DRAFT 2014 WATER MANAGEMENT PLAN

Kootenai Falls May 21, 2013 ~30 kcfs

(Photo courtesy of Tony Norris)

Bonneville Power Administration
U.S. Bureau of Reclamation
U.S. Army Corps of Engineers

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1 Introduction

The U.S. Army Corps of Engineers (Corps), Bureau of Reclamation (Reclamation), and Bonneville Power Administration (BPA), collectively referred to as the Action Agencies (AAs), have consulted with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) on the effects of operating the 14 Federal multi-purpose hydropower projects in the Federal Columbia River Power System (FCRPS) on fish species listed as endangered or threatened under the Endangered Species Act (ESA). These consultations resulted in biological opinions (BiOps) from NMFS and USFWS that identify FCRPS operations that must be implemented by the AAs to avoid jeopardizing the survival and recovery of ESA-listed fish species. The FCRPS BiOps and other applicable governing documents are described below in Section 2.

The 2014 Water Management Plan (WMP) describes the AAs plan for the 2014 water year (October 1, 2013 through September 30, 2014) for implementing the specific operations identified in the NMFS 2008 BiOp and NMFS 2010 Supplemental BiOp (collectively referred to as NMFS 2010 Supplemental BiOp), and the USFWS 2000 and 2006 BiOps. The AAs are the final authorities on the content of the WMP, although review, comment, and recommendations are solicited from the inter-agency Technical Management Team (TMT) for consideration during preparation of the WMP. The WMP is consistent with the adaptive management provisions in the NMFS 2010 Supplemental BiOp and the Corps' Record of Consultation and Statement of Decision (ROCASOD) adopting the project operations contained in the 2010 Supplemental BiOp and the Columbia Basin Fish Accords (Accords). The AAs will prepare seasonal updates to the 2014 WMP that will be posted on the following website for regional review through the TMT:
http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/

The system operations contained herein may be adjusted according to water year conditions based on coordination with the TMT.

2 Governing Documents

The following are the governing documents associated with the WMP—the biological assessments (BAs) produced by the AAs and submitted to NMFS and USFWS to initiate consultation; and the resulting BiOps issued by NMFS and USFWS:

2.1 Biological Assessments

- 1999 BA for the Effects of FCRPS Operations on Columbia Basin Bull Trout and Kootenai River White Sturgeon (Corps, BPA, Reclamation)

The AAs submitted a BA to USFWS in December 1999 addressing the effects of 2000-2010 FCRPS operations on bull trout and Kootenai white sturgeon. The BA addressed FCRPS project operations on the Columbia River and on the Snake River downstream of Lower Granite Dam. The BA is incorporated by reference in the 1999 Multi-Species BA

that may be found on the following website:
http://www.usbr.gov/pn/programs/fcrps/pdf/1999ba.pdf

- 2004 BA for the Effects of Libby Dam Operations on Kootenai River White Sturgeon (Corps, BPA)

Due to the critical habitat designation and new information on the Kootenai River white sturgeon, the Corps and BPA re-initiated consultation on the effects of Libby Dam operations on the Kootenai sturgeon and its critical habitat. The AAs submitted a BA to USFWS in July 2004 to supplement the 1999 FCRPS BA with this additional information. A complete administrative record of this consultation is on file at the USFWS Upper Columbia Office in Spokane, Washington.

- 2007 FCRPS BA and Comprehensive Analysis of the FCRPS and Mainstem Effects of Upper Snake and Other Tributary Actions (Corps, BPA, Reclamation)

The AAs submitted a BA and a Comprehensive Analysis to NMFS on August 21, 2007. The BA proposed a Reasonable and Prudent Alternative (RPA) of specific FCRPS operations that the AAs would implement to avoid jeopardy and adverse modification of critical habitat of listed fish species. The Comprehensive Analysis integrated the analysis of effects of the FCRPS with the analysis of effects of actions in the Upper Snake River and other tributaries. Both documents may be found on the following website:
http://www.salmonrecovery.gov/BiologicalOpinions/FCRPSBiOp/2008FCRPSBiOp/2007BAandCA.aspx

- 2007 Upper Snake BA (Reclamation)

Reclamation submitted a BA to NMFS in August 2007 that described actions involving operations and routine maintenance at 12 Federal projects located upstream of Brownlee Reservoir and evaluated the effects of those actions on ESA-listed fish species. The BA may be found on the following website:
http://www.usbr.gov/pn/programs/UpperSnake/

2.2 Biological Opinions

- USFWS 2000 FCRPS BiOp

The USFWS 2000 FCRPS BiOp, "Effects to Listed Species from Operation of the Federal Columbia River Power System," issued on December 20, 2000 evaluates the effects of operating the FCRPS on threatened Columbia Basin bull trout in areas downstream of Hells Canyon Dam and in the Upper Columbia Basin, and on endangered Kootenai River white sturgeon, and may be found on the following website:
http://www.fws.gov/pacific/finalbiop/BiOp.html

- USFWS 2006 Libby Dam BiOp

The USFWS 2006 Libby BiOp "The Effects of Libby Dam Operations on the Kootenai River White Sturgeon, Bull Trout, and Kootenai Sturgeon Critical Habitat" was issued on February 16, 2006 and supplemented the USFWS 2000 FCRPS BiOp. The document may be found on the following website:
http://www.salmonrecovery.gov/BiologicalOpinions/LibbySturgeonBiOp.aspx

In 2008, the USFWS issued a Clarified RPA for the 2006 Libby Dam BiOp in order to determine the success or non-success of Libby Dam sturgeon operations. Pursuant to this 2008 Clarified RPA, the Corps operates Libby Dam to provide additional flows to benefit Kootenai River white sturgeon. Operations for this year are further detailed in Section 6.4 below (Libby Dam Project Operations).

- NMFS 2008 Upper Snake BiOp

The NMFS 2008 Upper Snake BiOp was issued on May 5, 2008 and titled "Consultation for the Operation and Maintenance of 10 U.S. Bureau of Reclamation Projects and 2 Related Actions in the Upper Snake River above Brownlee Reservoir (Revised and Reissued Pursuant to court order, *American Rivers v. NOAA Fisheries,* CV 04-0061-RE (D. Oregon))." The document may be found on the following website: http://www.salmonrecovery.gov/BiologicalOpinions/UpperSnakeBiOp.aspx

- NMFS 2008/2010 FCRPS BiOp

The NMFS 2008 FCRPS BiOp, "Consultation on Remand for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(1)(A) Permit for Juvenile Fish Transportation Program (Revised and reissued pursuant to court order, *NWF v. NMFS,* Civ. No. CV 01-640-RE (D. Oregon)," was issued May 5, 2008.

The Corps adopted the NMFS 2008 BiOp and RPA in its Record of Consultation and Statement of Decision (ROCASOD) on August 1, 2008 BPA signed a Record of Decision (ROD) on August 13, 2008 and Reclamation signed a Decision Document on September 3, 2008. The NMFS 2008 BiOp, the Corps' ROCASOD, and Reclamation's Decision Document may be found on the following website:
http://www.salmonrecovery.gov/BiologicalOpinions/FCRPSBiOp.aspx

The NMFS 2008 BiOp included an RPA that is largely based on the AAs proposed action in the 2007 FCRPS BA. The "Hydro Actions" section of the RPA governs operations defined in the WMP and is included in this document as Appendix 7.

After the Obama Administration initiated review of the NMFS 2008 FCRPS BiOp, NMFS and the AAs jointly developed an Adaptive Management Implementation Plan (AMIP) in 2009. In February 2010 the Federal agencies entered into a voluntary remand to formally integrate the AMIP into the 2008 FCRPS BiOp. The resulting NMFS 2010 Supplemental FCRPS BiOp considered new information and incorporated the AMIP into the NMFS 2008 FCRPS BiOp RPA, and may be found on the following website:
http://www.salmonrecovery.gov/BiologicalOpinions/FCRPSBiOp/2010SupplementalFCRPSBiOp.aspx

The AAs amended their respective decision documents on June 11, 2010, which may be found on the following website:
http://www.bpa.gov/corporate/pubs/RODS/2010/

2.3 Additional Governing Documents

- Corps 2003 Columbia River Treaty Flood Control Operating Plan (FCOP)

The Columbia River Treaty between Canada and the United States of America provides that the powers and duties of the Canadian and United States Entities include the preparation of a Flood Control Operation Plan (FCOP) for Canadian storage in the Upper Columbia River Basin. The purpose of the FCOP for Canadian storage is to prescribe criteria and procedures by which the Canadian Entity will operate Mica, Duncan, and Arrow Reservoirs to achieve desired flood control objectives in the United States and Canada. The purpose of including Libby Reservoir in the FCOP is to meet the Treaty requirement to coordinate its operation for flood control protection in Canada. Because Canadian storage is an integral part of the overall Columbia River reservoir system, the FCOP for this storage must be related to the flood control plan of the Columbia River as a whole. The principles of the Columbia River system operation are therefore contained in the FCOP. A copy of the FCOP may be found on the following website: http://www.nwd-wc.usace.army.mil/cafe/forecast/FCOP/FCOP2003.pdf

3 WMP Implementation Process

3.1 TMT

The TMT[1] is an inter-agency technical group comprised of sovereign representatives responsible for making in-season recommendations to the AAs on dam and reservoir operations in an effort to meet the expectations of the applicable BiOps (listed above) and accommodate changing conditions, such as water supply, fish migration, water quality, new information, and maintenance issues. The TMT consists of representatives from the AAs (Corps, BPA, and Reclamation), NMFS, USFWS, the states of Oregon, Washington, Idaho, and Montana, and Tribal sovereigns.

3.2 Preparation of the WMP

Each fall, the AAs prepare an annual WMP (draft by October 1st and final by January 1st). The AAs prepared this WMP for the 2014 water year consistent with the NMFS 2010 Supplemental BiOp and the USFWS 2000 and 2006 BiOps. This WMP describes the planned operations of the FCRPS dams and reservoirs for the 2014 water year (October 1, 2013 through September 30, 2014)[2]. The operations are designed to:

1. Implement water management measures consistent with actions considered in their respective BiOps.
2. Assist in meeting the biological performance standards specified in the BiOps in combination with other actions or operations identified in the NMFS 2010 Supplemental BiOp.

[1] The TMT was part of the proposed RPA in the FCRPS BA Appendix B at B.2.1-13, and included in the NMFS 2008 FCRPS BiOp RPA No. 6 “In-Season Water Management”.
[2] In the preparation of the draft WMP, very little information is available about the upcoming year’s water supply; therefore, the draft provides only a general description of how the FCRPS will be operated for that water year.

3. Meet non-BiOp related requirements and purposes such as flood control, hydropower, irrigation, navigation, recreation, and fish and wildlife not listed under the ESA. Additional information regarding Columbia River flood control information may be found on the following website: http://www.nwd-wc.usace.army.mil/report/colriverflood.htm
4. Consider recommendations contained in the applicable Northwest Power and Conservation Council's Fish and Wildlife Program and amendments.

The WMP also includes any special operations planned for the year (e.g., special tests, required maintenance, construction activities, flood control procedures, etc.) that are known at the time the WMP is developed. Throughout the season, the AAs will utilize the TMT forum to provide the region with seasonal updates on water supply forecasts and specific project operations. These will be available on the following website: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/

3.3 Fish Passage Plan

The Corps coordinates with regional agencies to prepare an annual Fish Passage Plan (FPP) that provides detailed operating criteria for project fish passage facilities, powerhouses, and spillways to facilitate the safe and efficient passage of migratory fish. The FPP contains appendices that describe special operations for fish research studies, the juvenile fish transportation program, operation of turbine units within 1% of best efficiency, spill for fish passage, total dissolved gas (TDG) monitoring, and dewatering procedures. The FPP is coordinated through the inter-agency Fish Passage Operations and Maintenance (FPOM) Coordination Team and is available on the following website: http://www.nwd-wc.usace.army.mil/tmt/http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/

3.4 NMFS 2010 Supplemental BiOp Strategies

This WMP addresses Hydropower Strategy 1(included in this document as Appendix 7), strategies to enhance juvenile and adult fish survival through a coordinated set of hydropower project management actions to achieve performance standards, and to provide benefits to resident fish. The plan is structured to address water management actions associated with Hydropower Strategy 1, as defined in the NMFS 2010 Supplemental BiOp RPA Table of Actions . Hydropower Strategy 2, 3 and 4 are addressed in other documents such as the Fish Passage Plan, however some actions identified in the WMP may support those strategies.

1. Hydropower Strategy 1—Operate the FCRPS to provide flows and water quality to improve juvenile and adult fish survival.
2. Hydropower Strategy 2—Modify Columbia and Snake River dams to maximize juvenile and adult fish survival.
3. Hydropower Strategy 3—Implement spill and juvenile transportation improvements at Columbia River and Snake River dams.

4. Hydropower Strategy 4—Operate and maintain facilities at Corps mainstem projects to maintain biological performance.

Figure 1 outlines the Hydropower Strategy and the associated actions intended to ensure FCRPS operations improve the survival of ESA-listed fish species. These strategies and actions are described in greater detail in Sections 4 through 10.

Hydropower Strategy 1 **Operate the FCRPS to provide flows and water quality to improve juvenile and adult fish survival.**		
Action 1	RPA No. 4	Storage Project Operations (Libby, Hungry Horse, Albeni Falls, Grand Coulee, Dworshak)
Action 2	RPA No. 5	Lower Columbia and Snake River Operations (Bonneville, The Dalles, John Day, McNary, Ice Harbor, Lower Monumental, Little Goose, Lower Granite)
Action 3	RPA No. 6	In-Season Water Management
Action 4	RPA No. 7	Forecasting and Climate Change/Variability
Action 5	RPA No. 8	Operational Emergencies
Action 6	RPA No. 9	Fish Emergencies
Action 7	RPA No. 10	Columbia River Treaty Storage
Action 8	RPA No. 11	Non-Treaty Storage (NTS)
Action 9	RPA No. 12	Non-Treaty Long-Term Agreement
Action 10	RPA No. 13	Non-Treaty Coordination with Federal Agencies, States, and Tribes
Action 11	RPA No. 14	Dry Water Year Operations
Action 12	RPA No. 15	Water Quality Plan for Total Dissolved Gas and Water Temperature in the Mainstem Columbia and Snake Rivers
Action 13	RPA No. 16	Tributary Projects
Action 14	RPA No. 17	Chum Spawning Flows

Figure 1. FCRPS actions and associated RPA number as defined under Hydropower Strategy 1 for operating the FCRPS to improve survival of ESA-listed fish (excerpted from NMFS 2008 BiOp RPA Table of Actions).

3.5 Non-ESA Operations

Each year the AAs implement water management actions to achieve project purposes other than those required under the ESA, such as flood control, power generation, irrigation, navigation, recreation, and fish and wildlife not listed under the ESA. Table 1 includes non-ESA fish and wildlife related water management actions that may be

implemented and the time of year such actions typically occur. These actions are further described below.

Table 1. Location and duration of water management actions to support non-ESA listed fish and wildlife species.

Project – Action	Time of Year
Keenleyside (Arrow) - mountain whitefish actions	December – January
Keenleyside (Arrow) - rainbow trout actions	April – June
Libby - burbot actions	October - February
Dworshak – flow increase for hatchery release	March
Grand Coulee – kokanee	September – Mid November
Hanford Reach Fall Chinook Protection Program Agreement	October – June
McNary - waterfowl nesting	March – May
McNary - waterfowl hunting enhancement	October – January
John Day - goose nesting	March – May
Bonneville - Tribal fishing	April – October
The Dalles – Tribal fishing	April – October
John Day – Tribal fishing	April – October
Ice Harbor - waterfowl hunting enhancement	October – January
Little Goose – waterfowl hunting enhancement	October – January
Duncan - whitefish flows	March – May

4 Hydrosystem Operation

4.1 Priorities

The NMFS 2010 Supplemental BiOp and USFWS 2000 and 2006 BiOps list the following strategies for flow management:

- Provide minimum project flows in the fall and winter to support fisheries below the storage projects (e.g., Hungry Horse, Dworshak, and Libby). Limit the winter/spring drawdown of storage reservoirs to increase spring flows and the probability of reservoir refill.

- Draft from storage reservoirs in the summer to increase summer flows.

- Provide minimum flows in the fall and winter to support mainstem chum spawning and incubation flow below Bonneville Dam.

The AAs have reviewed these strategies and other actions called for in the NMFS 2010 Supplemental BiOp, and the USFWS 2000 and 2006 BiOps, and developed the following priorities (in order) for flow management and individual reservoir operations after ensuring adequate flood damage reduction is provided:

1. Operate storage projects (Hungry Horse and Libby) to meet minimum flow and ramp rate criteria for resident fish.

2. Refill the storage projects to provide summer flow augmentation. The target refill date may vary depending on the timing and shape of the spring runoff. For example, a late snowmelt runoff may result in a later refill in order to avoid excessive spill. Target refill dates for the storage projects are listed below in Table 4, and further described in the RPA Table in Appendix 7.

3. Operate storage projects to be at their April 10 elevation objectives, if possible and/or prudent, to provide spring flow augmentation.

4. Operate storage projects to balance the needs of chum flow augmentation and spring flow augmentation from the start of chum spawning in November through the end of chum emergence (approximately April) to maintain sufficient water depth to protect chum spawning and incubation habitat at the Ives Island complex below Bonneville Dam.

In addition to operations intended to benefit ESA-listed anadromous fish, the AAs operate the FCRPS projects to benefit ESA-listed resident fish that occur at or near each project or in its reservoir. Reservoirs are also operated to meet project minimum outflows; avoid involuntary spill and resulting elevated TDG; avoid fluctuations in outflow that may strand fish and degrade fish habitat; reduce the cross-sectional area of run-of-river reservoirs in order to minimize fish travel times, passage delays, and avoid increases in water temperatures; and to provide specific releases from storage projects in order to improve downstream flows and water temperatures for fish. These operations are generally the highest priority because of the direct linkage between a particular operation and impacts on fish near the dam.

Because the water year begins on October 1, the flow objectives are not encountered in the same order as the NMFS 2010 Supplemental BiOp flow priorities (e.g., chum spawning flows will be determined prior to spring and summer migration flows, even though chum flows are a lower priority). However, the AAs will make every effort to follow flow priorities while implementing operations as they occur chronologically during the year. Objectives include:

- Draft limits are a higher priority than the summer flow objectives in order to meet other project uses and reserve water in storage for the following year.

- Operate the storage reservoirs to achieve the April 10 elevation objectives with a high probability. These levels will vary with the runoff forecast. The ability to meet this objective is affected by the quantity of water released for flood control, changes in runoff volume forecasts, power generation, draft rate restrictions, water quality and fishery flows to support both lower Columbia River chum and Hanford Reach fall Chinook spawning, as well as minimum flow requirements below the projects.

- Refill the storage reservoirs by about June 30[3] while minimizing spill (except as needed to maintain flood control), in order to maximize available storage of water for the benefit of summer migrating fish. Although the June 30 refill objective generally has priority over spring flow (April, May, June) objectives, the AAs attempt to refill as well as meet the spring flow objectives and other fish needs.

- Manage the available storage to augment summer (July and August) flows in the lower Columbia River and lower Snake River in an attempt to meet flow objectives and to minimize increases in water temperature.

- At Grand Coulee Dam draft to support salmon flow objectives during July-August with variable draft limit of 1278 to 1280 feet by August 31 based on the water supply forecast. At Grand Coulee project draft to support salmon flow objectives during July and August. Draft include variable draft limit, Lake Roosevelt Incremental Storage Release Project, and Banks Lake Summer Draft.

- At Libby Dam implement the experimental draft to 10 feet from full by the end of September (except in lowest 20th percentile water years, as measured at The Dalles, when draft will increase to 20 feet from full by end of September). If the project fails to refill 20 feet from full, release inflows or operate to meet minimum flows through the summer months[4].

- At Hungry Horse Dam implement the experimental draft during July-September to a draft limit of 3550 feet (10 feet from full) by September 30, except in the driest 20 percentile of water conditions limit draft to 3540 feet (20 feet from full) when needed to meet lower Columbia flow augmentation objectives. If the project fails to refill 20 feet from full, release inflows or operate to meet minimum flows through the summer months[4].

- At Dworshak Dam draft to elevation 1535 ft by the end of August and elevation 1520 ft (80 ft from full) by the end of September unless modified per the Agreement between the U.S. and the Nez Perce Tribe for water use in the

[3] Libby Dam refill probability is likely to be later into July as defined in the VARQ Flood Control Operating Procedures and supporting effects analysis. *See*, Upper Columbia Alternative Flood Control and Fish Operations (VARQ) Environmental Impact Statement: http:/www.usbr.gov/pn/programs/fcrps/varq/index.html

[4] As specified in "Table 1. Storage Project Operations to be Included in the Annual WMP" in the NMFS 2008 FCRPS BiOp Reasonable and Prudent Alternative Table of Actions, found on the following website: http://www.nwcouncil.org/fw/program/2008amend/RPA.pdf

Dworshak Reservoir. Regulate outflow temperatures to attempt to maintain water temperatures at Lower Granite tailwater at or below the water quality standard of 68 degrees F. Maximum project discharge for salmon flow augmentation to be within state of Idaho TDG water quality standards of 110%.

These objectives are intended as general guidelines. The NMFS 2010 Supplemental BiOp and the USFWS 2000 and 2006 BiOps embrace the concept of adaptive management. Adaptive management is the concept that the operation of the system should be adjusted based on best available science and acquired knowledge about current conditions in the system and effects due to management actions, as opposed to following a rigid set of rules. Conditions that are continually changing include information on fish migration, stock status, biological requirements, biological effectiveness, and hydrologic and environmental conditions.

4.2 Conflicts

System managers recognize that water supply conditions are variable and unpredictable and there is often insufficient water to accomplish all the objectives addressed in the NMFS 2010 Supplemental BiOp, and USFWS 2000 and 2006 BiOps for the benefit of listed fish. This may be further complicated by responsibilities to provide for other authorized purposes such as flood protection, power system reliability, irrigation, recreation, and navigation needs. Management of water resources for any one fish species may conflict with the availability of water for other fish species or project purposes. The AAs, in coordination with regional parties through the TMT, consider the multiple uses of the system, while placing a high priority on measures to benefit listed species. Below are some of the typical conflicts that may occur.

4.2.1 Flood Control Draft versus Project Refill

The NMFS 2010 Supplemental BiOp, and USFWS 2000 and 2006 BiOps specify that the storage projects be as full as possible on April 10 to increase the likelihood of refill and to maximize both spring flow management and summer flow augmentation.

Flood control procedures specify the amount of storage needed to provide flood damage reduction. In furtherance of the flood damage reduction objective, storage space is provided to minimize the risk of forecast and runoff uncertainty. In an effort to reduce forecast error and to better anticipate the runoff timing or water supply, the AAs and the Northwest River Forecast Center (NWRFC) use the best available science to compute water supply forecasts. An annual forecast review will occur each fall by the Columbia River Forecast Group (CRFG) to evaluate the performance of the current forecast procedures. The CRFG will evaluate new forecasting techniques for potential implementation.

4.2.2 Spring Flow Management versus Project Refill and Summer Flow Augmentation

Flood control elevations are determined based on water supply and runoff forecasts and can change significantly from one forecast to the next. Changes in forecasts throughout the flood control season can make it difficult to achieve spring flow and project refill

objectives. The summer flow objective at McNary is supported by various flow augmentation measures. There is a limited amount of water available for flow augmentation and summer flow objectives are provided as a biological guideline.

4.2.3 Chum Flow versus Project Refill and Spring Flow Management

Providing a Bonneville Dam tailwater elevation level conducive to chum spawning and incubation in the Ives Island complex typically requires flow augmentation from storage reservoirs before reliable flow forecast information becomes available. Refill to the April 10 elevation objective at Grand Coulee has priority over the flow augmentation required to provide the chum spawning and protection level which is set in November-December and persist through chum fry emergence, typically early April. Although water supply forecasts are available in November and December the forecast errors are very large. Water supply forecasts become incrementally more reliable as time between the forecast and the forecast period decreases. If the tailwater elevation level selected during the spawning season is too high (requiring higher flows and potentially requiring deeper reservoir drafts), there is an increased risk of missing refill to the April 10 elevation objective at Grand Coulee thereby reducing spring flow augmentation if the higher flows are maintained throughout the chum incubation period. Conversely, if the flows must be reduced during the incubation period to target refill, then there is the risk of dewatering chum redds. When this conflict arises TMT will discuss balancing project refill and spring flows that benefit multiple ESUs have priority over maintaining the chum tailwater elevations set in December.

4.2.4 Libby Dam Sturgeon Flow versus Summer Flow Augmentation

Water released from Libby Dam for spring sturgeon spawning flows (pulse) during May and into July may impact the project's ability to refill, thus reducing the probability of reservoir refill, and consequently the amount of the water available for summer flow augmentation from Libby. Water released for sturgeon spawning flows will take a higher priority than refilling by early July to meet salmon summer flow targets.

4.2.5 Fish Operations versus Other Project Uses

In addition to flood control operation, there are other project purposes that may conflict with operations for the benefit of fish. For example; (1) a particular spill pattern at a project may impact the ability of commercial barges to access and enter navigation locks safely. Additionally, in some cases, spill must be curtailed temporarily to allow fish barges to safely moor and load fish at fish loading facilities; (2) spilling water for juvenile fish passage reduces the amount of power that can be generated to meet demand; and, (3) timing of releases for flow augmentation during fish migration periods may conflict with the shape or timing of power demand. In addition to power generation, operations for irrigation and reservoir recreation may conflict with releases of water for flow augmentation.

4.2.6 Conflicts and Priorities Summary

The conflicts described above pose many challenges to the AAs in meeting the multiple uses of the hydrosystem. The priorities for flow management and individual reservoir

operations outlined in section 4.1 will assist the AAs in their operational decision-making.

Discussion of conflicts between operational requirements and alternatives for addressing such conflicts will occur in TMT.

4.3 Emergencies

The WMP, the NMFS 2010 Supplemental BiOp, and the current FPP acknowledge that emergencies and other unexpected events occur and may cause interruptions or adjustments of fish protection measures. Such deviations may be short in duration, such as a response to an unexpected unit outage or power line failure, or a search and rescue operation, or longer in duration, such as what was experienced in 2001 in response to the low water conditions. Emergency operations will be managed in accordance with the TMT Emergency Protocols, the FPP and other appropriate AA emergency procedures. The TMT Emergency Protocols can be found Appendix 1: Emergency Protocols.

4.3.1 Operational Emergencies

The AAs will manage interruptions or adjustments in water management actions, which may occur due to unforeseen power system, flood control, navigation, dam safety, or other emergencies. Such emergency actions will be viewed by the AAs as a last resort and will only be used in place of operations outlined in the annual WMP, if necessary. Emergency operations will be managed in accordance with TMT Emergency Protocols, the FPP and other appropriate AA emergency procedures. The AAs will take all reasonable steps to limit the duration of any interruption in fish protection measures. Emergency Action Plans for generation and transmission emergencies are provided in the Attachments to the TMT Emergency Protocols.

4.3.2 Fish Emergencies

The AAs will manage operations for fish passage and protection at FCRPS facilities. The intended operation may be modified for brief periods of time due to unexpected equipment failures or other conditions. These events can result in short periods when projects are operating outside normal specifications due to unexpected or emergency events. Where there are significant biological effects of more than short duration emergencies impacting fish, the AAs will develop (in coordination with the in-season management Regional Forum (see BA Appendix B.2.1) and implement appropriate adaptive management actions to address the situation. The AAs will take all reasonable steps to limit the duration of any fish emergency. The AAs will operate in accordance with the TMT Emergency Protocols identified in Appendix 1 of the WMP.

4.3.3 Emergency Operations for Non-ESA listed Fish

The AAs agree to take reasonable actions to aid non-listed fish during brief periods of time due to unexpected equipment failures or other conditions and when significant detrimental biological effects are demonstrated. When there is a conflict in such operations, operations for ESA-listed fish will take priority.

4.4 Fish Research

Research studies sometimes require special operations that differ from routine operations otherwise described in the NMFS 2010 Supplemental BiOp, the USFWS 2000 and 2006 BiOps, and the current FPP. These studies are generally developed through technical workgroups of the Regional Forum (e.g., the Corps' Anadromous Fish Evaluation Program, Fish Facilities Design Review Work Group, and Studies Review Work Group). Specific research operations are further described in the Corps' FPP (Appendix A) and the AAs' seasonal updates to the WMP. In most cases, operations associated with research entail relatively minor changes from routine operations and are coordinated in regional technical forums (e.g., TMT and FPOM). In some cases, the nature or magnitude of operational changes for research may require further coordination and review in policy forums [e.g., Hydro Coordination Team (HCT) or Regional Implementation and Oversight Group (RIOG)]. Generally, research planning and coordination occurs throughout the late fall and winter, with final research plans established by late winter/early spring. In the event extraordinary events occur, such as extreme high/low runoff conditions[5] or a hydrosystem emergency, planned research may be modified prior to implementation to accommodate anticipated unique circumstances and/or to reallocate resources to obtain the greatest value given the circumstances.

4.5 Flood Control Shifts

The AA will look for opportunities to shift system flood control requirements from Brownlee and Dworshak to Grand Coulee periodically from January through April to provide more water for flow augmentation in the lower Snake River during the spring migration. The shift will be based upon end-of-month flood control elevations as stated in the final water supply forecasts produced early each month during this time period. Consideration of these flood control shifts by the Corps will include an analysis of impacts to flood risk management and will not be implemented if flood control would be compromised. These shifts may be implemented after coordination with TMT to discuss tradeoffs and impacts. The reservoirs must be back to their specific upper rule curve (URC) by April 30.

5 Decision Points and Water Supply Forecasts

5.1 Water Management Decisions and Actions

Table 2 below lists the key water management decisions/actions and when they need to be made. Some decision points, such as setting flow objectives, are clearly articulated in the NMFS 2010 Supplemental BiOp and the USFWS 2000 and 2006 BiOps. Other decision points, such as setting weekly flow augmentation levels, require thorough discussion and coordination. The decision points given below are spelled out in the BiOps, or are based on best professional judgment and expertise. These decisions are made by the AAs in consideration of actions called for in the BiOps, and input received through the regional forums (TMT, RIOG, and Regional Executives).

[5] For more detail on performance standards testing protocols, refer to Federal Columbia River Power System Juvenile Dam Passage Performance Standard and Metrics.

Table 2. Water Management Decision Points/Actions. See Appendix 7 for the NMFS 2008 BiOp RPA Table of Actions.

	Sept	Early Oct	Nov	Winter (December – March)	Early April	Early May	June	Early July
Operations	• Albeni Falls: discuss fall/winter minimum control elevation to support kokanee spawning and incubation • The Kalispel Tribe may submit a SOR requesting the draft of Albeni Falls Dam earlier in September than in recent years • Libby: Establish stable flows to protect bull trout and other resident fish while drafting to 10 ft from full by the end of September	• Bonneville: Assess potential tailwater elevations to support chum spawning • Preliminary discussions of flood control/ project refill strategy • Support for Hanford Reach fall Chinook protection operations begins.*(Non-BiOp Action)* • Consider Kootenai burbot temperature operation	• Early season WSF using SOI • Hanford Reach fall Chinook redd protection level set	• Bonneville: Determine winter/spring chum flow tailwater elevations • Determine flood control and refill strategies, including any available flood control shifts • Determine final April 10 objective based on FCEs from March Final WSF. • Min. flows from Hungry Horse and Columbia Falls set by April-August WSF • Begin discussing spring operations, spring transport • Begin discussing Hanford Reach	• Spring flow objectives set by April final forecasts • Determine spring flow management strategy including priority for refill • Determine Juvenile Fish Transport Operations for Lower Snake Projects and McNary • Determine spring spill start dates, levels, by project • April 3 start date for Minimum Operating Pool (MOP) at Lower Snake River projects • John Day: April 10 John Day begins operatingbetween 262.5 to 264.0 ft. • Determine refill start date based on streamflow forecast to exceed Initial Control Flow at The Dalles • Libby, Hungry Horse: If required, use April forecast to determine VARQ refill	• Libby: Evaluate likely tier for sturgeon volume using May final forecast. Regional technical team recommends shape and timing of sturgeon pulse. • Libby: May 15 until sturgeon flow begins - minimum outflow is 6 kcfs for bull trout. • Libby: Use May final forecast to calculate the tiered bull trout flow for post-sturgeon flow through August. • Determine refill start date based on streamflow forecast to exceed Initial Control Flow (ICF) at The Dalles (if this does not occur in April) • Libby/Hungry Horse: Use May forecast to determine VARQ refill flows	• Lower Granite: Summer flow objective determined by June final forecast • Libby, Hungry Horse: Use June forecast to determine VARQ refill flows • Libby: Regional technical team recommends shape and timing of sturgeon pulse • Determine summer flow augmentation strategy (early June) • Begin Dworshak temperature modeling • Dworshak: Refill by about June 30	• Grand Coulee: summer reservoir draft limit determined by July Final April–August volume forecast at The Dalles • Libby, Hungry Horse, and DWR: Draft for salmon • Libby: Refill probability is likely to be later into July (exact date to be determined in season) • Dworshak: Begin summer flow and temperature augmentation

	Sept	Early Oct	Nov	Winter (December – March)	Early April	Early May	June	Early July
	(Appendix 7) • Hungry Horse: Establish stable flows to protect bull trout and other resident fish while drafting to 10 ft from full by the end of September (Appendix 7)			operations *(non-BiOp action)* in January • Perform analysis to determine amount of Dworshak flexibility to operate above min. flow and still reach spring refill targets • Prepare outlook for meeting flow objectives • Libby: Determine end of Dec flood control elevation using Corps' Dec. forecast • Grand Coulee: Use March final forecast at The Dalles (April through September) to determine if Lake Roosevelt Inc Storage draft is 82.5 KAF or 132.5 Kaf (section 7.5.1)	flows • When not operating to meet minimum flows, operate storage projects to be at their upper flood control elevation on or about April 10, (the exact date to be determined during in-season management)	• Libby/Hungry Horse: Use The Dalles April-August May forecast todetermine the September draft limit.		
Forecasts				January,	April final forecast	May final forecast	June final forecast	

	Sept	Early Oct	Nov	Winter (December – March)	Early April	Early May	June	Early July
				February, and March volume forecasts released by the NWRFC	released by NWRFC	released by NWRFC	released by NWRFC	

5.2 Water Supply Forecasts

Water supply forecasts serve as a guide to how much water may be available for fish and other operations. Flow projections are provided to the TMT regularly during the flow management for fish passage season (April 3 – August 31).

The NWRFC, Corps of Engineers, Reclamation, and others prepare water supply forecasts to manage the Columbia and Snake Rivers. Table 4 below lists the forecasts used to implement actions described in the BiOps.

The NWRFC produces 3 ESP forecasts each week (or more often) for various forecast points, differentiated by the number of days of deterministic weather forecasts used to initialize the forecast. The three initializations used are the 10, 3, and zero days of weather forecast. In 2013, the Action Agencies used the 50% exceedance value for the 3 day initialization as the "Final" forecast.

The Action Agencies continue to track the performance of the 3 day initialization forecasts against the performance of the 0 and 10 day initializations. To date this analysis shows that the meteorological science is still not adequate to have a reliable forecast out 10 days into the future, whereas, 3-day forecasts continue to show significant skill. In 2014 the 50% exceedance value for the 3 day initialized ESP forecast for The Dalles and Lower Granite, released closest to and/or prior to the 5th working day of the month (or earlier) will be used as the "Final" forecast for each month. Flood Control or other computations will continue to be computed at the same intervals as before. This process for integrating the ESP forecasts into the water management planning process is being implemented as described. The Action Agencies will continue to track the process for 2014 and will evaluate after the water year is complete to determine if any additional adjustments need to be made.

Table 3. Forecast Designations (Table will be updated for the November Draft)

Date	**Forecast Designation**
8 January 2014	January Final
7 February 2014	February Final
7 March 2014	March Final
8 April 2014*	April Final
7 May 2014	May Final
6 June 2014	June Final
8 July 2014	July Final

***This represents the 6th working day of the month, but an additional day was determined necessary to ensure that snow information and the most recent ESP forecast would be included in the April Final forecast.**

Table 4. Water Supply Forecasts Used to Implement BiOp Actions. See Table 5 for project-specific operations.

Forecast Point	Forecast period	Forecast	BiOp Actions to be Determined
Hungry Horse	April – August Provided by Reclamation	January, February, and March Final	Sets min. flows at Hungry Horse and Columbia Falls
	May – September Provided by Reclamation	January, February, and March Final	Sets VARQ flood control targets
		April Final	Sets VARQ flood control targets and VARQ refill flows
		May and June Final	Sets VARQ refill flows
The Dalles	April – August Provided by NWRFC	April Final	Sets spring flow objective at McNary Dam and informs decision on juvenile fish transportation operations at McNary
		May Final	Sets end of September draft limits at Hungry Horse and Libby
		July Final	Sets end of August draft limit at Grand Coulee
Lower Granite	April – July Provided by NWRFC	April Final	Sets spring flow objective at Lower Granite and informs decision on juvenile fish transportation operations at Lower Snake projects
		June Final	Sets summer flow objective at Lower Granite
Libby	April – August Provided by Corps Seattle District	December Final	Sets end of December variable draft target
		January, February, and March Final	Sets VARQ flood control targets
		April Final	Sets VARQ flood control targets and VARQ refill flows
		May Final	Sets Libby min. sturgeon flow volume and min. bull trout flows for after sturgeon pulse through Sept. Sets VARQ refill flows
		June Final	VARQ refill flows
Dworshak	April – July Provided by Corps Walla Walla District	October to June	Manage for reservoir refill

6 Project Operations

Table 5 summarizes the major fish-related reservoir and flow operations by project, consistent with the 2010 NMFS Supplemental BiOp RPA Table (see Appendix 7). More detailed descriptions of each of these operations by project follow the table.

Table 5. Reservoir and Flow Operations for ESA-listed fish species.

Project	Flood Control & Project Refill	Kootenai River White Sturgeon	Bull Trout	Spring Anadromous	Summer Anadromous	Chum
Libby	Winter: Operate to VARQ flood control rule curve and achieve appropriate elevation by April 10 if possible. Spring: Adhere to VARQ Operating Procedures at Libby Dam, supply the appropriate tiered volume for sturgeon, supply appropriate minimum bull trout flow. Summer: to provide summer flow augmentation, refill, exact date to be determined in-season, dependant on available water supply, shape and spring flow operations, while also avoiding involuntary spill and meeting flood control objectives.	May – July: Provide USFWS sturgeon volume to augment flows at Bonners Ferry.	Year Round: Operate to maintain project minimum flow requirements. Operate using ramping rates to minimize adverse affects of flow fluctuations. May 15 – Sep 30: Operate to Bull Trout Minimum Flows and maintain a steady outflow if possible for July–September while operating to experimental draft to 10 ft from full by the end of September (except in lowest 20th percentile water years, as measured at The Dalles (May final Apr-Aug forecast), when draft will increase to 20 ft from full by end of September). Full is 2459 ft.	Operate to meet refill if possible without jeopardizing flood control, meeting sturgeon volume goals, supporting salmon flow objectives, and not exceeding TDG limits.	September: Experimental draft to 10 ft from full by the end of September (except in lowest 20th percentile water years, as measured at The Dalles (May final Apr-Aug forcast), when draft will increase to 20 ft from full by end of September). Full is 2459 ft.	Fall/winter storage may be used to support chum flows

Project	Flood Control & Project Refill	Kootenai River White Sturgeon	Bull Trout	Spring Anadromous	Summer Anadromous	Chum
Hungry Horse	Winter: Operate to VARQ flood control rule curves and to a 75% probability of meeting the April 10 elevation objective.	N/A	Year Round: Operate in order to maintain Columbia Falls and project minimum flow requirements. Operate using ramping rates to minimize adverse affects of flow fluctuations and maintain a steady outflow if possible for July – September. Experimental draft during July-September to a draft limit of 3550 ft (10 ft from full) by September 30, except in the driest 20 percentile of water conditions as measured at The Dalles (May final Apr-Aug forcast), limit draft to 3540 ft (20 ft from full).	Refill by about June 30 if possible without excessive spill and operate to help meet flow objectives without exceeding TDG limits.	September: Experimental draft during July-September to a draft limit of 3550 ft (10 ft from full) by September 30, except in the driest 20 percentile of water conditions as measured at The Dalles (May final Apr-Aug forcast), limit draft to 3540 ft (20 ft from full).	

Project	Flood Control & Project Refill	Kootenai River White Sturgeon	Bull Trout	Spring Anadromous	Summer Anadromous	Chum
Albeni Falls	Winter: Operate within standard flood control criteria. Spring: Refill by June 30. Spring: When not operating to meeting minimum flows, or to minimize downstream flooding, operate to be at the upper flood control elevation on or about April 10 (the exact date to be determined during in-season management) to increase flows for spring flow augmentation for fish.	N/A	Fall/Winter: Determine winter minimum control elevation after annual meeting with AAs, IDFG, NMFS, USFWS and interested parties. This year's winter minimum control elevation will be 2051 ft. Reach 2051 ft. msl by mid-November and maintain this elevation until the end of kokanee spawning as determined by IDFG survey. After the end of spawning, operate not to exceed flood control rule curve but not to fall below the minimum control elevation.			Fall/Winter: Storage may be used to support chum flows

Project	Flood Control & Project Refill	Kootenai River White Sturgeon	Bull Trout	Spring Anadromous	Summer Anadromous	Chum
Grand Coulee	Winter: Operate for flood control and to 85% probability of meeting April 10 elevation objective to increase spring flows in the Columbia River Spring: Refill by about June 30 and operate to help meet flow objectives (exact date to be determined during in-season management)	N/A		Operate to help meet the Spring flow objective at Priest Rapids and McNary Dams	July-August: Draft to support salmon flow objectives during July-August with variable draft limit of 1278 to 1280[6] ft by August 31 based on the water supply forecast August: Reduce pumping into Banks Lake and allow Banks Lake to operate up to 5 ft from full pool (elevation 1565) during August to help meet salmon flow objectives when needed.	Fall/Winter: Storage may be used to support chum flows
Dworshak	Winter: Operate to achieve April 10 elevation objective (exact date to be determined during in-season management) Spring: Refill by about June 30 and operate to help meet flow objectives	N/A			Draft to elevation 1535 ft by the end of August and elevation 1520 ft (80 ft from full) by the end of September unless modified per the Agreement between the U.S. and the Nez Perce Tribe for water use in the Dworshak Reservoir.	Fall/Winter: Storage may be used to support chum flows

[6] These draft limits will be modified by the Lake Roosevelt Incremental Storage Release Project (see Section 6.5.6).

Project	Flood Control & Project Refill	Kootenai River White Sturgeon	Bull Trout	Spring Anadromous	Summer Anadromous	Chum
Lower Granite	The pool can be drafted as low as 724 feet to protect levees during high flows.	N/A		Flow objective of 85-100 kcfs Operate within 1 ft of MOP to reduce juvenile travel time Operate within 1% of best efficiency	Flow objective of 50-55 kcfs Operate within 1 ft of MOP to reduce juvenile travel time Operate within 1% of best efficiency	
Little Goose	N/A	N/A		Operate within 1 ft of MOP to reduce juvenile travel time Operate within 1% of best efficiency Manually set Unit 1 lower operating limit	Operate within 1 ft of MOP to reduce juvenile travel time Operate within 1% of best efficiency Manually set Unit 1 lower operating limit	
Lower Monumental	N/A	N/A		Operate within 1 ft of MOP to reduce juvenile travel time Operate within 1% of best efficiency	Operate within 1 ft of MOP to reduce juvenile travel time Operate within 1% of best efficiency	
Ice Harbor	N/A	N/A		Operate within 1 ft of MOP to reduce juvenile travel time Operate within 1% of best efficiency	Operate within 1 ft of MOP to reduce juvenile travel time Operate within 1% of best efficiency	
McNary	N/A	N/A		Flow objective of 220-260 kcfs Operate within 1% of best efficiency	Flow objective of 200 kcfs Operate within 1% of best efficiency	

Project	Flood Control & Project Refill	Kootenai River White Sturgeon	Bull Trout	Spring Anadromous	Summer Anadromous	Chum
John Day	John Day reservoir may be operated between 257 and 268 feet for flood control objectives	N/A		Operate within 1.5 ft of minimum level that provides irrigation pumping to reduce juvenile travel time Operate within 1% of best efficiency	Operate within 1.5 ft of minimum level that provides irrigation pumping to reduce juvenile travel time Operate within 1% of best efficiency	
The Dalles	N/A	N/A		Operate within 1% of best efficiency	Operate within 1% of best efficiency	
Bonneville	N/A	N/A		Operate within 1% of best efficiency	Operate within 1% of best efficiency	Provide flows for chum when hydrologic conditions indicate system can likely maintain minimum project tailwater elevation (on Oregon shore 0.9 miles downstream of first powerhouse and 50 ft upstream of Tanner Creek) during spawning and incubation

6.1 Hugh Keenleyside Dam (Arrow Canadian Project)

6.1.1 Mountain Whitefish Flows

Desirable spawning flow levels are between 45-55 kcfs beginning the third week in December and continuing through mid-January. Egg protection flows are generally about 19 kcfs lower than the spawning flow from mid-January through the end of March. Through negotiation of annual agreements under the Treaty, more beneficial whitefish spawning flows are typically provided than would occur otherwise.

6.1.2 Rainbow Trout Flows

Rainbow trout spawning begins in April. Protection levels begin between 15 and 25 kcfs. The goal is to have stable or increasing river levels through June. Provision of flows for trout spawning downstream of Arrow is negotiated through annual agreements under the Treaty.

6.2 Hungry Horse Dam

Hungry Horse Dam is operated for multiple purposes including fish and wildlife, flood control, power, and recreation. Specific operations for flow management to aid anadromous and resident fish are listed in the following sections.

6.2.1 Winter/Spring Operations

Hungry Horse will be operated during the winter and early spring for flood control and to achieve a 75% probability of reaching the April 10 elevation objective in order to provide more water for spring flows. This is achieved by operating between the Upper Rule Curve (URC) as an upper limit and the Variable Draft Limits (VDL) as a lower operating limit for the reservoir. The URC is the maximum elevation allowed for flood control and is calculated by using the Storage Reservation Diagram (SRD) developed for VARQ flood control. A description of VDL is provided in Section 7.4. Reclamation computes Hungry Horse Dam's April 10 elevation objective by linear interpolation between the March 31 and April 15 forecasted flood control elevations based on the Reclamation March Final May - September Water Supply Forecast (WSF).

Refill at Hungry Horse usually begins approximately ten days prior to when streamflow forecasts of unregulated flow is projected to exceed the ICF at The Dalles, Oregon. During refill, discharges from Hungry Horse are determined using inflow volume forecasts, streamflow forecasts, weather forecasts, and the VARQ Operating Procedures. Other factors such as local flood control are also considered when determining refill operations. During the latter part of the flood control season (April) and the refill season (typically May through June), Hungry Horse discharges may be reduced for local flood protection in the Flathead Valley. The official flood stage for the Flathead River at Columbia Falls, Montana, is currently13 ft (an approximate flow of 44,000 cubic feet per second (cfs)). The flood stage at Columbia Falls was changed by the National Weather Service from 14 ft to 13 ft in the spring of 2013. In order to prevent or minimize flooding on the Flathead River above Flathead Lake, Reclamation will adjust outflows from Hungry Horse Dam as necessary (down to a minimum discharge of 300 cfs) as long as

there is enough space in the reservoir to manage the remaining runoff. Hungry Horse generally starts reducing discharges when the stage at Columbia Falls hits and begins to exceed 13 ft . However, depending on remaining runoff volume and available reservoir space, Hungry Horse may not start reducing discharges until Columbia Falls reaches a level higher than 13 ft.

Often during the spring, changes in flood control, transmission limitations and generation unit availability will require adaptive management actions for real-time operations in order to control refill and to avoid spill.

6.2.2 Summer Operations

Hungry Horse will operate to refill by about June 30 to provide summer flow augmentation, except as specifically provided by the TMT. However, the timing and shape of the spring runoff may result in reservoir refill before or after the June 30. For example, a late snowmelt runoff may delay refill to sometime after June 30 in order to avoid excessive spill.

During the summer, Hungry Horse is drafted within the NMFS 2010 Supplemental BiOp specified draft limits based on flow recommendations provided by TMT. TMT considers a number of factors when developing its flow recommendations, such as: the status of fish migration, attainment of flow objectives, water quality, and the effects that reservoir operations will have on other listed and resident fish populations. Hungry Horse discharges during the summer months should be even or gradually declining in order to minimize a double peak on the Flathead River. The summer reservoir draft limit at Hungry Horse is 3,550 ft (10 ft from full) by September 30 except in the lowest 20th percentile[7] of water years (less than 72.2 maf at The Dalles) when the draft limit is elevation 3,540 ft (20 ft from full) by September 30. If the project fails to refill, especially during drought years, minimum flow requirements (see Section 6.2.4) may draft the reservoir below these draft limits. Operations in September are primarily focused on benefiting listed resident bull trout and other fish species below the project. The intent is to maintain steady or gradually declining flows below the project. Hungry Horse may draft slightly above or below the end of September draft limit depending on inflows and minimum flow requirements. Hungry Horse may end the month at an elevation above the end of September draft limit if inflows are higher than were forecasted in the planned operation. Hungry Horse may end the month at an elevation below the end of September draft limit due to minimum flow requirements and if inflows are lower than were forecasted in the planned operation.

6.2.3 Reporting

Reclamation will fulfill the USFWS Reasonable and Prudent Measure (RPM) from the 2000 USFWS BiOp for annual and monthly reporting by contributing to the annual WMP and presenting weekly and biweekly reports of Hungry Horse operations through the TMT process. Reclamation will also fulfill the USFWS RPM recommendation for

[7] The lowest 20th percentile as measured at The Dalles (RPA 4 in RPA Table, pg 6 of 98) based on RFC's 30-year statistical period (1981-2010), using May final for The Dalles Apr-Aug (RPA 14 in RPA table, pg 15 of 98)

reporting actual operations by making available pertinent historic elevations and flows as related to Hungry Horse Dam that are available on the following website: http://www.usbr.gov/pn/hydromet/esatea.html.

6.2.4 Minimum Flows and Ramp Rates

The following minimum flows and ramp rates help guide project operations to meet various purposes, including power production. Minimum flows and ramp rates were identified in the 2000 USFWS BiOp for Hungry Horse Dam to protect resident fish and their food organisms in the Flathead River.

There are two minimum flow requirements for Hungry Horse Dam. One is for Columbia Falls on the mainstem Flathead River located just downstream from the confluence of the South Fork with the mainstem. This flow requirement generally governs Hungry Horse outflows during the fall and winter. The second minimum flow requirement is for the South Fork Flathead River just below Hungry Horse Dam. This minimum flow typically comes into play during refill of the project in spring when the minimum flows at Columbia Falls are met by the North and Middle Fork flows. The minimum outflow for Hungry Horse Dam and the minimum flow for Columbia Falls will be determined monthly based on the Reclamation WSF for the inflows into Hungry Horse for the period April 1 to August 31. Both minimum flows are determined monthly starting with the January forecast, and then set for the remainder of the year based on the March final runoff forecast. Table 6 shows how the minimum flows are calculated[8]. Reclamation's WSF will be provided to the TMT.

Table 6. Minimum Flows at Hungry Horse and Columbia Falls.

Forecasted April–August inflow at Hungry Horse (KAF)	Hungry Horse min flow[a] (CFS)	Columbia Falls min flow (CFS)
<1190	400	3,200
1,190 - 1,790	Interpolate between 400-900	Interpolate between 3,200-3,500
>1,790	900	3,500

a. To prevent or minimize flooding on the Flathead River above Flathead Lake, Hungry Horse discharges can be reduced to a minimum flow of 300 cfs when the stage at Columbia Falls exceeds 13 ft.

The maximum ramp up and ramp down rates are detailed in Table 7. The daily and hourly ramping rates may be exceeded during flood emergencies to protect health and public safety and in association with power or transmission emergencies. The ramp rates will be followed except when they would cause a unit(s) to operate in a zone that could result in premature wear or failure of the units. In this case the project will utilize a ramp rate which allows all units to operate outside the rough zone. The AAs will provide additional information to the USFWS describing operations outside the "rough zone."

[8] USFWS BiOp at Section 3.A.1 Page 6

Table 7. Hungry Horse Dam Ramping Rates.

Daily and Hourly Maximum Ramp Up Rates for Hungry Horse Dam (as measured by daily flows, not daily averages, restricted by hourly rates)		
Flow Range (measured at Columbia Falls)	**Ramp Up Unit Limit (daily max)**	**Ramp Up Unit Limit (hourly max)**
3,200 - 6,000 cfs	1,800 cfs/day	1,000 cfs/hour
>6,000 - 8,000 cfs	1,800 cfs/day	1,000 cfs/hour
>8,000 - 10,000 cfs	3,600 cfs/day	1,800 cfs/hour
>10,000 cfs	No limit	1,800 cfs/hour

Daily and Hourly Maximum Ramp Down Rates for Hungry Horse Dam (as measured by daily flows, not daily averages, restricted by hourly rates)		
Flow Range (measured at Columbia Falls)	**Ramp Down Unit Limit (daily max)**	**Ramp Down Unit Limit (hourly max)**
3,200 - 6,000 cfs	600 cfs/day	600 cfs/hour
>6,000 - 8,000 cfs	1,000 cfs/day	600 cfs/hour
>8,000 - 12,000 cfs	2,000 cfs/day	1,000 cfs/hour
>12,000 cfs	5,000 cfs/day	1,800 cfs/hour

6.2.5 Spill Operations

Hungry Horse will be operated to avoid spill if practicable. Spill at Hungry Horse is defined as any release through the dam that does not pass through the power plant. Full capacity of the power plant is around 408MW (~12,000 cfs) at full pool, however current transmission restrictions limit generation to 310 MW (~9,000 cfs). Large amounts of spill can cause TDG levels in the South Fork of the Flathead River to exceed the state of Montana's standard of 110%. Empirical data and estimates show that limiting spill to a maximum of 15% of total outflow will help to avoid exceeding the Montana State TDG standard of 110%.

6.3 Albeni Falls Dam

6.3.1 Albeni Falls Dam Fall and Winter Coordination

Pursuant to the 2000 USFWS BiOp and the USFWS letter of September 28, 2007 to the Corps and BPA on "Lake Pend Oreille Winter Lake Elevations," the AAs will meet annually with the USFWS, NMFS, and IDFG, along with the Kalispel Tribe and other interested parties, to evaluate Lake Pend Oreille female kokanee spawner numbers, the winter climate (precipitation) forecast, spawning and incubation success for threatened lower Columbia River chum salmon the previous winter, and recent history of winter elevations for Lake Pend Oreille (hereafter referred to as the "interagency meeting"). One of the purposes of this meeting is to recommend the winter minimum control elevation (MCE) to ensure winter lake operation addresses the needs of kokanee spawning, while also taking into consideration spawning and incubation needs for lower Columbia River chum salmon.

TMT members will review recommendations from the interagency meeting and develop a recommendation for the proposed Lake Pend Oreille fall and winter operations to the AAs for final decision.

6.3.2 Flood Control Draft

Albeni Falls Dam will be operated during the winter season using standard flood control criteria.

6.3.3 Refill Operations

During the spring Albeni Falls Dam will be operated to fill Lake Pend Oreille in accordance with standard flood control criteria. The AAs will operate Albeni Falls Dam to meet the flow objectives and refill by approximately June 30. When not operating to meet minimum flows, or for flood risk management, operate storage projects to be at the upper flood control elevation on or about April 10 (the exact date to be determined during in-season management) to potentially increase flows for spring flow augmentation for fish.

6.3.4 Summer Operations

During the summer, Albeni Falls Dam will be operated to maintain Lake Pend Oreille elevation at Hope, Idaho, between elevation 2,062 ft and 2,062.5 ft. The annual fall drawdown to the winter minimum control elevation begins soon after Labor Day.

6.4 Libby Dam

Libby Dam flows will be regulated consistent with existing treaties, Libby Project authorization for public safety, and other laws to achieve water volumes, water velocities, water depths, and water temperature at a time to maximize the probability of allowing significant sturgeon recruitment and to provide a year-round thermograph that approximates normative conditions, while also meeting flood damage reduction objectives. The year-round project minimum outflow is 4.0 kcfs.

6.4.1 Coordination

The AAs will continue to coordinate Libby Dam BiOp operations at TMT.

6.4.2 Burbot Flows

Providing low temperatures, if possible, from Libby Dam to aid upstream migration of burbot to spawning areas in the Kootenai River in Idaho will occur each winter. These low temperatures may be called for over an extended period from October through February. Specific details of this operation for the current year will be developed and will be included in the fall/winter update. An interagency Memorandum of Agreement for this species was completed in June 2005. Use of VARQ flood control procedure and implementation of the variable end-of-December flood control target elevation may aid this operation in years with below average runoff forecasts.

6.4.3 Ramp Rates and Daily Shaping

The purpose of the following actions is to provide better conditions for resident fish by limiting the flow fluctuations and setting minimum flow levels. In addition, ramping rates protect varial zone productivity by emulating a normative hydrograph. These ramp rates for Libby Dam were proposed in the BA supplement to minimize impacts to bull

trout and are included in the USFWS 2006 BiOp. The following ramp rates (Table 8) will guide project operations to meet various purposes, including power production.

Daily and hourly ramping rates may be exceeded during flood emergencies to protect health and public safety and in association with power or transmission emergencies. Variances to these ramping rates during years when water supply forecasting errors overestimate actual runoff, or variances are necessary to provide augmentation water for other listed species or other purposes, will be coordinated through the TMT process. This is expected in only the lowest 20th percentile water years. At the project, the ramp rates will be followed except when they would cause a unit(s) to operate in the rough zone, a zone of chaotic flow in which all parts of a unit are subject to increased vibration and cavitation that could result in premature wear or failure of the units. In this case the project will utilize a ramp rate which allows all units to operate outside the rough zone.

Table 8. Prescribed maximum ramp rates to protect resident fish and prey organisms in the Kootenai River in addition to minimizing levee erosion along the river. Rate of change may be less than stated limits.

		Summer (05/01 - 09/31)	
		Hourly	Daily
Ramp Up	4-6 kcfs	2500 cfs	1 unit
	6-9 kcfs	2500 cfs	1 unit
	9-16 kcfs	2500 cfs	2 units
	16-QPHC	5000 cfs	2 units
Ramp Down	4-6 kcfs	500 cfs	500 cfs
	6-9 kcfs	500 cfs	1000 cfs
	9-16 kcfs	1000 cfs	2000 cfs
	16-QPHC	3500 cfs	1 unit
		Winter (10/01 - 04/30)	
		Hourly	Daily
Ramp Up	4-6 kcfs	2000 cfs	1 unit
	6-9 kcfs	2000 cfs	1 unit
	9-16 kcfs	3500 cfs	2 units
	16-QPHC	7000 cfs	2 units
Ramp Down	4-6 kcfs	500 cfs	1000 cfs
	6-9 kcfs	500 cfs	2500 cfs
	9-16 kcfs	1000 cfs	1 unit
	16-QPHC	3500 cfs	1 unit

(USFWS 2006 BiOp at Description of the proposed action, page 7, Table 1.)

6.4.4 Flood Control

The Corps will continue to use its forecast procedure in December to determine the December 31 flood control elevation. In water years where the December forecast for the period April through August is less than 5,900 KAF based on the Corps' forecast procedures, the end-of-December draft elevation will be higher than 2,411 ft. If the December forecast for April-August is 5,500 KAF or less, the end-of-December target elevation would be 2,426.7 ft. The end-of-December elevation is a sliding scale between elevation 2,426.7 ft and 2,411 ft when the forecast is between 5,500 and 5,900 KAF.

Libby Dam will be operated during January through March (into April if the start of refill has not been declared) to the VARQ flood control storage reservation diagram (SRD). During the refill period from about April through June, Libby Dam will release flow in accordance with VARQ Flood Control Operating Procedures at Libby Dam. Refill at Libby Dam will begin 10 days prior to when the forecasted unregulated flow at The Dalles is expected to exceed the ICF. Once refill begins, Libby Dam outflow will be no lower than the computed VARQ flow (or inflow, if that is lower than the VARQ flow), unless otherwise allowed by the VARQ Operating Procedures. For example, changes to reduce the VARQ flow can occur to protect human life and safety, during the final stages of refill, or through a deviation request.

The VARQ flow will be recalculated with each new Corps water supply forecast and outflows will be adjusted accordingly. If the VARQ operating procedures require discharges above powerhouse capacity, spill from Libby Dam may occur. The intent is to adjust Libby Dam discharge to maximize reservoir refill probability and minimize the potential for spill.

6.4.5 Spring Operations

The purpose of the following actions is to refill Libby Dam in order to provide the flow for Kootenai River white sturgeon, bull trout ramping rates, and anadromous fish flow augmentation water. Libby Dam will provide flows for sturgeon, bull trout, and salmon during spring; for salmon and bull trout during summer and for bull trout and resident fish in September while attempting to minimize a double peak or large flow fluctuations in the June – September period. AAs will operate Libby Dam to provide for summer flow augmentation, exact refill date to be determined in-season by available water supply and shape and spring flow operations, while also avoiding involuntary spill and meeting flood control objectives. During the spring, the AAs will operate Libby Dam to meet its flow and refill objectives. If both these objectives cannot be achieved, VARQ and sturgeon flow operations are a higher priority over summer refill.

When not operating to minimum flows, the project will be operated to achieve a 75% chance of the upper flood control rule curve on or about April 10 (the exact date to be determined during in-season management) to increase flows for spring flow management.

6.4.6 Bull Trout Flows

From May 15 to June 30 and during the month of September, a minimum flow of 6,000 cfs will be provided and minimum flows of 4,000 cfs will be provided for the rest of the

year. Volume to sustain the basal flow of 6,000 cfs from May 15 through May 31 will be accounted for with sturgeon volumes, and in the fall should be drawn from the autumn flood control draft. Table 9 shows how the bull trout minimum flow is determined during this period.

Table 9. **Minimum bull trout releases from Libby Dam July 1 through 31 August, based on the May final Libby water supply forecast for the April-August period (May 15 – June 30 and all of September the minimum is 6 kcfs).**

Forecast Runoff Volume (Maf*) at Libby	Minimum bull trout flows (kcfs) between sturgeon and salmon flows
0.00 < forecast < 4.80	6 kcfs
4.80 < forecast < 6.00	7 kcfs
6.00 < forecast < 6.70	8 kcfs
6.70 < forecast < 8.10	9 kcfs
8.10 < forecast < 8.90	9 kcfs
8.90 < forecast	9 kcfs

**Maf = million acre-feet*

6.4.7 Sturgeon Operation

The purpose of the actions below is to provide water for sturgeon spawning and egg incubation. Libby Dam will provide the tiered volume for sturgeon flows as described in the USFWS 2006 BiOp, the Clarified RPA from USFWS and as summarized in Figure 2. The outflow during sturgeon augmentation period will be equal to or greater than the VARQ flow. The release operation will be developed prior to commencement of the sturgeon tiered flow release. Water temperature profiles will be monitored near the dam starting in April and continue through July to provide information necessary for timing of sturgeon spawning/rearing flow augmentation. Also, water temperature profiles in the forebay are used to determine when warmer temperatures may be provided to assist sturgeon spawning. Reservoir temperature data collection is occurring and is intended to allow better planning for temperature management of water releases.

This sturgeon water will be in addition to needs for listed bull trout and salmon, and will be measured above the 4,000 cfs minimum releases from Libby Dam. Accounting for these total tiered volumes will begin when the USFWS determines benefits to conservation of sturgeon are most likely to occur or when additional flow is needed to sustain basal flow of 6,000 cfs from May 15 through May 31. Sturgeon flows will generally be initiated between mid-May and the end of June to augment lower basin runoff entering the Kootenai River below Libby Dam, consistent with the current version of the Kootenai River Ecosystem Function Restoration Flow Plan Implementation Protocol and USFWS 2006 BiOp and applicable clarifications.

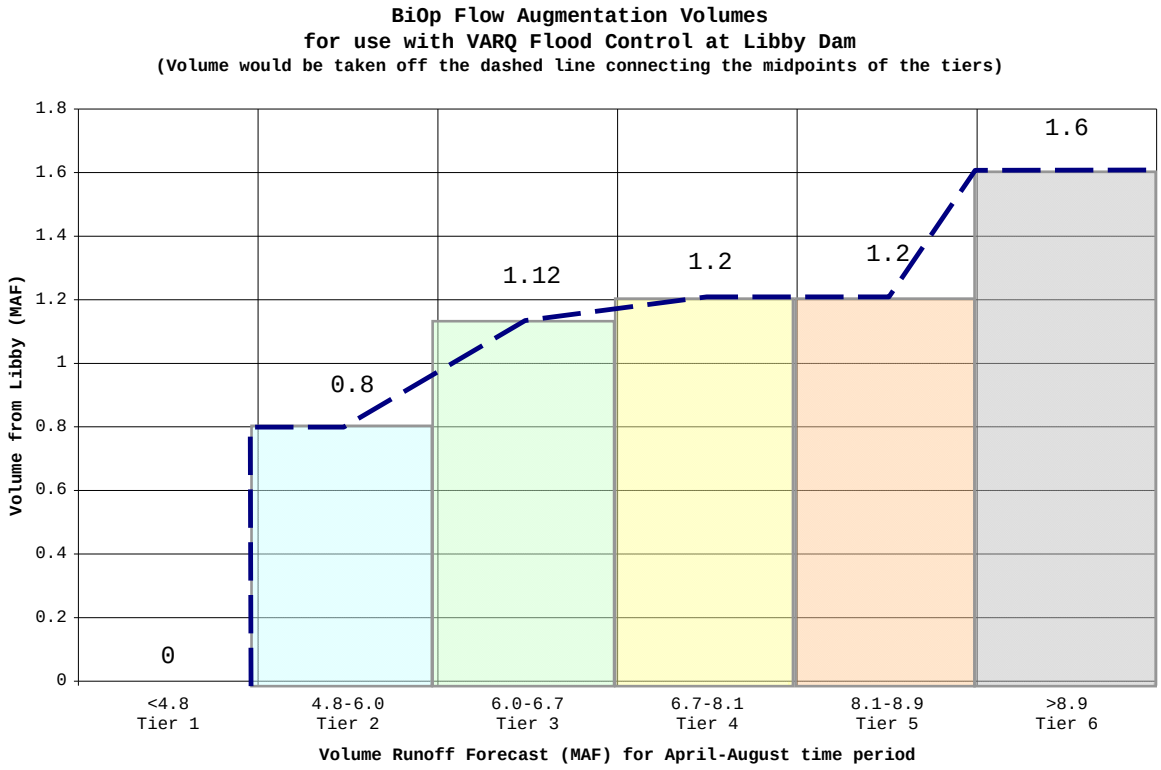

Figure 2. "Tiered" volumes of water for sturgeon flow enhancement to be released from Libby Dam according to the Libby May final forecast of April - August volume. Actual flow releases would be shaped according to seasonal requests from the USFWS and in-season management of water actually available.

6.4.8 Post-Sturgeon Operation

After the sturgeon operation, flows will be set to refill, if possible, in July, while trying to minimize a double peak. Summer operations will be coordinated through TMT in-season management. Libby Dam releases will follow ramp rates listed in the 2006 USFWS BiOp and shown on Table 8.

6.4.9 Summer Operations

During the summer, the AAs draft Libby Dam within the NMFS 2010 Supplemental BiOp and USFWS BiOp's specified draft limits based on flow recommendations coordinated at TMT. TMT considers a number of factors when developing its flow recommendations, such as: the impact of flow fluctuations on bull trout and other resident fish below the project, the status of juvenile salmon outmigration in the lower Columbia, attainment of flow objectives, water quality, and the effects that reservoir operations will have on other listed and resident fish populations.

During the summer (July-September), the AAs will operate Libby Dam to augment flows for juvenile salmon out-migration in the Columbia River and to help meet local resident fish needs. In the summer the AAs will draft to 10 ft from full by the end of September

(except in lowest 20th percentile[9] water years (The Dalles May final April-August <72.2 maf), as measured at The Dalles, when draft will increase to 20 ft from full by end of September). If the project fails to refill, then release inflows or operate to meet minimum bull trout flows through the summer months. Rationale for the experimental draft was adopted by the Northwest Power and Conservation Council (Council) and further details of the evaluation can be found in the FCRPS 2008 Biological Opinion from NMFS (Appendix B.2.1).

Arrangements for retention of July-September water in Lake Koocanusa are possible through a Libby-Canadian storage water exchange under the current Libby Coordination Agreement, which was signed February 16, 2000. However, this operation cannot be guaranteed in any given year because it must be mutually beneficial to the Canadian Entity and the U.S. Entity. Information needed for such a determination such as the volume of the water year, is not available until well into the migration season. This operation, if any, for a given water year is generally not finalized until June or July of that year. The exchange agreement reduces the draft of Lake Koocanusa and provides an equivalent amount of water from Canada.

The Corps will use the best available forecast at the end of August to set flow that will gradually draft Libby to the target elevation by the end of September as defined in the FCRPS BiOp RPA (Appendix 7). If this calculated flow is greater than the bull trout minimum of 6 kcfs, then the discharge will be maintained until the draft target is met or the month ends, whichever comes first.

6.4.10 Kootenai River Habitat Restoration Project

From August through October in 2013-2015, the AAs will be operating Libby Dam in coordination with the Kootenai Tribe of Idaho in order to complete the Kootenai River Habitat Restoration Project. The restoration strategy for this portion of the project is to: stabilize eroding banks, trap sediment, and promote floodplain development, increase riparian vegetation, and increase channel margin and side channel complexity. Releasing minimum between 6 to 8 kcfs during September depending on the end of August elevation (minimum flows are 6 kcfs and 4 kcfs respectively in September and October) will facilitate the construction work. Flows in September will depend on hydrologic conditions, current forecast, as well as what habitat work is currently planned by not only KTOI but also the Corps downstream of Libby Dam. In order to accommodate this operation, the AAs will coordinate with TMT on the actual operation to reach the BiOp 30 September elevation target of either 2439 or 2449 ft. In the event of high rainfall events in the summer, the TMT will discuss shifting the target from 30 September to 31 August to increase the probability of reaching the elevation target and support the Habitat Restoration Project.

[9] The lowest 20th percentile as measured at The Dalles (RPA 4 in RPA Table, pg 6 of 98) based on RFC's 30-year statistical period (1981-2010) using May final for The Dalles Apr-Aug (RPA 14 in RPA table, pg 15 of 98)

6.5 Grand Coulee Dam

Grand Coulee Dam is operated for multiple purposes including fish and wildlife, flood control, irrigation, power, and recreation. Specific operations for flow management to aid anadromous and resident fish are listed in the following sections.

6.5.1 Winter/Spring Operations

Grand Coulee will be operated for flood control from January through April using the NWRFC's forecast for unregulated runoff at The Dalles (adjusted for available storage capacity upstream of The Dalles other than at Grand Coulee Dam) and Grand Coulee's Flood Control SRD. Grand Coulee is also operated during this period to support chum operations (described in detail in Section 7.3) and to maintain an 85% probability of reaching the April 10 elevation objective in order to provide more water for spring flows.

Maintaining an 85% probability of reaching the April 10 elevation objective is achieved by operating between the URC as an upper elevation limit and the VDL as a lower elevation limit for the reservoir from January through March. A description of VDL is provided in Section 7.4.

Reclamation computes Grand Coulee Dam's April 10 elevation objective by linear interpolation between the March 31 and April 15 forecasted flood control elevations based on the NWRFC March Final April-August WSF at The Dalles. The March forecast is chosen for the calculation of the April 10 elevation objective in order to allow enough time to react and to plan Grand Coulee operations accordingly. The April final forecast is typically not released until the 5th business day of the month, after which the Corps calculates flood control elevations. This usually means that final April 15 and April 30 flood control elevations are not released until around April 8 at the earliest. It is notable that even modest changes in The Dalles water supply forecast can produce significant changes in the forecasted flood control elevations for Grand Coulee. In order to achieve final April flood control targets, actual Grand Coulee elevations on April 10 may be below or above the April 10 objective depending on draft rates and water supply conditions.

The most likely situation that would require Grand Coulee to draft below the April 10 elevation objective is an increase in the WSF between March and April. Large increases in the WSF forecast can require large reservoir drafts in order to achieve the April 30 flood control elevation. In this situation, drafting below the April 10 elevation objective may be desirable in order to avoid exceeding draft rates and to avoid spilling through the outlet tubes. Even minimal spill though the outlet tubes can create elevated TDG levels below Grand Coulee Dam. This situation most recently occurred in 2012, when Grand Coulee began pre-drafting in late March as a result of an increasing WSF and anticipated excessive draft rates during April. The operation was discussed and coordinated at TMT and resulted in an adaptive management operation that still resulted in a large draft and high discharges from Grand Coulee during April but minimized spill and avoided potential high TDG production by pre-drafting.

An additional factor that needs to be considered during spring operations is the on-going Third Power Plant (TPP) overhaul at Grand Coulee. The TPP overhaul will result in one TPP unit being out of service at any given time during the overhaul period. This is in addition to other units being out of service for routine scheduled maintenance. A TPP unit has a hydraulic capacity of 20 kcfs – 30 kcfs depending on unit and head. Every effort is made to schedule annual and other routine maintenance outside of the "normal" spring flood control/refill period when possible but heavy runoff years, early or delayed runoff timing, and/or unscheduled maintenance in conjunction with the TPP overhaul will increase the probability of spill and excessive TDG production. Adaptive management operations at Grand Coulee may need to be considered during the TPP overhaul period in order to minimize spill and TDG production. The TPP overhaul is currently scheduled to be completed in 2024. Grand Coulee operations will be discussed and coordinated at TMT.

Opportunities to shift system flood control requirements from Brownlee and Dworshak to Grand Coulee will also be considered. The deepest reservoir draft typically occurs around April 30. Refill at Grand Coulee normally begins approximately one day prior to when streamflow forecasts of unregulated flow is projected to exceed the ICF at The Dalles Dam.

During the spring, the AAs will operate the FCRPS to help meet the flow objectives, to meet system flood control requirements and to refill the projects. If all of these objectives cannot be achieved, the TMT will make an in-season recommendation, weighing considerations unique to each particular year and project. System flood control requirements during refill, especially during above average years, may result in significant spill below Grand Coulee Dam in order to control refill, meet downstream flood control flow objectives, and to limit downstream flooding. High levels of spill below Grand Coulee can result in high TDG levels specifically in the river reach between Grand Coulee and Chief Joseph dams. A more detailed discussion of spill operations is discussed in Section 6.5.9.

6.5.2 Summer Operations

Grand Coulee will operate to refill by about June 30 to provide summer flow augmentation, except as specifically provided by the TMT. Grand Coulee will be operated during the summer (July and August) to help meet the flow objectives for juvenile salmon out-migration. Grand Coulee will draft to support salmon flow objectives during July-August with variable draft limit of 1278 to 1280 ft by August 31 based on the water supply forecast. If the July Final April through August forecast for The Dalles is equal to or greater than 92 Maf then Lake Roosevelt's draft limit will be 1,280 ft. If the forecast is less than 92 Maf, the draft limit will be 1,278 ft. These draft limits will be modified to implement the Lake Roosevelt Incremental Storage Release Project (see Section 6.5.6).

6.5.3 Banks Lake Summer Operation

Banks Lake will be allowed to draft to elevation 1,565 ft. by the end of August to provide more water for summer flow augmentation. Pumping to Banks Lake will be reduced and irrigation for the Columbia Basin Project will be met by drafting the reservoir up to 5 ft. from full (elevation 1,570 ft.) by the end of August.

6.5.4 Project Maintenance

Drum gate maintenance is planned to occur during April and May annually. The reservoir must be at or below elevation 1,255 ft to accomplish this work. Typically the flood control elevations during this time of year provide the required elevations and sufficient time to accomplish this work. However, during dry years flood control operations will not draft Lake Roosevelt low enough for a long enough period of time to perform necessary maintenance on the drum gates. Drum gate maintenance may be deferred in some dry water years; however drum gate maintenance must occur at a minimum one time in a 3-year period, two times in a 5-year period, and three times in a 7-year period. The drum gates are extremely important dam safety features and must be maintained at a satisfactory level. Drum gate maintenance was deferred in 2013 and is planned to be performed in 2014 if conditions allow.

6.5.5 Kokanee

Every attempt is made to refill Lake Roosevelt to 1,283 ft by September 30 (coordination with tribe will determine actual date) and maintain an elevation 1,283 to 1,285 ft or greater through the middle of November to aide in kokanee brood stock collection, improve spawning access to tributaries, and to increase retention time during a critical period for zooplankton production.

6.5.6 The Lake Roosevelt Incremental Storage Release Project

The Lake Roosevelt Incremental Storage Release Project is a component of the Columbia River Water Management Program (CRWMP) and is intended to improve municipal and industrial water supply, provide water to replace some ground water use in the Odessa Subarea, enhance stream flows in the Columbia River to benefit fish, and to provide water to interruptible water right holders in drought years. A Memorandum of Understanding (MOU) regarding the Lake Roosevelt Incremental Storage Release Project was signed by the State of Washington, Reclamation, and the Columbia Basin Irrigation Districts in December 2004. In December 2007, Water Resource Management Agreements in support of the incremental storage releases from Lake Roosevelt were signed by the State of Washington, the Confederated Tribes of the Colville Reservation, and the Spokane Tribe of Indians.

The Lake Roosevelt Incremental Storage Release Project will not reduce flows during the salmon flow objective period (April - August). This project provides that Lake Roosevelt will be drafted by an additional 1.0 ft in non-drought years and by about 1.8 ft in drought years by the end of August. A third of this water will go to in-stream flows. A more detailed description of this item is provided in Section 7.5 and in the FCRPS BA (Appendix B.2.1, pages 5-9).

6.5.7 Chum Flows

Grand Coulee may be used to help meet tailwater elevations below Bonneville Dam to support chum spawning and incubation. The chum operation is described in more detail in Section 7.3.

6.5.8 Priest Rapids Flow Objective

Grand Coulee will be operated to help meet the flow objective at Priest Rapids as coordinated with TMT.

6.5.9 Spill Operations

Forced spill at Grand Coulee, as the result of system flood control requirements, may result in high levels of TDG below Grand Coulee Dam. In order to control refill, meet downstream flood control flow objectives, and to limit downstream flooding, Grand Coulee has to spill any required discharge that is in excess of power plant capacity. If Lake Roosevelt is above elevation 1265.5 ft, Grand Coulee can spill water over the drum gates. However, if Lake Roosevelt is below elevation 1265.5 ft, then all spill must be through the outlet tubes which can result in high levels of TDG below the project. Another factor that can cause elevated TDG levels downstream of the dam include elevated TDG levels in the forebay because of high TDG levels coming into Lake Roosevelt from Canada. High TDG levels resulting from outlet tube spill and/or from high forebay TDG generally affects the river reach between Grand Coulee and Chief Joseph Dams. The spillway flow deflectors at Chief Joseph Dam are very efficient at stripping TDG and reducing TDG traveling further downstream. During forced spill events, Grand Coulee will be operated to minimize TDG production to the extent practicable. Involuntary spill at Grand Coulee Dam will be managed in coordination with Chief Joseph Dam. Grand Coulee will be operated to minimize TDG production during involuntary spill events.

6.6 Chief Joseph Dam

Chief Joseph will spill according to the spill priority list and TDG production estimates.

6.7 Priest Rapids Dam

6.7.1 Spring Operations

The spring flow objective at Priest Rapids Dam is 135 kcfs from April 10 to June 30.

6.7.2 Hanford Reach Protection Flows

Grant County PUD manages the discharge from Priest Rapids Dam at the following intervals during the year to provide protection for the spawning, incubation and rearing of fall Chinook salmon.

- October-November, reverse loading (low flows during daylight hours, spill excess at night) to reduce the formation of redds at high river elevations on Vernita Bar

- November-May, maintain "Critical Elevation" in the Hanford Reach (minimum flow restriction to prevent dewatering of redds)

- March-June, reduce daily flow fluctuations to decrease mortality to juvenile fall Chinook from stranding and entrapment

6.8 Dworshak Dam

6.8.1 Spring Operations

The spring flow operation is to maintain a 95% probability of refilling Dworshak while also maximizing the releases of stored water from Dworshak reservoir in order to maximize the chance of meeting the lower Snake spring flow objective and aid out-migrating salmon and steelhead. During the spring, the AAs will operate Dworshak Dam to improve the probability of meeting the flow and refill objectives, refilling by about June 30. The reservoir is deemed to be at "full" at elevations of 1599 ft or above. If both these objectives cannot be achieved, the TMT will make an in-season recommendation, weighing considerations unique to each particular year.

6.8.2 Flow Increase for Dworshak National Fish Hatchery Release

Project will release 4-6 kcfs from Dworshak, if necessary, in order to move juvenile fish into the mainstem Clearwater River during the spring hatchery releases. Note: not in NMFS 2010 Supplemental BiOp.

6.8.3 Summer Operations

Summer flow augmentation is provided from Dworshak to increase listed fish survival by improving water quality (moderating river temperatures), and increasing water velocities in the lower Snake River.

The summer temperature moderation and flow augmentation releases from Dworshak will be shaped with the intent to maintain water temperatures at the Lower Granite tailrace fixed monitoring site at or below 68º F. The Corps maintains and operates a water quality analysis model (CE-QUAL-W2), which is used in-season to forecast water temperatures and inform Dworshak release decisions. The model extends from Dworshak (Clearwater River) and Hells Canyon (Snake River) dams downstream through Ice Harbor Dam. Dworshak releases generally are sufficient to provide effective temperature management in the Lower Granite tailrace but can be overwhelmed by extremely hot weather or high discharges of warm water from Hells Canyon Dam.

During the summer (July and August) the AAs will operate Dworshak to help meet flow/temperature objectives in coordination with TMT. The AAs plan to draft to elevation 1535 ft by the end of August and elevation 1520 ft (80 ft from full) by the end of September unless modified per the Agreement between the U.S. and the Nez Perce Tribe (Dworshak Board Operational Plan) for water use in the Dworshak Reservoir. The extension of the draft limit into September assures that water will be released consistent with the NPT Agreement. Releases under the NPT Agreement will be determined in the

annual plan prepared by the COE, NMFS, Nez Perce, Idaho, and BPA and presented to TMT for implementation.

6.8.4 Fall/Winter Operations

After summer fish operations are completed (including the NPT Agreement operations in September), flows from Dworshak will be limited to minimum discharge (one small turbine operating above the cavitation zone and within 110% TDG, approximately 1,600 cfs) unless higher flows are required for flood control, emergencies, or other project uses. The purpose of these actions is to manage the filling of Dworshak reservoir while operating the project for multiple uses. Flows from Dworshak also may be maintained above minimum flow if Corps analysis determines there is flexibility to release a volume of water above minimum flow and still maintain a high reliability of meeting spring refill objectives. Opportunities to shift system flood control requirements from Brownlee and Dworshak to Grand Coulee will be considered periodically from January through April.

6.8.5 Project Maintenance

Dworshak Unit 2 (100 MW "small" unit) has excessive bearing wear as identified during the 2012 annual maintenance inspection. Due to the excessive bearing wear, the Corps may have to accelerate the overhaul of Unit 2, and could impact the Unit 3 head cover overhaul, or limit discharge from the project. The overhaul of unit 2 will be performed as soon as possible, but further information on completion of the required maintenance is not available at this time. The status of Dworshak unit maintenance will be coordinated at the TMT.

6.9 Brownlee Dam

Opportunities to shift system flood control requirements from Brownlee to Grand Coulee will be considered. See section 4.5 on Flood Control Shifts for more details. The shifts could occur from January through April. The reservoirs need to be back to their specific URC by April 30. The purpose of this shift is to allow Brownlee to be at higher elevations to increase the probability for increased spring flows in the Snake River. These shifts may be implemented after coordination with TMT.

6.10 Lower Granite Dam

6.10.1 Reservoir Operations

The AAs will operate the FCRPS run-of-river Snake River projects (Ice Harbor, Lower Monumental, Little Goose and Lower Granite projects) to minimize water travel time through the Snake River to aid in juvenile fish passage. These projects are operated for multiple purposes including fish and wildlife, irrigation, navigation, power, recreation, and limited flood control. Lower Snake River projects (Ice Harbor, Lower Monumental, Little Goose and Lower Granite projects) will be operated at minimum operating pool (MOP) with a 1-foot operating range from April 3 until small numbers of juvenile migrants are present (approximately September 1) unless adjusted to meet authorized project purposes, primarily navigation. Additionally, the Lower Snake River MOP operation reduces the reservoir cross-section and surface area, which is another tool to assist in moderating temperatures. The Corps conducts a bathymetric survey of the

federal navigation channel annually to assure a 14 foot depth is maintained in the federal navigation channel. The surveys conducted in 2011 demonstrated impairment of the federal navigation channel in the Lower Granite pool. In accordance with the RPA, until maintenance activities are conducted to provide adequate channel depths for safe navigation, the Corps supports adopting the variable MOP operation used during the 2013 season and will coordinate this operation with the TMT.

6.10.2 Turbine Operations

To enhance juvenile passage survival, turbines at Lower Granite will be operated within 1% of peak efficiency during the juvenile and adult migration seasons (April 1 through October 31; see appendix C of the 2014 FPP).

6.10.3 Spring Flow Objectives

The April final runoff volume forecast at Lower Granite Dam for April to July determines the spring flow objective at Lower Granite Dam. When the forecast is less than 16 million acre-feet (Maf), the flow objective will be 85 kcfs. If the forecast is between 16 and 20 Maf, the flow objective will be linearly interpolated between 85 and 100 kcfs. If the forecast is greater than 20 Maf, the flow objective will be 100 kcfs. The flow objective is measured as the season average of the discharge at Lower Granite between the planning dates of April 3 to June 20. These flow objectives are provided as a biological guideline and will likely not be met throughout the entire migration season in all years because the flow in the Snake River primarily depends on the volume and shape of the natural runoff and augmentation volumes available are small in comparison to the objective. Flow in the Snake River during this period is supported by drafting Dworshak Dam and flow augmentation water from the Upper Snake River. Dworshak storage is released from the April 10 elevation to the April 30 flood control elevation at a rate that does not exceed the State TDG water quality standards (110 % TDG) at the project.

6.10.4 Summer Flow Objectives

The June final runoff volume forecast at Lower Granite Dam for April to July determines the summer flow objective at Lower Granite Dam. When the forecast is less than 16 Maf, the flow objective will be 50 kcfs. If the forecast is between 16 and 28 Maf, the flow objective will be linearly interpolated between 50 and 55 kcfs. If the forecast is greater than 28 Maf, the flow objective will be 55 kcfs. The summer flow objective is measured as the season average of the discharge at Lower Granite between the planning dates of June 21 to August 31. The summer flow in the Snake River is augmented by the release of stored water upstream of Lower Granite Dam. The Summer flow objectives are provided as a biological guideline and will likely not be met throughout the entire migration season in all years because there is a limited amount of stored water available for flow augmentation and the natural shape of the runoff generally produces decreasing streamflows from July to the end of August.

6.10.5 Spill Operations

Spill operations for fish passage are described in appendix E of the 2014 FPP.

6.10.6 Juvenile Fish Transport Operations

Transport operations are described in appendices B and E of the 2014 FPP.

6.11 Little Goose Dam

6.11.1 Reservoir Operations

The AAs will operate the FCRPS run-of-river Snake River projects (Ice Harbor, Lower Monumental, Little Goose and Lower Granite projects) to minimize water travel time through the Snake River to aid in juvenile fish passage. These projects are operated for multiple purposes including fish and wildlife, irrigation, navigation, power, recreation, and limited flood control. Lower Snake River projects (Ice Harbor, Lower Monumental, Little Goose and Lower Granite projects) will be operated at minimum operating pool (MOP) with a 1-foot operating range from April 3 until small numbers of juvenile migrants are present (approximately September 1) unless adjusted to meet authorized project purposes, primarily navigation. Additionally, the Lower Snake River MOP operation reduces the reservoir cross-section and surface area, which is another tool to assist in moderating temperatures. The AAs will coordinate changes in MOP with the TMT.

6.11.2 Turbine Operations

To enhance juvenile passage survival, turbines at Little Goose will be operated within 1% of peak efficiency during the juvenile and adult migration season of April 1 through October 31 (see Appendix C of the 2014 FPP).

6.11.3 Spill Operations

Spill operations for fish passage are described in appendix E of the 2014 FPP.

6.11.4 Juvenile Fish Transport Operations

Transport operations are described in appendices B and E of the 2014 FPP.

6.11.5 Waterfowl Hunting Enhancement

In order to enhance waterfowl hunting, the Little Goose pool is held constant several times a week from October to January.

6.12 Lower Monumental Dam

6.12.1 Reservoir Operations

The AAs will operate the FCRPS run-of-river Snake River projects (Ice Harbor, Lower Monumental, Little Goose and Lower Granite projects) to minimize water travel time through the Snake River to aid in juvenile fish passage. These projects are operated for multiple purposes including fish and wildlife, irrigation, navigation, power, recreation, and limited flood control. Lower Snake River projects (Ice Harbor, Lower Monumental, Little Goose and Lower Granite projects) will be operated at minimum operating pool (MOP) with a 1-foot operating range from April 3 until small numbers of juvenile migrants are present (approximately September 1) unless adjusted to meet authorized

project purposes, primarily navigation. Additionally, the Lower Snake River MOP operation reduces the reservoir cross-section and surface area, which is another tool to assist in moderating temperatures. The AAs will coordinate changes in MOP with the TMT.

6.12.2 Turbine Operations

To enhance juvenile passage survival, turbines at Lower Monumental will be operated within 1% of peak efficiency during the juvenile and adult migration season of April 1 through October 31 (see Appendix C of the 2014 FPP).

6.12.3 Spill Operations

Spill operations for fish passage are defined in appendix E of the 2014 FPP.

6.12.4 Juvenile Fish Transport Operations

Transport operations are defined in appendices B and E of the 2014 FPP.

6.13 Ice Harbor Dam

6.13.1 Reservoir Operations

The AAs will operate the FCRPS run-of-river Snake River projects (Ice Harbor, Lower Monumental, Little Goose and Lower Granite projects) to minimize water travel time through the Snake River to aid in juvenile fish passage. These projects are operated for multiple purposes including fish and wildlife, irrigation, navigation, power, recreation, and limited flood control. Lower Snake River projects (Ice Harbor, Lower Monumental, Little Goose and Lower Granite projects) will be operated at minimum operating pool (MOP) with a 1-foot operating range from April 3 until small numbers of juvenile migrants are present (approximately September 1) unless adjusted to meet authorized project purposes, primarily navigation. Additionally, the Lower Snake River MOP operation reduces the reservoir cross-section and surface area, which is another tool to assist in moderating temperatures. The AAs will coordinate changes in MOP with the TMT.

6.13.2 Turbine Operations

To enhance juvenile passage survival, turbines at Ice Harbor will be operated within 1% of peak efficiency during the juvenile and adult migration season of April 1 through October 31 (see Appendix C of the 2014 FPP).

6.13.3 Spill Operations

Spill operations for fish passage are defined in appendix E of the 2014 FPP.

6.13.4 Waterfowl Hunting Enhancement

In order to enhance waterfowl hunting, the Ice Harbor pool is held constant several times a week from October to January.

6.14 McNary Dam

6.14.1 Turbine Operations

To enhance juvenile passage survival, turbines at all of the Lower Columbia River projects will be operated within 1% of peak efficiency during the juvenile and adult migration season of April 1 through October 31 (see Appendix C of the 2014 FPP).

6.14.2 Spring Flow Objectives

The spring flow objective at McNary Dam is set according to the April final runoff volume forecast at The Dalles Dam for April to August. When the forecast is less than 80 Maf the flow objective will be 220 kcfs. If the forecast is between 80 Maf and 92 Maf the flow objective will be linearly interpolated between 220 kcfs and 260 kcfs. If the forecast is greater than 92 Maf the flow objective will be 260 kcfs. The spring flow objective is measured as the season average discharge at McNary Dam between the planning dates of April 10 to June 30. The flow objective is provided as a biological guideline and will not be met throughout the migration season in all years due to variability in volume and shape of the natural runoff.

6.14.3 Summer Flow Objectives

The summer flow objective at McNary Dam is 200 kcfs. The summer flow objective is measured as the season average of the discharge at McNary Dam between the planning dates of July 1 to August 31. The flow in the summer at McNary is augmented by the release of stored water upstream of McNary Dam. The summer flow objective cannot be met in all years as there is a limited amount of stored water available for flow augmentation and the natural shape of the runoff generally produces decreasing streamflows from July to the end of August..

6.14.4 Weekend Flows

Weekend flows are often lower than weekday flows due to less electrical load demand in the region. During the spring and summer migration period (April through August), the AAs will strive to maintain McNary flows during the weekend at a level which is at least 80% of the previous weekday average.

6.14.5 Spill Operations

Spill operations for fish passage are defined in appendix E of the 2014 FPP.

6.14.6 Waterfowl Nesting

To improve waterfowl nesting conditions in the McNary pool between March and May each year, the pool is operated in the top 1 ft of the pool range for several hours every 4 days.

6.14.7 Waterfowl Hunting Enhancement

In order to enhance Waterfowl hunting, the McNary pool is held constant several times a week from October to January.

6.14.8 Juvenile Fish Transport Operations

The Corps does not plan to continue transport activities from McNary Dam in 2014-2018. In 2012 the juvenile bypass outfall at McNary Dam was relocated to reduce predation on bypassed fish. Testing in 2012 showed higher survival of bypassed summer migrants than had been observed prior to the outfall relocation. Subsequently, in 2013, NOAA and other State and tribal fish managers submitted a System Operations Request (SOR) requesting that summer migrants that were collected in the juvenile bypass system be allowed to migrate in-river, rather than be transported as in previous years. The rationale being that the survival of bypassed fish had improved with the outfall relocation and that the benefit to summer migrants from transport did not warrant the continuation of summer transport from McNary Dam. The Corps agreed and did not transport from McNary in 2013.

6.15 John Day Dam

6.15.1 Reservoir Operations

John Day pool will operate within a 1.5 ft range of the minimum level that provides irrigation pumping (262.5-264.0 ft) from April 10 to September 30. The purpose of this action is to provide a smaller reservoir cross section to reduce juvenile salmon travel time.

6.15.2 Turbine Operations

To enhance juvenile passage survival, turbines at all of the Lower Columbia River projects will be operated within 1% of peak efficiency during the juvenile and adult migration season of April 1 through October 31 (see Appendix C of the 2014 FPP).

6.15.3 Spill Operations

Spill operations for fish passage are defined in appendix E of the 2014 FPP.

6.15.4 Tribal Fishing

To accommodate tribal fishing, the John Day pool may operate within a 1.5 ft operation range during tribal fishing seasons.

6.16 The Dalles Dam

6.16.1 Turbine Operations

To enhance juvenile passage survival, turbines at all of the Lower Columbia River projects will be operated within 1% of peak efficiency during the juvenile and adult migration season of April 1 through October 31 (see Appendix C of the 2014 FPP).

6.16.2 Spill Operations

Spill operations for fish passage are defined in appendix E of the 2014 FPP.

6.16.3 Tribal Fishing

To accommodate tribal fishing, The Dalles pool may operate within a 1.5 ft operation range during tribal fishing seasons.

6.17 Bonneville Dam

6.17.1 Turbine Operations

To enhance juvenile passage survival, turbines at all the Lower Columbia projects will be operated within 1% of peak efficiency during the juvenile and adult migration seasons of April 1 through October 31 (see Appendix C of the 2014 FPP). Modified turbine operations may be considered through coordination with the TMT.

6.17.2 Spill Operations

Spill operations for fish passage are defined in appendix E of the 2014 FPP.

6.17.3 Chum Operation

See section 7.3 for a detailed discussion on the chum operation.

6.17.4 Tribal Fishing

To accommodate tribal fishing, The Bonneville pool may operate within a 1.5 ft operation range during tribal fishing seasons.

6.17.5 Spring Creek Hatchery Release

Bonneville Dam turbine operations (i.e., reduced turbine loading) for the April and May releases of tule fall Chinook from the Spring Creek National Fish Hatchery will be determined at a later date through discussions with TMT.

7 Specific Operations

7.1 Canadian Storage for Flow Augmentation

7.1.1 Columbia River Treaty (Treaty) Storage

The U.S. Section of the Columbia River Treaty Operating Committee will seek a Non-Power Uses Agreement with Canada that will allow storage of 1 Maf of water in Canadian Treaty space for release during the migration season. These supplemental operating agreements must be mutually beneficial and typically provide non-power benefits for fisheries downstream of Arrow for whitefish spawning and trout protection as described is Section 6.1.

Annual agreements between the U.S. and Canadian entities to provide flow augmentation storage in Canada for U.S. fisheries will include provisions that allow flexibility for the release of any stored water to provide U.S. fisheries benefits to the extent possible by:

- Providing the greatest flexibility possible for releasing water to benefit U.S. fisheries April through July;

- Giving preference to meeting April 10 elevation objectives or achieving refill at Grand Coulee Dam over flow augmentation storage in Canada in lower water supply conditions; and

- Releasing flow augmentation storage to avoid causing damaging flow or excessive TDG in the U.S. or Canada.

BPA and the Corps will continue to coordinate with Federal agencies, States and Tribes on Treaty operations and operating plans.

7.1.2 Non-Treaty Storage (NTS) Long Term Agreement

BPA and BC Hydro executed a Long Term Non-Treaty Storage (NTS) agreement effective 10 April 2012 through 15 September 2024. The U.S. and Canadian Entities are satisfied that mutual benefits can be achieved without adversely affecting the operation of Treaty storage in Canadian projects in accordance with the Columbia River Treaty or delivery of the Canadian Entitlement. This new agreement will provide both power and non-power benefits for BC Hydro, BPA, and Canadian and U.S. interests, including the opportunity to provide benefits for ESA-listed fish. Under the terms of this agreement, 5 Maf of NTS space is available between Active (3 Maf) and Recallable (2 Maf) Accounts which are shared equally between the two Entities. Water transactions are typically made by mutual agreement subject to limitations described in the contract. BPA has firm release rights for up to 0.5 Maf of water in the driest water conditions, if not exercised in the previous year.

7.1.3 Non-Treaty Coordination with Federal Agencies, States, and Tribes

BPA will continue to coordinate with Federal agencies, States, and Tribes on non-Treaty seasonal agreements and operations during the fish passage season.

7.2 Upper Snake River Reservoir Operation for Flow Augmentation

Reclamation will attempt to provide 487 Kaf annually of flow augmentation from the Reclamation projects in the Upper Snake River basin consistent with its Proposed Action as described in the November 2007 Biological Assessment for O&M of its projects in the Snake River basin above Brownlee Reservoir. Reclamation's flow augmentation program is dependent on willing sellers and must be consistent with Idaho State law.

7.3 Bonneville Chum Operations

The Columbia River chum Evolutionarily Significant Unit (ESU) includes all naturally spawning populations and three hatchery programs of chum salmon in the Columbia River and its tributaries in Washington and Oregon. The hatchery programs include Grays River and Washougal/Duncan in Washington and Big Creek in Oregon. There are two major population groups (with several smaller groups throughout the basin): Grays

River basin and populations from the I-205 Bridge upstream to Bonneville Dam. The Ives/Pierce Islands is one of ten spawning areas upstream of the I-205 Bridge and is the focus of the Bonneville chum operations described below.

The AAs plan to operate the FCRPS to provide flows to support chum salmon spawning, incubation and egress from the Ives/Pierce Islands spawning areas. The Ives/Pierce Island complex represents a small but important spawning location for the segment of the population that spawns in the mainstem Columbia River above I-205. Listed Lower Columbia River Tule fall Chinook salmon and non-listed up-river bright fall Chinook salmon are also known to spawn in the Ives/Pierce Islands area. The NMFS 2010 Supplemental BiOp recognizes that access to spawning habitat in the Ives/Pierce area is primarily a function of the Bonneville Dam tailwater. When the Bonneville Dam tailwater elevation is greater than 11.2 ft above mean sea level (msl) salmon begin to have access to the Ives/Pierce Islands spawning area. Managing the water surface elevation with the operations through Bonneville Dam has been the management measure used to maintain this spawning area. Providing spawning access to Hamilton, Hardy and Duncan creeks is similarly a function of sufficient tailwater elevation but must be coupled with sufficient fall rain events to recharge the aquifer and water up the spawning areas within t the creeks.

Observations over recent years (2011-13) have further refined the zones of available spawning habitat in the Ives/Pierce Islands spawning area. Adult chum salmon have access to two distinct zones of available habitat within specific Bonneville Dam tailwater elevation ranges. The first zone of available habitat is between tailwater elevations 11.2 and 12.0 ft. The second zone is above elevations 13.0 ft. Both zones of habitat are available at water surface elevations exceeding 13.5 ft. Since 2000, when the regulation for chum began, there has been no protection levels set at more than 14 feet. It is not anticipated that one will ever be set above 14 feet due to the impacts to refill.

These impacts were addressed in the NMFS 2010 Supplemental BiOp which outlined , chum salmon spawning operations as having lower priority than spring flow objectives or summer refill. If all of the BiOp objectives cannot be met, the AAs will work with NOAA Fisheries and the regional salmon managers to identify operations that would best benefit salmon while maintaining other fish protection measures.

There are two phases of the Ives/Pierce area chum operations: spawning (typically from early November through late December) and incubation and egress (typically from late December through early April).

7.3.1 Spawning Phase

In the first week of November (or when fish arrive), and generally when fall rains begin, Bonneville Dam will start operating to provide a tailwater elevation (TWE) range of 11.3-12.0 ft until spawning ends or December 31. The official project TWE gauge is located 0.9 mile downstream of Bonneville Dam's powerhouse 1 on the Oregon shore, 50 ft upstream of Tanner Creek at river mile 144.5. Generally, the range of outflow from Bonneville Dam required to maintain this TWE can vary from less than the project

minimum discharge (80 kcfs) up to 135 kcfs. This range demonstrates the profound effect of natural conditions downstream of Bonneville Dam on the water elevation. Tides, wind, wave and unregulated inflows to the Columbia River all have an influence on the ability to regulate the TWE below Bonneville Dam with the outflow from Bonneville Dam.

In addition to the uncertainty and variability of downstream conditions that affect TWE at Bonneville Dam, there are many upstream variables as well. Generally, the flow at Bonneville Dam is augmented by storage releases from Grand Coulee Dam which takes approximately 24 hours to arrive at Bonneville Dam and must pass through several non-federal dams that can alter the shape and timing of the flow. Further, the volume of unregulated flow into the Columbia River upstream of Bonneville Dam is difficult to predict but is critical in meeting the spawning elevations. The ability to operate Bonneville Dam to a particular TWE constraint is contingent on the ability of the hydrosystem to forecast and manage all of these variables and conditions. Reservoir operations upstream of Bonneville may provide additional water to help support the chum operation.

The hydrosystem is often unable to maintain the TWE within the range of 11.3-12.0 ft during daylight hours throughout the entire spawning period. Significant seasonal rain events commonly require that the operation must be modified in order to manage the additional water. Research to assess the impacts of higher flows (day and night) on chum redd development indicated that increased flows nightly up to 175 kcfs delayed spawning by temporarily displacing fish until flows decreased to base levels, but did not force fish to abandon their redds and search for new locations (Tiffan et al. 2009).

7.3.2 Chum Spawning Operational Steps

The spawning operation should utilize the considerations below to minimize the establishment of high elevation redds. Managing the spawning operation to minimize the required protection level increases the probability that the protection level can be maintained through egress in the early spring.

- Early season forecasts can be used by TMT to determine a level of caution when choosing the spawning elevations to provide below Bonneville. A general apprehension to provide tailwater elevations above 11.5 ft is prudent in most years. Fall precipitation can lead to chum spawning at higher elevations than intended. It may be difficult to commit to providing those elevations without a solid water supply forecast.

- If the water supply forecast indicates it is unlikely that the high elevation redds could be maintained through emergence consider managing mainstem flows to discourage redds from being established in the Ives Island area. Shaping flows in a manner that would discourage redd development above a particular elevation is a potential tool to keep redds below high risk elevations. Reverse load factoring with nighttime discharges more than 75 kcfs over the daytime discharge level has been used as a measure to avoid the placement of high elevation redds.

Steps 1-7 below describes the typical transition from controlled operation to an uncontrolled operation when conditions are such that the daytime TWE range cannot be maintained. The steps are reversed if it is possible to return to a controlled operation and high elevation redds have not been established.

1. Maintain a minimum Bonneville TWE of 11.3 ft during all hours (24 hours per day).

2. Daily during the hours of 0600-1700, maintain the Bonneville TWE in the range of 11.3-12.0 ft.

3. As needed to pass water in excess of what is necessary to meet steps 1 and 2, increase the TWE up to 18.5 ft anytime between the hours of 1700-0600. The preference is to concentrate the highest TWE around midnight without exceeding 16.5 ft.

4. If step 3 is insufficient to pass excess flow, increase the TWE up to 12.5 ft anytime between the hours of 0600-1700.

5. If steps 3 and 4 are insufficient to pass excess flow, discuss options with TMT for passing additional water during daytime hours. Discussions typically include higher TWE, larger operating range (1-ft vs. 4-ft), daytime spikes in flow, multi-day increases in TWE, etc. Generally, the options will depend on weather and flow conditions and the number of actively spawning fish present.

There are several conditions that typically preclude the chum spawning operation for multiple days. These events are usually forecasted well in advance, and an appropriate course of action is coordinated through the TMT. Below are some examples of the conditions where the chum operation cannot be managed within the above constraints:

6. Conditions downstream of Bonneville (e.g., high tides, high inflows) result in high TWE regardless of project discharge. Even at minimum discharge, these conditions could raise the TWE above the target range.

7. Heavy precipitation events increase inflow to the Columbia River both upstream and downstream of Bonneville Dam. The combination of low required flow at Bonneville, unregulated inflows to the Columbia River upstream of Bonneville, and the lack of storage capacity in the lower Columbia River, result in little to no control over the resulting TWE below Bonneville Dam.

7.3.3 Incubation and Egress

Washington Department of Fish and Wildlife (WDFW) will inform TMT when they establish chum spawning is complete at the Ives/Pierce Island area; this usually occurs in late December but will not extend past December 31. Following the completion of spawning, the operation is shifted to provide a tailwater elevation (to be determined by TMT) equal to or greater than the elevation of the highest redds that will be protected. This elevation is typically around 11.3 ft -11.5 ft msl during normal water years. Redds established due to conditions beyond the control of the action agency may not be protected. This operation continues until the completion of emergence and egress which

can extend to the start of the spring flow management season around April 10. At that time, spring flow augmentation volumes generally provide sufficient flows to maintain the protection elevations necessary. If the emergence period extends beyond April 10 and the decision is made to maintain the tailwater, TMT will need to discuss the impacts of TDG associated with spill and/or operation of the corner collector for fish passage at Bonneville Dam and its potential for negatively affecting fry in the gravel. Bonneville typically starts its spring spill around April 10, but a delay in the start of spill may be needed. The chum protection level decision will be revisited at least monthly through the TMT process to assure it is consistent with the need to provide spring flows for listed Columbia and Snake River stocks.

7.3.4 Considerations for Dewatering Chum Redds

While a conservative approach to managing tailwater elevations during spawning reduces the risk of dewatering redds, it does not eliminate dewatering as a possibility. The conditions in each year vary too dramatically to allow for the development of set criteria for whether or not to dewater redds, therefore the basis for a dewatering decision depends greatly on in-season conditions so are best made in TMT. Factors that should be considered in making a dewatering decision include:

- The number of redds which would be affected by the decision and the percentage they represent of:
    - the overall Ives/Pierce Islands complex
    - the total population spawning above the I-205 Bridge
    - the entire ESU
- Emergence timing based on temperature units
- Status of the FCRPS reservoir elevations
- Expected benefit to reservoir levels and river operations which would be provided by the dewatering decision
- Precipitation and runoff forecasts
- Expected river operations due to power market environment
- Status of the upriver spring Chinook, steelhead and sockeye listed stocks
- Existence and status of a brood contingency plan

7.3.5 Dewatering and Alternative Redd Maintenance Options

If water supply conditions indicate that it is not possible to maintain the minimumtailwater elevation established in December for Bonneville Dam, flows will be reduced to the next occupied habitat band that can be maintained. If chum redds are dewatered as a result of diminished water supply conditions a “rewetting operation” once a day for ~1 hour has been utilized as an interim measure to provide some level of protection in the event that water supply conditions improve sufficiently to restore the full protection level.

If protection for all redds has been suspended TMT should consider implementing a water release strategy that would allow chum to migrate from habitat in Hamilton, Hardy and Duncan creeks if they are isolated from the mainstem Columbia. Impacts to refill will be looked at and the exact details of a release to establish connectivity will be set through coordination in TMT.

7.4 Description of Variable Draft Limits

Variable Draft Limits (VDLs) are period-by-period draft limits at Grand Coulee and Hungry Horse from January-March 31. These are planned limits to Firm Energy Load Carrying Capability (FELCC) generation to protect the ability to refill Grand Coulee and Hungry Horse to their April 10 elevation objectives with an 85% and 75% confidence respectively.

The VDLs are based on: (1) The April 10 elevation objective which is calculated from the forecasted March 31 and April 15 flood control elevations (2) statistical inflow volumes (85% exceedance for Grand Coulee and 75% exceedance for Hungry Horse), (3) actual downstream and project flow objectives, to meet at-site and Vernita Bar requirements, and (4) refill requirements at upstream projects and the flow forecasts which drive such upstream requirements.

VDLs are calculated monthly from January through March after updated volume forecasts and flood control elevations have been issued. The VDL at the end of a period (e.g., January 31) is computed as the carryover storage needed to meet the next periods' storage and outflow requirements with the goal of refilling to the elevation objective on April 10. For example, Grand Coulee's January VDL is computed as:

- The expected April 10 Flood Control elevation based on January forecast.
- Minus February 1-April 10 inflow volume of 2,424 ksfd (85% statistical inflow volume). This volume data is reduced by Banks Lake pumping.
- Plus February 1 to April 10 minimum discharge requirement for Vernita Bar.
- Plus expected and realistic upstream refill requirement in February 1 to April 10 while observing the applicable upstream reservoir elevation limits.

The VDL is not a mandatory draft elevation and operation above the VDL is acceptable as long as it is not a higher elevation than flood control curve, FELCC is already being met, and at-site and downstream flow objectives are also being served. Also, VDLs at Grand Coulee are further limited by VDL lower limits of 1260 ft in January, 1,250 ft in February and 1,240 ft in March.

7.5 The Lake Roosevelt Incremental Storage Release Project of the Washington State Department of Ecology, Columbia River Water Management Program.

7.5.1 Lake Roosevelt Incremental Storage Releases

The Lake Roosevelt Incremental Storage Releases portion of Washington State's Columbia River Water Management Program (CRWMP) result in additional water withdrawals from Lake Roosevelt for both out-of-stream use and instream flows. The Incremental draft results in a release of 82,500 acre-feet in most years, or about 1.0 ft of draft at Lake Roosevelt. For every two acre-feet of water put to out-of-stream use, one acre-foot of water will go to instream flows ("*no net loss plus one-third"*). In years when the March 1 final forecast of April through September runoff at The Dalles is less than 60 million acre-feet, an additional draft of 50,000 acre-feet for interruptible water users and instream flow will occur, for a total draft of 132,500 acre-feet or about 1.8 ft of draft

7.5.2 Releases Framework and Accounting for Lake Roosevelt Incremental Draft

The only way to demonstrate that the water came from Lake Roosevelt and not stream flows during the juvenile fish migration period is to draft Lake Roosevelt. Based on RPA 4 in the 2008 FCRPS BiOp, there are two elevation objectives during the juvenile fish migration period: (1) end of June (early July) refill, and (2) August 31 draft, the latter of which is forecast based. When water is released in the April-through-June spring period from the Lake Roosevelt incremental draft water account, then Lake Roosevelt would need to miss refill by that amount. Lake Roosevelt would draft below the end of August draft limit by the amount released in both the spring and July-August summer flow augmentation periods.

7.5.3 2014 Operations

The amount and timing of water to be released in 2014 will not be determined until the March final WSF for April – September at The Dalles is completed. Estimates of 2014 incremental storage releases will be included in the 2014 seasonal update.

7.6 Public Coordination

Actions in the WMP will be coordinated with NOAA Fisheries, USFWS, and the states and tribes in preseason planning and in-season management of flow and spill operations. This coordination will occur in the TMT process and will utilize the best available science. At all appropriate decision points, the AAs will routinely seek timely input and concurrence from the USFWS on all matters affecting USFWS listed fish through the Columbia River Treaty, IJC, and all other decision making processes involving trans-boundary waters in the Columbia River basin. This will include notification of all meetings and decision points and provision of opportunities to advise the AAs during meetings and in writing, as appropriate.

8 Water Quality

8.1 Water Quality Plans

The Corps has completed a comprehensive Water Quality Plan (WQP) outlining the physical and operational changes that could be used to improve the overall water quality in the mainstem waters of the Clearwater, Snake, and Columbia rivers. The plan was updated in January 2009 and may be found on the following website:

http://www.nwd-wc.usace.army.mil/tmt/wq/studies/wq_plan/wq200814.pdf

The WQP is currently being revised and the Corps anticipates having an updated WQP completed in 2014.

8.1.1 Total Dissolved Gas Monitoring

Exposure to high levels of TDG over long periods of time can be harmful or lethal to fish. Environmental monitoring in the waters impacted by operations at the dams is necessary where voluntary spill is employed for juvenile fish passage to ensure that gas levels do not exceed TDG thresholds established in NMFS BiOps, and applicable state water quality criteria and waivers. The Corps TDG monitoring program is described in the December 2008 TDG Monitoring Plan of Action, which included data quality criteria for fixed monitoring stations, goals related to the accuracy, precision, and completeness of data at each fixed monitoring station and the methodologies that are used in the attempt to achieve those goals, calibration protocols (data quality control), data review and corrections (data quality assurance), and completeness of data. The Plan of Action can be found on the following website:

http://www.nwd-wc.usace.army.mil/tmt/wqnew/tdg_monitoring/2010-14.pdf

The Reservoir Control Center is responsible for monitoring the TDG and water temperature conditions in waters impacted by Corps projects on the Columbia and Snake rivers. To assess water quality conditions in these waters, the Corps operates TDG and temperature monitors in the forebays and the tailwaters of the lower Columbia River/lower Snake River dams, and other selected river sites. The Corps prepares a Total Dissolved Gas Management Plan (TDG Management Plan) each year (see Appendix 4). This TDG Management Plan provides information addressing voluntary and involuntary spill, use of the spill priority list, the process for setting spill caps, TDG management policies, and the TDG monitoring program.

9 Dry Water Year Operations

Flow management during dry years is often critical to maintaining and improving habitat conditions for ESA-listed species. A dry water year is defined as the lowest 20th percentile years based on the NWRFC's averages for their statistical period of record (currently 1981-2010) using the May final water supply forecast for the April to August period as measured at The Dalles (72.2 Maf). The AAs will complete the following activities to further the continuing efforts to address the dry flow years:

- Within the defined "buckets" of available water (reservoir draft limits identified in Reasonable and Prudent Alternative (RPA) Action 4), flexibility will be exercised in a dry water year to distribute available water across the expected migration season to optimize biological benefits and anadromous fish survival. The AAs will coordinate use of this flexibility in the TMT.
- In dry water years, operating plans developed under the Treaty may result in Treaty reservoirs being operated below their normal refill levels in the late spring and summer, therefore, increasing flows during that period relative to a standard refill operation.
- Annual agreements between the U.S. and Canadian entities to provide flow augmentation storage in Canada for U.S. fisheries needs will include provisions that allow flexibility for the release of any stored water to provide U.S. fisheries benefits in dry water years, to the extent possible.
- Under the long term Non-Treaty Storage Agreement the U.S. has firm release rights for up to 0.5 Maf of water during the spring of the driest 20th percentile of years, if not exercised in the previous year.
- BPA will implement, as appropriate, its Guide to Tools and Principles for a Dry Year Strategy to reduce the effect energy requirements may pose to fish operations and other project purposes.

10 FCRPS Hydrosystem Performance Standards

The AAs will operate the FCRPS hydrosystem as described in this 2014 WMP, in an adaptive management framework, to make progress towards meeting biological performance goals. Those goals are contained in the 2008 NOAA Fisheries Biological Opinion as supplemented in the 2010 Supplemental BiOp. Adult and juvenile fish survival estimates from research, monitoring, and evaluation studies will be considered in annual planning as future plans are developed.

11 Conclusion

The 2014 WMP has been coordinated with and reviewed by the TMT. Seasonal updates will be developed as described in the introduction to this plan. Additionally, operations may be adjusted in-season based on recommendations from the TMT.