufficient to have sustained separate steelhead populations in these streams, much less have sustained separate steelhead populations over the past 60 years when flows frequently dropped to zero in these streams. Yet, steelhead have persisted year after year when there was zero flow, which contradicts the results from critical flow model. Given the decades of persistence of steelhead at flows well-below the estimated critical flows, it is apparent that the critical flows are either unrealistic, or (if model is correct) steelhead could not have persisted in Webb and Sweetwater Creeks in the last six decades unless they are part of a larger population. With the apparent contradictions and uncertainties in the critical flow analysis, NMFS views the critical flow model as one of several lines of evidence that habitat conditions for steelhead in the Sweetwater and Webb Creeks are impaired by stream flows, but the critical velocities and model predictions themselves do not appear to be valid.

Effects of Water Temperature Alterations on Juvenile Steelhead

Water temperatures in Sweetwater, Webb, and Lower Lapwai Creeks under recent operations were frequently above the optimal temperature for steelhead throughout the summer, which would likely cause physiological stress to steelhead if the fish were unable to find refuge from the high temperatures. Occasionally, water temperatures have reached the upper limit for steelhead survival. In this type of environment, steelhead likely rely on thermal refugia for growth and survival. Pockets of cool water typically occur in streams in locations where groundwater seeps into the stream and mixes with surface flows. Groundwater upwelling is largely a function of local geomorphic drivers such as stream bed topography (Harvey and Bencala 1993) and broader geomorphic drivers such as basin topography, surficial geology, and reach-scale channel morphology (Tonina and Buffington 2009). Stream flows also positively affect the amount of hyporheic exchange (Poole and Berman 2001; Tonina and Buffington 2009), but discharge only influences the volume and rate of exchange that occurs in each particular location rather than the number or size of locations where upwelling occurs.

High temperatures in Sweetwater, Webb, and Lower Lapwai Creeks are typical of conditions seen today in many tributaries to the Lower Clearwater River where steelhead occur. Occasional periods of time where temperatures approach or exceed the lethal limit are documented in many Lower Clearwater River basin tributaries where steelhead are found. Steelhead apparently cope with these high temperatures by taking advantage of pockets of cool water that form in locations where there is an influx of cooler subsurface flows (Ebersole et al. 2001). Stream temperatures during summer under the proposed action are likely to be similar to the stream temperatures observed in recent years. Compared to unregulated flows, water temperatures in Sweetwater Creek might be warmed by as much as 1°C to 2°C; however, actual temperatures in the absence of the LOP are unknown and the accuracy of the temperature model is also unknown. With unregulated flows, steelhead would likely be less reliant on thermal refugia for growth and survival, but temperatures would still likely exceed the thermal tolerance of steelhead on numerous occasions, and thermal refugia would still play a significant role. The 1°C to 2°C water temperature increase over temperatures that would occur with unregulated flows would likely make conditions less favorable for steelhead, occasionally push temperatures beyond the lethal limit, and make steelhead more susceptible to disease if fish were not able to find pockets of cooler water. The aggregate result is that the temperature effects of the action are likely to harm or kill an unknown number of steelhead from increased thermal stress in comparison to unregulated flows, but the number of steelhead harmed or killed by the action would be less than the number killed under the baseline when disconnected flows prevented steelhead from moving to seek lower temperatures.

Temperatures ranging from roughly 20°C to 23°C are described by Sullivan et al (2000) as a range that salmonids can generally tolerate for periods of time ranging from several hours to several days by suspending feeding and other physical activities. Steelhead are not threatened with outright mortality at temperatures from 20°C to 23°C, but they are generally incapable of growth at these temperatures, and given a choice, steelhead will seek cooler water. Because stream temperatures would commonly exceed 20°C with unregulated flows, the availability of thermal refugia would still likely limit fish production in the Sweetwater, Webb, and Lapwai Creeks. Ebersole et al (2001) observed that the thermal refugia in trout-producing streams located in arid regions of Oregon were often "too small and too infrequent to sustain high densities of rainbow trout." The environmental conditions described by Ebersole et al (2001) are similar to the conditions in the Lapwai Creek drainage and many mid- and low-elevation tributaries in the Lower Clearwater River Basin where summer precipitation does not significantly contribute to surface flows.

Steelhead Monitoring in Sweetwater, Webb, and Lapwai Creeks

Under the terms and conditions in NMFS' 2006 Opinion, the UI[5] has been contracted by BOR to conduct biological monitoring in Sweetwater and Webb Creeks to determine if steelhead abundance or distribution were responding to minimum flows that began in 2006. These monitoring results provide insight to biological effects that are likely to occur under the proposed action. In the past two years (2008 and 2009) summer stream flows in Sweetwater Creek have been slightly lower than minimum flows under the proposed action (2.2 cfs observed in 2008-09, and 2.5 cfs proposed), but the flows are close enough to the proposed action to suggest how steelhead will fare under the proposed action. Flows in Webb Creek in 2008 to 2009 were less than half of the proposed flows, so the results are not as comparable as Sweetwater Creek, but they still provide a point of reference.

Monitoring results from 2008 and 2009 show that steelhead densities in Sweetwater, Webb, and Lapwai Creeks differed from densities observed in 2003 by Chandler and Richardson (2005) in the same vicinities (Figure 10), but there is no clear pattern in the differences. In Webb Creek and Sweetwater Creek, steelhead densities were higher in 2003 than 2008-2009, but the absolute change in numbers was relatively small. The most prominent change in fish density occurred in Upper Lapwai Creek, with a significant increase in fish production occurring in 2008 to 2009.

Since stream flows provided to Sweetwater and Webb Creeks in 2008 and 2009 were an improvement over flows in previous years, increased steelhead densities were expected, but steelhead densities in 2008-09 are lower than densities in 2003 were when no minimum flows were provided. The reasons for the different results from 2003 to 2008-09 are unknown and there are a variety of possible causes. The relatively high densities in the Lapwai Creek drainage upstream from the Sweetwater Creek might also suggest that steelhead abundance in the Lapwai Creek drainage as a whole may have increased from fish moving out of Sweetwater and Webb

[5] University of Idaho data are unpublished analyses provided by Rick Hartson and Brian Kennedy.

Creeks to higher quality areas in Lapwai Creek, but this is merely a possibility and not conclusive. Fish mobility during the summer has improved in Sweetwater, Webb, and Lower Lapwai Creeks under the recent LOID operations, so movement is a plausible explanation. Other possible reasons for the results include: (1) Sampling error due to insufficient number of sample sites or different sampling methods; (2) stream flows provided in 2008 and 2009 were not sufficient to increase fish density; (3) steelhead densities in Sweetwater and Webb Creeks are limited by habitat problems other than stream flow, such as temperature and low habitat complexity; (4) differences in the number of adult returns to the Lapwai Creek drainage or differences in the locations where redds were constructed; or (5) insufficient time to see a change in abundance of steelhead in Sweetwater and Webb Creeks.

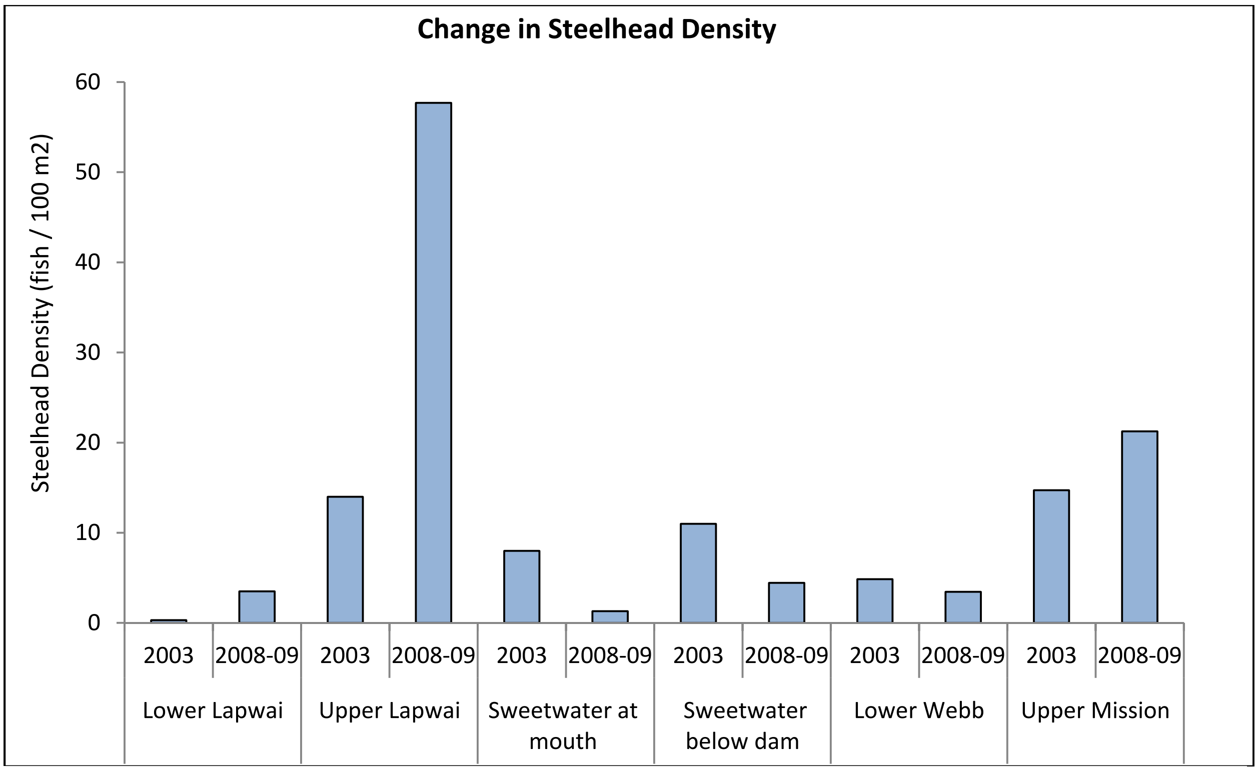


Figure 10. Juvenile steelhead densities measured at similar locations by Chandler (2005) and UI.

The UI data on steelhead age classes from 2008 and 2009 (Figure 11) provides no additional insight, but higher densities in 2008 in the Lapwai Creek drainage might reflect the unusually high flows and lower temperatures that occurred in late spring and early summer during 2008. Figure 11 shows that Age-0 fish were nearly absent in Sweetwater Creek at the sites in both 2008 and 2009. The UI survey has only two sampling sites in Sweetwater Creek, so it is possible that Age-0 fish were in other parts of the stream that were not sampled. If the low numbers of Age-0 fish in Sweetwater Creek are not due to sampling error or random variation, the results raise the possibility that egg survival and spawning success in Sweetwater Creek are low, or that few adults are spawning in the stream. If adults are reaching the stream in low numbers or not spawning in Sweetwater Creek at all, it might take several years before adults respond to higher stream flows, or there may be some characteristic in the hydrograph that is discouraging adults from spawning in Sweetwater Creek. The age class distribution in Lower Webb Creek is dominated by Age-0 fish, with a small number of Age-1 fish (Figure 11), which is a common finding in many streams, and does not indicate a problem with any particular life stage.

There are no conclusive findings that can be drawn from the UI information on age classes or fish densities. The UI also monitored steelhead growth and physical condition (ratio of weight to length), which shows a possible inverse relationship between fish densities and growth. Juvenile steelhead in Sweetwater and Webb Creeks appear to grow faster and achieve higher weights than fish in Upper Lapwai Creek or Mission Creek where densities are much higher. Although there are differences in fish density, age class, and growth in streams where flows are altered by the LOP, and nearby streams where flows are not altered by the LOP, the cause of these differences is not apparent. However, they do not appear to be related to the flows during the dry portion of the summer.

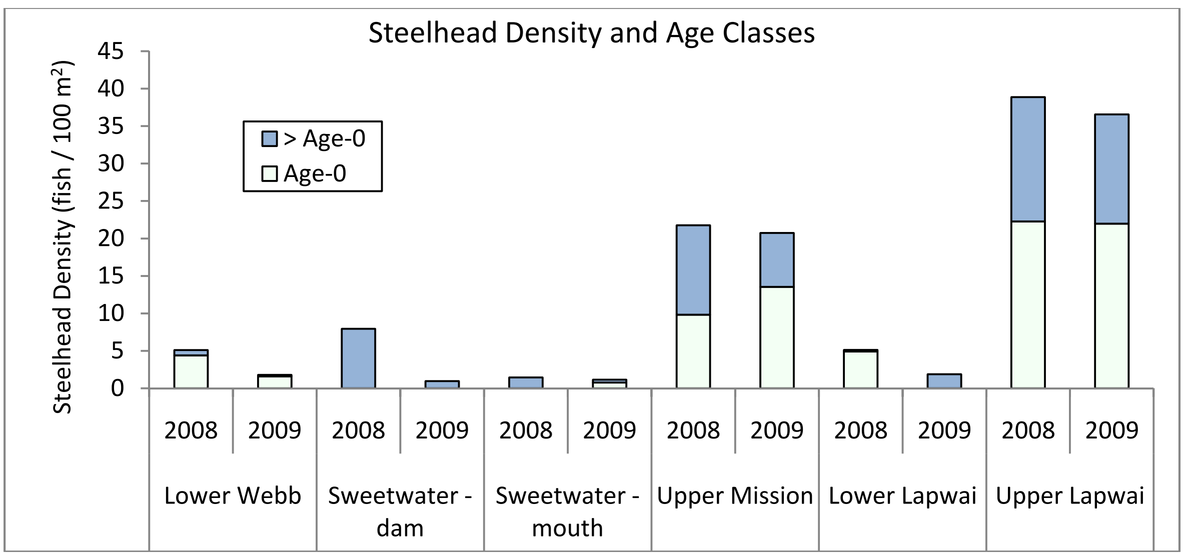


Figure 11. Average density and age-class composition of juvenile steelhead captured throughout the summers by UI in 2008 and 2009.

Comparison of Steelhead Densities in Streams Similar to Sweetwater and Webb Creeks

Comparative analysis of fish and habitat conditions in Sweetwater and Webb Creeks and similar streams provides another line of evidence concerning effects of the action on juvenile steelhead. The available data on fish densities consist of a variety of fish inventories performed occasionally in Lower Clearwater River basin tributaries. Data from recent years consist of thorough habitat and fish inventories by the Tribe in the Lapwai Creek and Big Canyon drainages, inventories in the Potlatch River drainage by the IDFG, and repeated sampling of juvenile steelhead in Sweetwater, Webb, Mission, and Lapwai Creeks from the UI in 2008 and 2009.

In the next figure (Figure 12), steelhead densities observed in August 2009 are plotted against stream flows, normalized by drainage area. Fish densities and stream flows were observed on the same days. The time of observation follows an extended period with hot weather and no rainfalls. These conditions represent the lowest flows that might typically occur during periods of drought. Summer droughts create harsh conditions for survival and growth, and minimum summer flows for the LOP were established with the notion that harsh summer conditions are likely to limit steelhead survival and growth when they are made worse by water withdrawals. While this is undoubtedly true to some degree, the streams with relatively low flows during one particular drought period in 2009 had the highest fish densities (Figure 12). Flows similar to the proposed minimum in Sweetwater Creek during a severe drought are relatively higher than flows elsewhere in the Lapwai Creek Drainage, but fish densities are low.

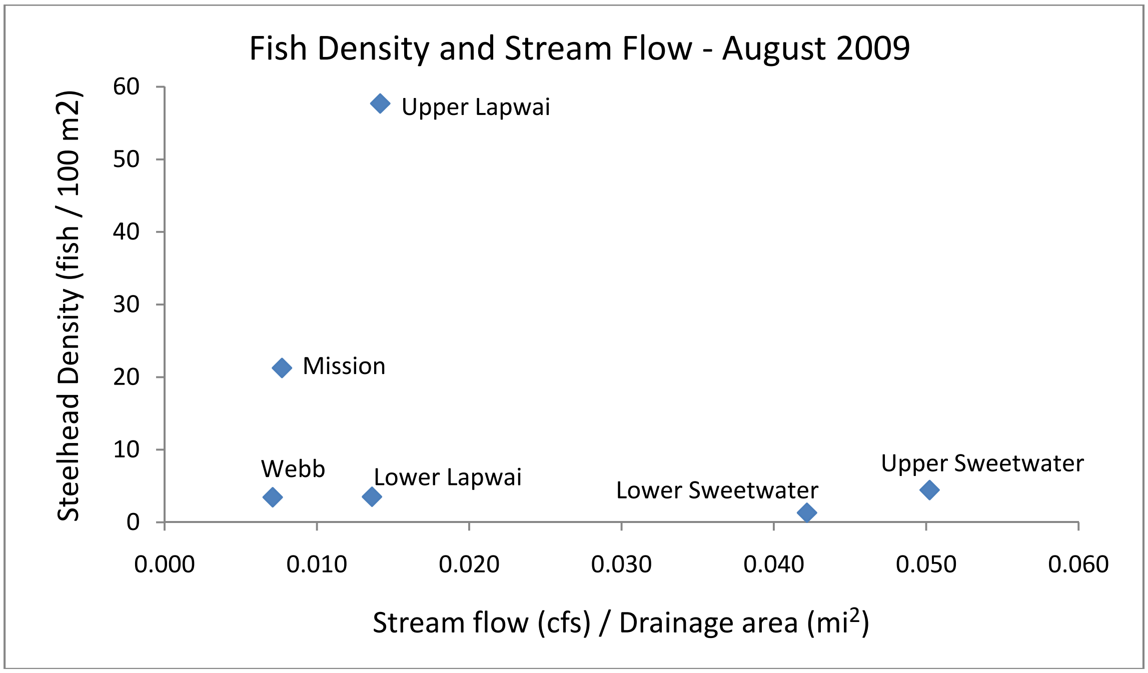


Figure 12. Densities of juvenile steelhead observed by UI from August 12 through August 20, 2009, and discharge measurements in the same locations on August 8, 2009.

The results in Figure 12 must be viewed with some skepticism since the discharges are only from a single day. However, the measured discharges are the culmination of 4 to 5 weeks of drought preceding the sampling dates, and the results likely reflect the prolonged exposure to drought rather than random fish densities on one particular day. However, the amount of potential error is unknown. Furthermore, the exact opposite pattern from the one seen in Figure 12 would be likely if the same type of data were plotted for observations made in June or early July; therefore, the figure only represents drought conditions, and it is not representative of average flows throughout the entire summer. Streamflows in Mission and Upper Lapwai Creeks during June and early July would be relatively higher than streamflows in areas affected by the LOP since a much amount of flow is diverted from Sweetwater and Webb Creek in these months compared late summer.

The most important consideration regarding the relationships shown in Figure 12 is that minimum flows in late summer are probably not the most significant factor limiting steelhead abundance since there is no relationship between low flows and steelhead densities in the Lapwai Creek drainage. This finding also invalidates the assumption used by Entrix (2009) in their critical flow model that stream flows in August or September are predictors of steelhead survival or production in the Sweetwater and Webb Creeks. If minimum flows are limiting steelhead abundance, the effect apparently occurs at some other time of year, but this should be considered a hypothesis rather than a conclusive finding.

A broad comparison of fish densities in the Lower Clearwater River Basin indicates that steelhead densities in Sweetwater and Webb Creeks in 2008-09 are near the mid-range of fish densities observed most steelhead-producing streams in Lower Clearwater River Basin tributaries (Figure 13). The lower portions of Mission Creek and Big Canyon Creek are probably the streams that have the most similarity to Sweetwater Creek in terms of elevation, relief, geomorphology, and hydrology. Upper Lapwai and Upper Mission Creek drainages are probably most similar to Webb Creek in the same regards. Steelhead densities in all of the stream affected by the LOP are less than the densities observed in nearby streams that have the most similar characteristics. Under the proposed action, fish densities in Sweetwater and Webb Creeks would likely be the roughly the same or higher than those shown in Figure 13 if past LOP operations have been limiting steelhead abundance in streams affected by the LOP.

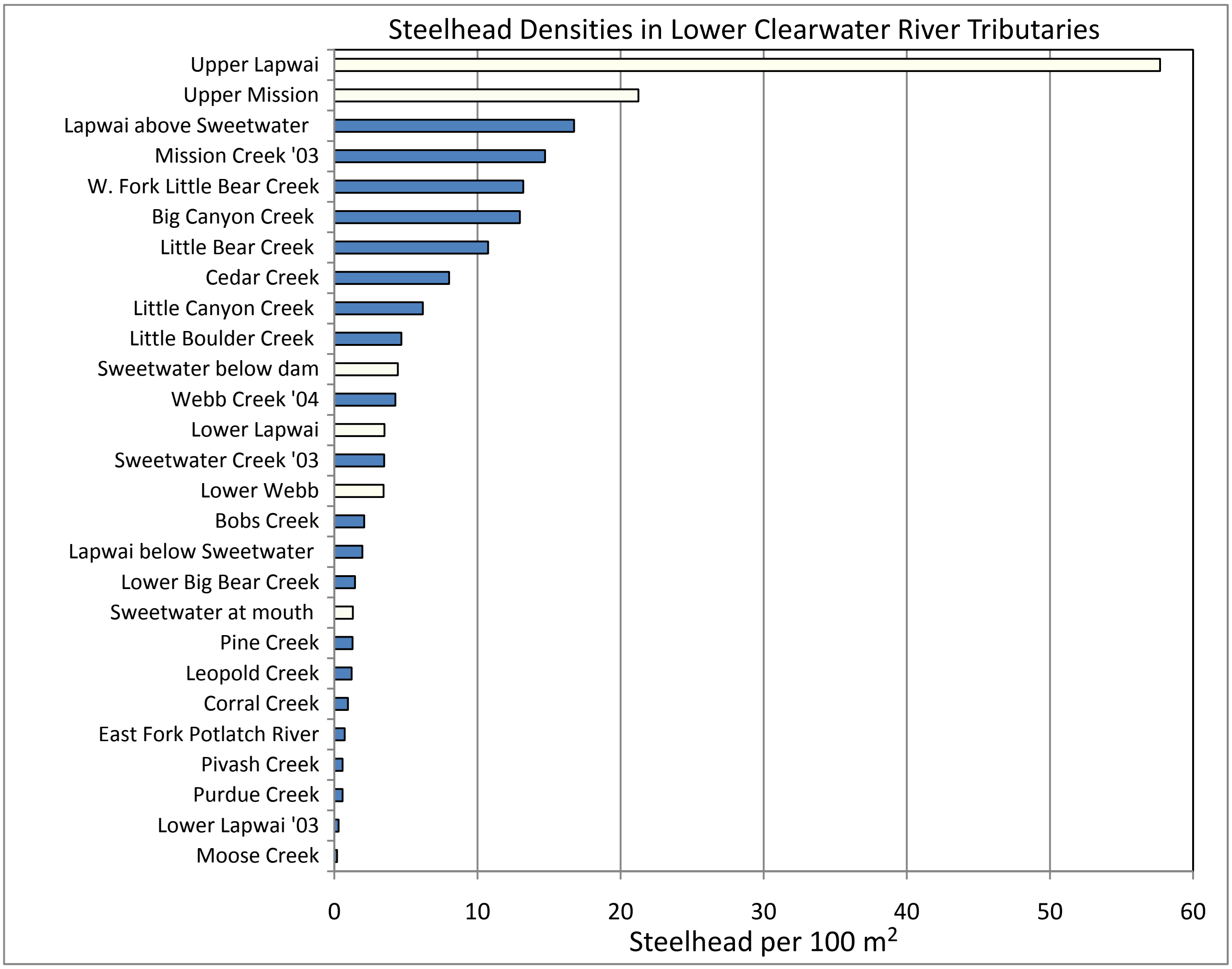


Figure 13. Juvenile steelhead densities in Lower Clearwater River Tributaries. The dark bars are from the Nez Perce Tribe or Idaho Dept. of Fish and Game in 2003 or 2004; the light bars are average densities from the University of Idaho in 2008 and 2009.

Summary of Biological Effects in Sweetwater, Webb, and Lapwai Creeks

The weight of evidence from the biological information evaluated in this Opinion indicates that steelhead abundance in Sweetwater and Webb Creeks is likely to be artificially constrained by the proposed minimum flows, but there is considerable uncertainty about the extent to which the action might actually constrain steelhead abundance. The most apparent stressor to steelhead in Sweetwater, Webb, and Lower Lapwai Creeks under the baseline is elevated temperatures in summer, and temperatures in summer are likely to improve only slightly from baseline conditions. The proposed action would not likely have a significant effect on temperature during the spring or winter. Compared to unregulated flows, the LOP would maintain existing temperatures in summer that are 1°C to 2°C higher than might occur otherwise. A temperature change of this magnitude might appear to be a minor concern, but these streams naturally exhibit high temperatures and small increases in temperature would increase the frequency and duration of instances where temperatures exceed the tolerance of steelhead. Whether temperatures are excessive naturally or from the proposed action, suitable habitat would exist only in pools that have lower temperatures. The limiting factor in streams with excessive temperatures is likely to be established by the availability of pools with groundwater influx (Ebersole et al. 2001; Torgersen et al. 1999), which is somewhat influenced by the amount of surface flow, but is largely a function of streambed topography and groundwater characteristics (Tonia 2005).

Steelhead in Sweetwater Creek are not responding to flow as reflected in habitat quality ratings from IFIM. Habitat quality ratings indicated that both depth and velocity under the proposed minimum flows would be less than what would occur with unregulated flows, and that the proposed minimum flows would be favorable for Age-0 fish and only modestly suited for Age-1 fish. Fish surveys by UI in Sweetwater Creek found only Age-1 fish in two consecutive years, at minimum flows of 2.2 cfs (compared to 2.5 cfs under the proposed action), which is the opposite of what the model suggests. Results in Webb Creek appear more consistent with the IFIM ratings. The observed steelhead densities in Sweetwater Creek either indicate the model results are incorrect or that something other than flow is affecting fish abundance.

Streamflows in Sweetwater and Webb Creeks increased in several increments from 2006 to 2009, but minimum flows of 2.2 cfs in Sweetwater Creek in 2008-09 caused no apparent change in fish abundance, when these fish densities are compared to densities observed in 2003 when no minimum flows were provided. The proposed action provides a relatively small increase in flows in Sweetwater Creek compared to flows observed in 2008 to 2009; consequently, the existing data suggests that few changes from baseline steelhead abundance are likely to occur in Sweetwater Creek. There is only one year of fish abundance data prior to 2006; consequently, the available data may be insufficient to detect a response. It is very likely that more time is needed to see a response in steelhead since barely a single generation has passed since minimum flows have been provided to by the LOP. Minimum flows will roughly double in Webb Creek, so there is a greater potential for increased abundance in this stream.

The negative relationship that Entrix (2009) found between steelhead survival and late summer stream flows in other drainages is not reflected in the Lapwai Creek Drainage when fish densities are plotted against low flows in August. Steelhead densities in the Lapwai Creek drainage show no apparent relationship with late summer flows. This finding suggests that if flows are a negative on steelhead abundance in Sweetwater and Webb Creeks, the effect apparently occurs at some time of the year other than late summer, or the effect is obscured by confounding variables such as temperature and habitat complexity.

The only conclusion that can be drawn from the analysis of biological effects is that the proposed action is likely to more or less maintain abundance and distribution that similar or slightly better than present in Sweetwater, Webb, and Lower Lapwai Creeks, and modestly improve conditions in Webb Creek. The prospects for steelhead in Webb Creek would be improved accordingly, but overall, the proposed action is not likely to cause a significant increase or decrease in steelhead abundance in Sweetwater, Webb, and Lower Lapwai Creeks.

Effects of the Proposed Action on Salmon and Steelhead in the Mainstem Rivers and the Captain John Creek Drainage

The LOP has only minor or negligible effects on anadromous fish and their habitat outside the Lapwai Creek drainage. Rearing habitat and possibly spawning habitat for Snake River Basin steelhead and listed spring/summer Chinook salmon occur in the lower reaches of Captain John Creek, fall Chinook salmon from the Tribal hatchery are reared in artificial ponds near the mouth of Lapwai Creek, and wild fall Chinook salmon are likely to occur in the Clearwater River at the mouth of Lapwai Creek. In addition, Captain John Creek is designated critical habitat for Snake River Basin steelhead and spring/summer Chinook salmon. Fish distribution in Captain John Creek is limited by a natural falls that blocks all fish passage at stream mile 5.8. The LOP diversion in Captain John Creek is located several miles upstream from this impassable falls.

The Captain John Creek diversion withdraws roughly 4% of the stream flow during the spring runoff period and occasional storm events. The effects of the LOP on salmon and steelhead are negligible in the Captain John Creek drainage since the point of water diversion is several miles upstream from a natural fish passage barrier, and the size and timing of the water withdrawal has minor effects on peak flows in Captain John Creek. Water is not diverted from Captain John Creek in the summer or winter when flows are most likely to become a limiting factor for anadromous fish. Based on the presence of the natural falls, the minor amount of water diverted out of the drainage, and the timing of the withdrawals during the flood period would only have insignificant effects. For this reason, the LOP would likely not adversely affect Snake River Basin steelhead, spring/summer Chinook salmon, or their designated critical habitat in the Captain John Creek drainage.

Wild fall Chinook salmon occur in the mainstems of the Snake and Clearwater Rivers, but are unlikely to occur in the Lapwai Creek Drainage, based on life history characteristics described by Healey (1991) and Connor et al. (2002). Adult, wild fall Chinook salmon spawn and rear in large, mainstem rivers (typically larger than Lapwai Creek at the mouth), and are unlikely to enter a stream as small as Lapwai Creek for spawning. Juvenile fall Chinook salmon typically begin downstream migration upon emergence from redds, largely because they are incapable of swimming upstream or holding a position as fry, and possibly due to genetic disposition for migration (Healey 1991). Fry appear to develop the ability to hold a position within a few days after emergence, but they may travel a long distance before developing this ability (Healey 1991). Wild juvenile fall Chinook salmon are unlikely to be capable of swimming upstream into Lapwai Creek, but they may temporarily occupy the periphery of Lapwai Creek in eddies or areas of low velocity as they move downstream.

The proposed action, when considered independently from other actions affecting stream flows in the action area, has no meaningful effect on anadromous fish migration in Clearwater, Snake, and Columbia Rivers. However, water withdrawals, no matter how small, affect all flows downstream, and cumulatively, water withdrawals in the Snake River Basin add up to a significant change in stream flows in the mainstem Snake and Columbia Rivers. The aggregate effects of water withdrawals on mainstem passage, including the contribution of past withdrawals from the LOP were evaluated in the FCRPS biological opinion (NMFS 2008b) and its associated SCA (NMFS 2008a). The proposed action would withdraw a volume of water that is similar to what is described in the baseline; therefore, the aggregate effect of water withdrawals from the LOP and other sources are not likely to cause a meaningful change in the mainstem passage conditions that exist under the environmental baseline described in the SCA. Consequently, the LOP will continue to cause the same effects on the migration of Snake River Basin steelhead, spring/summer Chinook, fall Chinook, or sockeye salmon that exists under that baseline.

Listed hatchery fish from the North Lapwai Creek Valley Satellite Rearing Facility are reared in a series of ponds adjacent to Lapwai Creek. The rearing ponds are not physically connected to Lapwai Creek, although a pipe is sometimes used to pump water from Lapwai Creek into the ponds. The LOP may occasionally preclude the use of Lapwai Creek as a water source for the rearing ponds at the North Lapwai Valley satellite rearing facility; however, the rearing facility is also supplied by a well; consequently, operation of the facility is not dependant on water from Lapwai Creek.

Population Level Effects

The population structure of Snake River Basin steelhead described previously in the Opinion consists of the Snake River Basin steelhead DPS, six MPGs, and individual populations within each major group. Steelhead in the Lapwai Creek drainage are part of the *Lower Mainstem Clearwater River Population* (Lower Mainstem Population), which is part of the *Clearwater River MPG* (Clearwater MPG). The Clearwater MPG includes five populations including the Lower Mainstem Population, but the North Fork Clearwater River population is extirpated, so only four populations besides the Lower Mainstem Population presently exist. Population-level effects are evaluated by considering how effects of the LOP on steelhead abundance in the Sweetwater and Webb Creeks would affect the viability criteria for the Lower Mainstem Population, the Clearwater River MPG, and the DPS as a whole.

Existing steelhead abundance in Sweetwater and Webb Creeks is likely lower than would exist in the absence of the LOP, but the absolute difference in abundance due to past flow effects is unknown. The comparison of fish densities in streams similar to Sweetwater and Webb Creeks, shown above in Figure 13, suggests that steelhead abundance in these streams would be higher under unregulated flows but differences in habitat features other than flow and comparing data from different years also affects these fish densities. Since the proposed action does not substantially change flows or habitat conditions from 2008-2009 in Sweetwater Creek, the proposed action is not likely to cause a significant change in existing steelhead abundance in Sweetwater Creek. Prospects for higher fish abundance in Webb Creek will be improved since flows will be doubled, but the IFIM assessment indicates that habitat conditions in Webb Creek would still be of moderate quality, so any increases in abundance are likely to be modest. While the proposed action improves prospects for greater steelhead abundance in the Lapwai Creek drainage, it is not likely to have a significant effect on the existing steelhead abundance since the habitat changes are modest.

Since the action is unlikely to significantly change steelhead abundance in the action area, the viability rating of the Lower Mainstem Population will remain largely unchanged by the proposed action. The 2009 TRT viability analysis indicates that the Lower Mainstem Population is "maintained," with productivity of the MPG under the baseline at replacement under an increasing population trend, and the criteria for spatial structure and diversity sufficiently met. In order for the MPG to meet viability criteria, production and abundance of steelhead in the Lower Mainstem Population production must increase to achieve at least a "viable" rating. The proposed action increases flows from the baseline, which improves the prospects for meeting viability criteria.

If the action provided more flow than is presently proposed, it might result in a larger increase in steelhead abundance. However, this higher amount of flow would not substantially change the prospects for the MPG since additional improvements in other parts of the Lower Mainstem Population area, and in the other populations as well, would still be necessary to meet viability criteria. Although Sweetwater, Webb, and Lapwai Creeks might potentially have greater abundance with higher flows than the proposed action, the forgone production under the proposed action does not deter the Lower Mainstem Population from increasing in abundance or achieving a "viable" status rating. A-run steelhead have exhibited a strong positive trend in abundance for more than a decade, and abundance in Sweetwater and Webb Creeks will likely continue to increase accordingly as long as the trend continues and habitat conditions are not made worse than the baseline. If the increasing trend does not continue, the Lower Mainstem Population is not put at risk by the action since the population is presently at the replacement rate and habitat conditions are improved by the proposed action.

2.1.4. Cumulative Effects

'Cumulative effects' are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Cumulative effects that reduce the ability of a listed species to meet its biological requirements may increase the likelihood that the proposed action will result in jeopardy to that listed species or in destruction or adverse modification of a designated critical habitat.

There are no specific state or private actions known to NMFS that are planned in the action area that would appreciably change the baseline conditions and are reasonably certain to occur. Current water withdrawals, land uses, and floodplain alterations for flood control are likely to continue as they have in the past, with possible increases due to population growth. LOID is undertaking efforts to install water meters, which may reduce the amount of future water use, but the funding is not certain, and the actual effects on water use are also uncertain.

2.1.5. Conclusion

After reviewing the status of the listed species of salmon and steelhead affected by the proposed action, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, NMFS concludes that the action, as proposed, is not likely to jeopardize the continued existence of Snake River Basin steelhead, Snake River spring/summer Chinook salmon, Snake River fall Chinook salmon, Snake River sockeye salmon, and listed salmon and steelhead species in the Columbia River, nor likely to destroy or adversely modify designated critical habitat for any of these species. These conclusions are based on the following considerations.

Jeopardy Determination and Rationale

An action jeopardizes a species if it would be reasonably expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). The species considered in the Opinion consist of Snake River Basin steelhead, Snake River spring/summer Chinook salmon, Snake River fall Chinook salmon, and Snake River sockeye salmon. The action adversely affects Snake River Basin steelhead in Sweetwater, Webb, and Lapwai Creeks, and the effects analysis has focuses on this species. The remainder of the species do not occur in Sweetwater, Webb, or Lapwai Creeks, and the effects of the action are negligible outside the Captain John Creek and Lapwai Creek Drainages since the physical changes in depth and velocities in the mainstem rivers caused by the LOP are overwhelmed by natural fluctuations in flow and effects of FCRPS operations.

The LOP stream flow alterations affecting Snake River spring/summer Chinook salmon in Captain John Creek are not of a magnitude where the action would adversely affect Chinook salmon.

The proposed action does not change stream flows that were described in the SCA as the environmental baseline in the mainstems of the Clearwater, Snake, and Columbia Rivers. The LOP water withdrawals under the proposed action are less than 0.05% of the volume of water that has been withdrawn under the environmental baseline for irrigation purposes and does not functionally change mainstem passage conditions affecting Snake River Basin steelhead, Snake River spring/summer Chinook salmon, Snake River fall Chinook salmon and Snake River sockeye salmon or the other downstream populations considered in the SCA.

The proposed action continues long-established water diversions from Sweetwater and Webb Creeks. Past operation of the LOP has likely diminished steelhead abundance in these streams and in Lapwai Creek, and similar effects would continue to persist under the proposed action, but with minor improvements to stream flows. The proposed action provides larger minimum flows than the past and improves the prospects for greater steelhead abundance in Webb Creek, but it is not likely to cause any meaningful change to the present steelhead abundance in Sweetwater or Lapwai Creeks.

Steelhead in Sweetwater, Webb, and Lapwai Creeks are part of the Lower Mainstem Population of steelhead. The Lower Mainstem Population is rated as “maintained” by the TRT. A “maintained” status means the average steelhead production in this population is presently at the replacement rate, which is adequate for the sustained persistence of this population as long as the positive trend in adult returns of A-run steelhead does not become negative, or habitat conditions are not made worse. The proposed action would not jeopardize the continued existence of the Snake River Basin steelhead DPS because steelhead production rate in the Lower Mainstem Population is adequate for sustained persistence of the population and the proposed action does not significantly change the production rate of this population. The forgone steelhead production in Sweetwater, Webb, and Lower Lapwai Creeks is not large enough to reduce appreciably the likelihood of both the survival and recovery of the DPS.

Critical Habitat Determination and Rationale

The purpose of critical habitat designation is to identify areas which have those physical or biological features essential to the conservation of the species and which may require special management considerations or protection; and also to conserve specific areas outside the geographical area occupied by the species that are essential for its conservation [ESA 3(5)(a)]. Section 3(3) of the ESA defines "conservation" as "to use and the use of all methods and procedures necessary to bring any endangered species or threatened species to a point at which the measures provided pursuant to [the] Act are no longer necessary." In view of the statutory language concerning critical habitat and the pivotal role of "conservation" in designating critical habitat, an action would adversely modify or destroy critical habitat if it altered the PCEs in a manner that diminished the conservation role or value of the designated critical habitat.

The aggregate condition of the PCEs defines the quality of the critical habitat. In Sweetwater, Webb, and Lapwai Creeks, habitat quality has been diminished by past LOP operations, to the extent that steelhead abundance in these streams is lower than it would be if the PCEs were unaffected by the LOP. Under the environmental baseline, all PCEs in Sweetwater, Webb, and Lapwai Creeks have been sufficient to sustain steelhead in these streams. The proposed action will cause adverse effects on some of the PCEs in Sweetwater , Webb, and Lapwai Creeks (flow, temperature, cover) but that these effects will be less than they were under past operations. For the most part, the PCEs in the Sweetwater, Webb, and Lapwai Creeks will remain similar to their present state.

Outside the Lapwai Creek Drainage, the proposed action does not change the essential physical and biological features that were described in the SCA for the mainstems of the Clearwater, Snake, and Columbia Rivers. Any potential effects are largely unquantifiable because minor fluctuations in flow due to natural events or changes in the operation of the FCRPS will overwhelm any potential effect of the proposed action on depth and velocity in these larger rivers.

There is no specific conservation role for critical habitat defined in a recovery plan for any of the listed Snake River salmon or steelhead species; consequently, the effects of the action on critical habitat were evaluated by examining the condition of PCEs in the action area, as influenced by the aggregate effects of the action, baseline conditions, and cumulative effects. The proposed action affects PCEs related to stream flow, with the largest effects occurring in Sweetwater, Webb, and Lower Lapwai Creeks. In these streams, PCEs have been diminished in quality from past LOP operations and factors unrelated to the LOP. In their present state, the PCEs in the Sweetwater, Webb, and Lapwai Creeks presently support all freshwater life stages. Under the proposed action, PCEs related to flow would be improved from the baseline, but the quality of the PCEs would remain diminished in comparison to the potential quality in the absence of the LOP. The proposed action would likely impose an artificial restriction on the quality of juvenile rearing habitat in Sweetwater, Webb, and Lower Lapwai Creeks, but it maintains or improves essential features such as foraging areas, free movement, and access to cover, to the extent that these features are affected by the action. Beyond the Lapwai Creek drainage, the action causes negligible effects to PCEs for the Lower Clearwater River Mainstem Population as a whole or the Snake River steelhead DPS. Downstream from Lapwai and Captain John Creeks, the proposed action affects only mainstem migration by decreasing velocity and water depth in the Clearwater, Snake, and Columbia Rivers, but the changes to these features would be immeasurable, and the incremental change in flow is too small to cause a discernable biological effect.

The proposed action does not destroy or adversely modify critical habitat because it maintains PCEs related to spawning, rearing, and migration in Sweetwater, Webb, and Lower Lapwai Creeks in a functional condition that provides habitat elements that are necessary to support all freshwater life stages of Snake River Basin steelhead; and it has negligible effects on migration in the mainstem rivers. The effect of the action on PCEs is primarily a local effect in the Lapwai Creek Drainage, where increased flows improve PCEs but do not restore PCEs to their potential quality that would exist in the absence of the LOP. Critical habitat for the Lower Mainstem Population as a whole is virtually unaffected by the proposed action, since effects of the action on PCEs in the mainstem are limited to immeasurable changes in depth and velocity. Since the local effects of the action do not diminish the conservation value of the critical habitat for the Lower Mainstem Population, and the effects on PCEs in the mainstem rivers are negligible, the proposed action has no appreciable effect on the conservation value of Snake River Basin steelhead critical habitat as a whole.

2.1.6. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. The following recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be implemented by BOR, to the extent that their authorities allow:

1. The BOR should pursue opportunities to modify the existing diversion dams to provide upstream fish passage and screen the diversion canals to prevent steelhead from entering them if passage is provided.

2. The BOR should pursue opportunities to moderate water temperatures in Sweetwater Creek through revegetation of riparian areas lacking a canopy cover, or other appropriate restorative measures.

3. The BOR should cooperate with the Tribe to rehabilitate stream channels that have become incised, diked, or straightened.

4. The BOR should exercise their authority as allowed to develop estimates on the cost and the total amount of water saved if the Sweetwater Canal were replaced with a pipeline to reduce water losses to evaporation and leakage, as a contingency or alternative to

developing a pumping plant. The average volume of water withdrawn from Sweetwater Creek is estimated to be roughly 7,000 af per year (BA, Appendix B, pages B-74 to B-79, years 2003 to 2008), and water delivered to LOID customers has averaged roughly 5,400 af per year. Water losses over this period have averaged 1,600 af or 22.8%. Some of this loss has been reduced by lining portions of the Sweetwater Canal, but significant losses remain. It may not be possible to eliminate water losses by piping the water, but if 50% to 75% (of 1600 af) were recovered, this would amount to 800 to 1200 af or 3.3 cfs to 5 cfs if spread over 4 months.

Please notify NMFS if the BOR carries out any of these recommendations so that we will be kept informed of actions that minimize or avoid adverse effects and those that benefit listed species or their designated critical habitats.

2.1.7. Reinitiation of Consultation

Reinitiation of formal consultation is required and shall be requested by the Federal agency or by NMFS where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) If the amount or extent of taking specified in the ITS is exceeded; (b) if new information reveals effects of the action that may affect listed species or designated critical habitat in a manner or to an extent not previously considered; (c) if the identified action is subsequently modified in a manner that has an effect to the listed species or designated critical habitat that was not considered in the Opinion; or (d) if a new species is listed or critical habitat is designated that may be affected by the identified action (50 CFR 402.16).

Specific circumstances that would require re-initiation of consultation include, but are not limited to the following:

1. Biological or physical monitoring in the action area indicates that the instream flows provided by BOR in Sweetwater and Webb Creeks are limiting steelhead populations in Sweetwater Creek, Webb Creeks or Lapwai Creek downstream from the mouth of Sweetwater Creek in a manner that is greater than that which is described above in this Opinion.

2. Annual diversion from Sweetwater Creek exceeds the amount necessary to achieve the contracted delivery amount of 8,444 af.

3. The status of the Lower Mainstem Clearwater River Population viability rating changes from "maintained" to a lower status.

To reinitiate consultation, contact the Idaho State Habitat Office of NMFS and refer to the NMFS Number assigned to this consultation.

2.2. Incidental Take Statement

Section 9(a)(1) of the ESA prohibits the taking of endangered species without a specific permit or exemption. Protective regulations adopted pursuant to section 4(d) extend the prohibition to threatened species. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 CFR 222.102). Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(o)(2) exempts any taking that meets the terms and conditions of a written ITS from the taking prohibition.

2.2.1. Amount or Extent of Take

The proposed action is expected to cause incidental take of Snake River Basin steelhead through the effects of stream flow alterations. Juvenile steelhead occur in locations where streamflows will be reduced from what would occur naturally in a manner that is likely to diminish habitat suitability and incidental take is reasonably certain to occur through this change in habitat. Adult steelhead only use Sweetwater , Webb, and Lapwai Creeks for spawning which occurs when stream flows are higher; therefore, no incidental take of adult steelhead is anticipated. When the proposed action provides flows that are lower than those that would occur in the absence of the LOP, incidental take is likely to occur under the following circumstances: (1) Steelhead embryos and alevins may be killed when reduced surface flows either dewater redds or cause insufficient intergravel flows during the incubation period through the time when alevins would emerge from the gravels; and (2) stream flows artificially constrain steelhead abundance, growth, or survival due to reduced carrying capacity, high water temperatures or other stresses caused by flow reductions. The incidental take exempted by this ITS is the loss of steelhead from these two circumstances. Despite the use of best scientific and commercial data available, NMFS cannot quantify the number of individual fish or incubating eggs likely to be harmed or killed by this action. When take cannot be quantified, NMFS describes the extent of take, and any quantifiable habitat indicators, which are linked to the mechanism of take, and which would define the limits anticipated in this Opinion.

There are critical uncertainties about the effects of the action and the amount of take that is likely to occur. The effects analysis pointed out several instances where effects of the action are not distinguishable from natural or baseline habitat conditions. Specifically, water temperatures were identified in this Opinion as potentially limiting steelhead production in the Lapwai Creek Drainage regardless of the proposed action's effects. Temperatures in Sweetwater, Webb, and Lapwai Creeks often reach levels that are lethal to steelhead during the summer months. Fish must either move downstream to cooler water or find niches of microhabitat with cool groundwater inflow. Finding these microhabitats for monitoring purposes is not feasible due to uncertainty as to their location and trespass issues with local private landowners. In addition, as noted above in the Effects Analysis, changes in flows from the proposed action would not necessarily result in changed water temperatures. For these reasons, temperatures would not be an appropriate measure to determine the extent of take.

Another possible measure of the extent of take could be measurements of fish densities resulting from the proposed action. However, as stated above, increases in flows over the last several years have not corresponded to increases in fish density in Sweetwater or Webb Creeks. There are a number of possible reasons for this, as described above; therefore, fish density would not be an appropriate measure of the extent of take at this time. However, in the long term, it would be the most appropriate measure to determine the potential benefits of increased flows under the proposed action.

Connectivity affects the juveniles' ability to move to more optimal habitat during periods of environmental stress. It is anticipated that the proposed action will maintain connectivity in Sweetwater Creek because previous survey data indicate that connectivity occurred at flows which are lower than the flows proposed under the proposed action. Connectivity in Sweetwater Creek is an important component of the effects NMFS describes above in the Opinion. If the proposed flows do not provide connectivity, the extent of take NMFS analyzed in this Opinion would be exceeded. There are private property trespass issues involved but it is feasible to devise a monitoring program which would evaluate connectivity at a few, carefully selected sites that would be especially sensitive to dewatering. Therefore, connectivity would be an appropriate extent of take measure in Sweetwater Creek. The extent of take would be exceeded if it was determined that flows in Sweetwater Creek were not providing connectivity at these critical locations.

Connectivity is less certain in Webb Creek. This is, in part, due to physical characteristics of Webb Creek that could potentially cause dewatered locations to change in high flow years when large amounts of gravel could be deposited downstream. Webb Creek would then flow through these gravel deposits until the next high flow event when the gravel accumulations would again be moved downstream. However, the proposed minimum flows in Webb Creek, during the drier period of the year, are greater than flows that would occur in an unregulated system and this was an important consideration in NMFS effects analysis in the above Opinion. If flows were less than proposed for Webb Creek, for a significant length of time, take of steelhead in Webb Creek would increase. For this reason, flow is an appropriate extent of take measure in Webb Creek.

The amount of take resulting from the LOP cannot be quantified primarily because stream flows do not harm or kill fish outright and instead fish are harmed or killed indirectly through mechanisms such as displacement, poor growth, and environmental stress. Fish naturally die from the same mechanisms and there is no way to distinguish deaths attributable to the effects of the action from deaths from causes unrelated to the action. Additionally, a portion of the take caused by the LOP is likely to occur outside the Lapwai Creek Drainage from delayed mortality from poor rearing conditions. There is presently no means to determine rates of mortality during migration or ocean residence that could be attributed to a specific action such as the LOP. Compounding the difficulty identifying take is the fact that the LOP has been operating for the past 60 years, so there is no undisturbed baseline against which to compare before and after effects of the action. Available survey data on steelhead densities in the Lapwai Creek Drainage are counts of those juvenile steelhead that have survived after some unknown amount of take from LOP operations has already occurred.

Because stream flow is the principal cause of take from the proposed action and take cannot be quantified with available information, stream flow will be used as a quantifiable habitat indicator for take in both Sweetwater and Webb Creeks. In addition, connectivity will be used as a quantifiable indicator of take in Sweetwater Creek.

As a quantifiable habitat indicator, flows can be measured accurately and, as established above in the Analysis of Effects, low flows are the primary cause of take in Sweetwater and Webb Creeks. However, the exact numerical relationship between stream flows and the amount of incidental take cannot be determined for the reasons referenced above. NMFS anticipates that at flow levels provided in the proposed action, connectivity would be achieved at all times when the LOP is operating in Sweetwater Creek. If flows, at the levels proposed by the BOR in Sweetwater Creek, became disconnected, increased levels of incidental take would occur. Additionally, if flows in Sweetwater Creek were reduced below those analyzed in the Opinion for more than 24 hours, stream flows may become disconnected and increased levels of incidental take would occur. For these reasons, flow and connectivity in Sweetwater Creek are sufficiently sensitive and appropriate indicators of take. As noted above, stream flow in Webb Creek would be an appropriate quantifiable habitat indicator for take.

The extent of take encompasses all areas of Sweetwater and Webb Creeks where steelhead occur and Lapwai Creek downstream from the mouth of Sweetwater Creek. All juvenile steelhead in these areas would be subjected to effects of the proposed action, with the potential for take.

Using flow and connectivity as quantifiable habitat indicators, the extent of take exempted by the ITS in Sweetwater Creek is described below. Using flow as a quantifiable habitat indicator, the extent of take exempted by the ITS in Webb Creek is described below. The anticipated extent of take would be exceeded if monitoring finds either of the following conditions:

1. Stream flows in Sweetwater or Webb Creeks are less than the proposed minimum flows, when the LOP is operating, due to causes other than natural events that prevent normal operation, emergency repairs that require suspension of minimum flows, or experimental flow manipulations to investigate effects of the action. Stream flows would be considered to be less than the proposed minimum flows if the hourly average flow falls short of the minimum flow requirement more than 2 times per year by 20% or more and unforeseen circumstances (such as impassable road conditions or unavailability of personnel due to illness or other absences) preclude correcting the deficiency within 24 hours.

2. Site specific monitoring determines that stream flows described in the proposed action are not successful at providing connectivity in Sweetwater Creek.

2.2.2. Reasonable and Prudent Measures

The RPMs are non-discretionary measures to avoid or minimize the impact of take that must be carried out by BOR, or parties acting under BOR's authority, for the exemption in section 7(o)(2) to apply. The BOR has the continuing duty to regulate the activities covered in this ITS where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) will lapse if the BOR fails to exercise its discretion to require adherence to the terms and conditions of the ITS, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions. Similarly, if any applicant fails to act in accordance with the terms and conditions of the ITS, protective coverage will lapse.

NMFS believes that full application of conservation measures included as part of the proposed action, together with use of the RPMs and terms and conditions described below, are necessary and appropriate to minimize the likelihood of incidental take of listed species due to completion of the proposed action.

The BOR shall:

1. Provide flows below the diversion dams in Sweetwater and Webb Creeks, as described in the proposed action.

2. Develop, in coordination with NMFS, a stream flow connectivity monitoring plan that will determine if the extent of take in Sweetwater Creek is being exceeded.

3. Monitor stream flows to determine if the extent of take exempted by this ITS is exceeded in Sweetwater and/or Webb Creeks.

4. Develop and implement studies to answer critical uncertainties regarding the effects of the action.

5. Determine the optimal flow allocation between Webb and Sweetwater Creeks to maximize steelhead production, and adjust flows accordingly.

6. Provide to NMFS an annual report of all reporting elements identified in the proposed action and this Opinion.

7. Notify NMFS as soon as possible of any steelhead that may have been injured or killed by the LOP.

2.2.3. Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the BOR and its cooperators, including the applicant, if any, must fully comply with conservation measures described as part of the proposed action and the following terms and conditions that implement the RPMs described above. Partial compliance with these terms and conditions may invalidate this take exemption, result in more take than anticipated, and lead NMFS to a different conclusion regarding whether the proposed action will result in jeopardy or the destruction or adverse modification of designated critical habitats.

1. To implement RPM #1, the BOR shall provide minimum flows at the points of diversion in Sweetwater and Webb Creeks as described in Table 1 of this Opinion and the additional instream flows under the storage conditions as shown in Table 2 of this Opinion.

2. To implement RPM #2, the BOR shall develop in coordination with NMFS a monitoring plan to ensure connectivity in Sweetwater Creek. This plan shall be developed prior to July 15, 2010, and implemented immediately thereafter.

3. To implement RPM #3, at a minimum, the BOR shall continue operation of the stream gages at the Sweetwater Creek diversion dam and mouths of Sweetwater and Webb Creeks.

4. To implement RPM #4, the BOR shall:

    a. Cooperate with NMFS to develop and implement a monitoring plan to answer critical uncertainties regarding the effects of the action on water temperatures and steelhead abundance in Sweetwater and Webb Creeks. This plan shall be completed no later than 6 months after the signing of this Opinion. The plan shall monitor fish densities in Sweetwater and Webb Creeks and shall be implemented annually starting in 2011 and

    b. Develop in coordination with NMFS a monitoring plan to assess connectivity in Webb Creek. This plan shall be developed prior to July 15, 2010, and implemented immediately thereafter

5. To implement RPM #5, the BOR shall determine the optimal flow allocation between Webb and Sweetwater Creeks to maximize aggregate steelhead production, and adjust flows accordingly and in a manner consistent with this Opinion, as mutually agreed by LOID, the Nez Perce Tribe, BOR, and NMFS. A completed study and report shall be submitted to NMFS later than 4 years after the signing of this Opinion.

6. To implement RPM #6, the BOR shall provide to NMFS an annual report of all reporting elements identified in the proposed action and in this Opinion. All completed monitoring reports, and other written correspondence related to the proposed action shall be sent to the address below no later than May 20 of each year:

    Director, Idaho State Habitat Office
    Habitat Conservation Division
    National Marine Fisheries Service
    10095 W. Emerald
    Boise, Idaho 83704

7. To implement RPM #7, the BOR shall notify NMFS as soon as possible if BOR employees or parties acting under BOR's authority find any steelhead that may have been injured or killed by the LOP as follows:

    a. If listed fish are found in imminent peril of death or harm, such as finding live fish out of water in a drying pool, the finder may take immediate steps to rescue the fish by transferring them to flowing water or other safe location, even if those efforts may accidentally kill the fish. Accidental death of fish from an attempted rescue by BOR employees or parties authorized by BOR, is exempted from section 9 take prohibitions as described in 65 FR 42422 §223.203(b)(3). The finder should photograph the affected fish before moving it, if possible, and note the number, size, and location of fish rescued or killed. The finder must notify the Boise Field Office of NMFS Law Enforcement at (208) 321-2956 as soon as possible.

    b. If a sick, injured, or dead steelhead or salmon are found in association with project activities, and the sick or injured fish are not imminently imperiled, the finder should leave the fish alone, make note of any circumstances likely causing the death or injury, location and number of fish involved, and take photographs, if possible. The finder must contact the Boise Field Office of NMFS Law Enforcement at (208) 321-2956 as soon as possible. The finder may be asked to carry out instructions provided by Law Enforcement to collect specimens or take other measures to ensure that evidence intrinsic to the specimen is preserved.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

3.1. Statutory Requirements

The consultation requirements of section 305(b) of the MSA direct Federal agencies to consult with NMFS on all actions, or proposed actions that may adversely affect EFH. Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that may be taken by the action agency to conserve EFH.

The Pacific Fishery Management Council (PFMC) has designated EFH in Idaho for Chinook salmon and coho salmon (PFMC 1999). The proposed action and action area for this consultation are described in the introduction to this document. The action area includes areas designated as EFH for various life-history stages of Chinook and coho salmon.

Briefly, this Opinion found that salmonid habitat in the mainstem of the Clearwater River, Snake River, Columbia River, and Captain John Creek is not likely to be adversely affected by the proposed action. The LOP adversely affects EFH for Chinook and coho salmon in the Lapwai Creek drainage. The effects of the LOP on EFH for Chinook salmon are similar to those described for Chinook salmon in this Opinion, and for coho salmon, the effects are similar to those described for Snake River Basin steelhead.

Based on information provided in the BOR's BA and the analysis of effects presented in the ESA portion of this document, NMFS concludes that the proposed action will have the following adverse effects on EFH designated for Chinook and coho salmon:

- Under the proposed action, the LOP would continue to reduce summer stream flows in Sweetwater, Webb, and Lapwai Creeks below their natural potential, but the proposed action would partly restore flows historically reduced by the LOP.

- The LOP has contributed to drying the stream channels in past years. However, even without any effects of the LOP, Chinook spawning is likely precluded by low or dry channel conditions in most years. With or without the proposed action, spawning gravels potentially used by Chinook salmon are often dry in late summer.

- Pools potentially used by Chinook and coho salmon for rearing in Lapwai Creek are few in number and typically are too shallow or dry to support salmon.

- Flows for coho salmon appear to be sufficient to support spawning, since the fish spawn after the irrigation season when flows typically increase from summer low flows.

- The proposed action will increase the flows compared to past operations, and will increase the habitat potential over the existing conditions.

3.2. EFH Conservation Recommendations

NMFS believes that the following three conservation measures are necessary to avoid, mitigate, or offset the impact of the proposed action on EFH. These Conservation Recommendations are a non-identical set of the ESA Terms and Conditions.

1. Provide flows below the diversion dams in Sweetwater and Webb Creeks, as described in the proposed action.

2. The BOR shall monitor stream flows at the Sweetwater Creek diversion dam and mouth of Webb Creek to ensure that minimum flows are provided as planned, and adjust flows accordingly to meet the applicable minimum flows.

3. The BOR shall determine the optimal flow allocation between Webb and Sweetwater Creeks to maximize steelhead production, and adjust flows accordingly, as mutually agreed by LOID, the Tribe, BOR, and NMFS.

3.3. Statutory Response Requirement

Federal agencies are required to provide a detailed written response to NMFS' EFH conservation recommendations within 30 days of receipt of these recommendations [50 CFR 600.920(k)(1)]. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse affects that the activity has on EFH. If the response is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations. The reasons must include the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

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

3.4. Supplemental Consultation

The BOR must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations [50 CFR 600.920(1)(1)].

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (Data Quality Act [DQA]) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these DQA components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users.

This ESA consultation concludes that the proposed Operation and Maintenance of the Lewiston Orchards Project will not jeopardize the affected ESA-listed species. Therefore, the BOR can authorize, fund or carry out this action. The intended users are the action agencies and their permittees or applicants, if any.

Individual copies were provided to the entities listed on the transmittal letter. This consultation will be posted on NMFS Northwest Region website (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

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

Objectivity:

Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including NMFS ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01, *et seq.*, and the MSA implementing regulations regarding EFH, 50 CFR 600.920(j).

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

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

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

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6. TERMS AND DEFINITIONS

Abundance	In the context of salmon recovery, abundance refers to the number of adult fish returning to spawn.
Acre-feet (af)	A common water measure volume in a river system. It is the amount of water it takes to cover one acre (43,560 square feet) to a depth of one foot.
Adaptive Management	The process of adjusting management actions and/or directions based on new information.
Anadromous Fish	Species that are hatched in fresh water, migrate to and mature in salt water, and return to fresh water to spawn.
Beverton-Holt Function	This function predicts the number of progeny that will return to spawn from a given number of parental spawners.
Biogeographical Region	An area defined in terms of physical and habitat features, including topography and ecological variations, where groups of organisms have evolved in common.
Broad-Sense Recovery Goals	Goals defined in the recovery planning process, generally by local recovery planning groups, that go beyond the requirements for delisting, to address, for example, other legislative mandates or social, economic, and ecological values.
Compensatory Mortality	Refers to mortality that would have occurred for another reason.
Compliance Monitoring	Monitoring to determine whether a specific performance standard, environmental standard, regulation, or law is met.
Delisting Criteria	Criteria incorporated into ESA recovery plans that define both biological viability (biological criteria) and alleviation of the causes for decline (threats criteria based on the five listing factors in ESA section 4[a][1]), and that, when met, would result in a determination that a species is no longer threatened or endangered and can be proposed for removal from the Federal list of threatened and endangered species.
Distinct Population Segment (DPS)	A listable entity under the ESA that meets tests of discreteness and significance according to USFWS and NMFS policy. A population is considered distinct (and hence a "species" for purposes of conservation under the ESA) if it is discrete from and significant to the remainder of its species based on factors such as

physical, behavioral, or genetic characteristics, it occupies an unusual or unique ecological setting, or its loss would represent a significant gap in the species' range.

Diversion Refers to taking water out of the river channel for municipal, industrial, or agricultural use. Water is diverted by pumping directly from the river or by filling canals.

Diversity All the genetic and phenotypic (life history, behavioral, and morphological) variation within a population. Variations could include anadromy vs. lifelong residence in fresh water, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, physiology, molecular genetic characteristics, etc.

Effectiveness Monitoring Monitoring set up to test cause-and-effect hypotheses about recovery actions: Did the management actions achieve their direct effect or goal? For example, did fencing a riparian area to exclude livestock result in recovery of riparian vegetation?

Environmental Baseline The past and present impacts of all Federal, state, or private actions and other human activities in an action area, the anticipated impacts of all proposed Federal projects in an action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process.

ESA Recovery Plan A plan to recover a species listed as threatened or endangered under the U.S. Endangered Species Act (ESA). The ESA requires that recovery plans, to the extent practicable, incorporate (1) objective, measurable criteria that, when met, would result in a determination that the species is no longer threatened or endangered; (2) site-specific management actions that may be necessary to achieve the plan's goals; and (3) estimates of the time required and costs to implement recovery actions.

Evolutionarily Significant Unit (ESU) A group of Pacific salmon or steelhead trout that is (1) substantially reproductively isolated from other conspecific units and (2) represents an important component of the evolutionary legacy of the species.

Factors For Decline Five general categories of causes for decline of a species, listed in the Endangered Species Act section 4(a)(1)(b): (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence.

Flow Augmentation	Water released from system storage at targeted times and places to increase streamflows to benefit migrating salmon and steelhead
Hyporheic Zone	Area of saturated sediment and gravel beneath and beside streams and rivers where groundwater and surface water mix.
Implementation Monitoring	Monitoring to determine whether an activity was performed and/or completed as planned.
Independent Population	Any collection of one or more local breeding units whose population dynamics or extinction risk over a 100-year time period is not substantially altered by exchanges of individuals with other populations.
Indicator	A variable used to forecast the value or change in the value of another variable.
Intrinsic Productivity	The average of adjusted recruits per spawner estimates for only those brood years with the lowest spawner abundance levels.
Lambda	Also known as population growth rate, or the rate at which the number of fish in a population increases or decreases.
Large Woody Debris (LWD)	A general term for wood naturally occurring or artificially placed in streams, including branches, stumps, logs, and logjams. Streams with adequate LWD tend to have greater habitat diversity, a natural meandering shape, and greater resistance to flooding.
Legacy Effects	Impacts from past activities (usually a land use) that continue to affect a stream or watershed in the present day.
Limiting Factor	Physical, biological, or chemical features (e.g., inadequate spawning habitat, high water temperature, insufficient prey resources) experienced by the fish at the population, intermediate (e.g., stratum or major population grouping), or ESU levels that result in reductions in viable salmonid population (VSP) parameters (abundance, productivity, spatial structure, and diversity). Key limiting factors are those with the greatest impacts on a population's ability to reach its desired status.

Major Dams	Large hydro-electric projects developed by Federal agencies within the Pacific Northwest. Twenty-nine major dams are in the Columbia River Basin. Two dams are in the Rogue River Basin. A total of 31 dams comprise the Federal Power System.
Management Unit	A geographic area defined for recovery planning purposes on the basis of state, tribal or local jurisdictional boundaries that encompass all or a portion of the range of a listed species, ESU, or DPS.
Major Population Group (MPG)	A group of salmonid populations that are geographically and genetically cohesive. The MPG is a level of organization between demographically independent populations and the ESU.
Morphology	The form and structure of an organism, with special emphasis on external features.
Northern Pikeminnow	A large member of the minnow family, the Northern Pikeminnow (formerly known as Squawfish) is native to the Columbia River and its tributaries. Studies show a Northern Pikeminnow can eat up to 15 young salmon a day.
Quasi-Extinction Threshold (QET)	The point at which a population has become too small to reliably reproduce itself, even though a few fish remain. Since there is debate about the exact population level at which this condition occurs, several possible levels (50, 30, 10, 1) are considered. Results from short-term quasi-extinction probability modeling are used to help assess near-term (24-year) extinction risk.
Operating Requirements	These are the limits within which a reservoir or dam must be operated. Some requirements are established by Congress when a project is authorized; others evolve with operating experience.
Parr	The stage in anadromous salmonid development between absorption of the yolk sac and transformation to smolt before migration seaward.
Peak Flow	The maximum rate of flow occurring during a specified time period at a particular location on a stream or river.
Phenotype	The external appearance of an organism resulting from the interaction of its genetic makeup and the environment.
Piscivorous Fish	Fish that prey on other fish for food.

Population Bottlenecks	The most significant limiting factors currently impeding a population from reaching its desired status. Bottlenecks result in the greatest relative reductions in abundance, productivity, spatial distribution, or diversity and are defined by considering viability impairment across limiting life stages and limiting factors.
Productivity	A measure of a population's ability to sustain itself or its ability to rebound from low numbers. The terms "population growth rate" and "population productivity" are interchangeable when referring to measures of population production over an entire life cycle. Can be expressed as the number of recruits (adults) per spawner or the number of smolts per spawner.
Proposed Action	A proposed action or set of actions
Prospective Actions	Actions from both the FCRPS Biological Assessment and Upper Snake Biological Assessment, August 2007
Reasonable and Prudent Measure (RPM)	Actions NMFS believes necessary or appropriate to minimize the impacts, i.e., amount or extent of incidental take [50 CFR 402.02]
Recovery Domain	An administrative unit for recovery planning defined by NMFS based on ESU boundaries, ecosystem boundaries, and existing local planning processes. Recovery domains may contain one or more listed ESUs.
Recovery Goals	Goals incorporated into a locally developed recovery plan. These goals may go beyond the requirements of ESA de-listing by including other legislative mandates or social values.
Recruits per Spawner	Generally, a population would be deemed to be "trending toward recovery" if average population growth rates (or productivities) are expected to be greater than 1.0.
Redd	A nest constructed by female salmonids in streambed gravels where eggs are deposited and fertilization occurs.
Resident Fish	Fish that are permanent inhabitants of a water body. Resident fish include trout, bass, and perch.
Riparian Area	Area with distinctive soils and vegetation between a stream or other body of water and the adjacent upland. It includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation.

River Reach	A general term used to refer to lengths along the river from one point to another, as in the reach from the John Day Dam to the McNary Dam.
Runoff	Precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface water.
Salmonid	Fish of the family *Salmonidae*, including salmon, trout, chars, grayling, and whitefish. The term usually refers to salmon, trout, and chars.
Smolt	A juvenile salmon or steelhead migrating to the ocean and undergoing physiological changes to adapt from freshwater to a saltwater environment.
Snowpack	The accumulation of snow in the mountains that occurs during the late fall and winter.
Spatial structure	The geographic distribution of a population or the populations in an ESU.
Stratum/major Population Group	An aggregate of independent populations within an ESU that share similar genetic and spatial characteristics.
Streamflow	Streamflow refers to the rate and volume of water flowing in various sections of the river.
Streamflow Records	For over 100 years, water resource managers in the Northwest have maintained records on the seasonal volume and rate of flow in the Columbia River. These historical records are of profound importance to planning system operations each year.
Technical Recovery Team (TRT)	Teams convened by NMFS to develop technical products related to recovery planning. TRTs are complemented by planning forums unique to specific states, tribes, or regions, which use TRT and other technical products to identify recovery actions. See SCA Section 7.3 for a discussion of how TRT information is considered.
Threats	Human activities or natural events (e.g., road building, floodplain development, fish harvest, hatchery influences, and volcanoes) that cause or contribute to limiting factors. Threats may exist in the present or be likely to occur in the future.
Viability Criteria	Criteria defined by NMFS-appointed Technical Recovery Teams based on the biological parameters of abundance, productivity, spatial structure, and diversity, which describe a viable salmonid

population (VSP) (an independent population with a negligible risk of extinction over a 100-year time frame) and which describe a general framework for how many and which populations within an ESU should be at a particular status for the ESU to have an acceptably low risk of extinction. See SCA Section 7.3 for a discussion of how TRT information is considered.

Viable Salmonid Population (VSP) An independent population of Pacific salmon or steelhead trout that has a negligible risk of extinction over a 100-year time frame. Viability at the independent population scale is evaluated based on the parameters of abundance, productivity, spatial structure, and diversity.

VSP Parameters Abundance, productivity, spatial structure, and diversity. These describe characteristics of salmonid populations that are useful in evaluating population viability. See NOAA Technical Memorandum NMFS-NWFSC-42, "Viable salmonid populations and the recovery of evolutionarily significant units," McElhany et al., June 2000