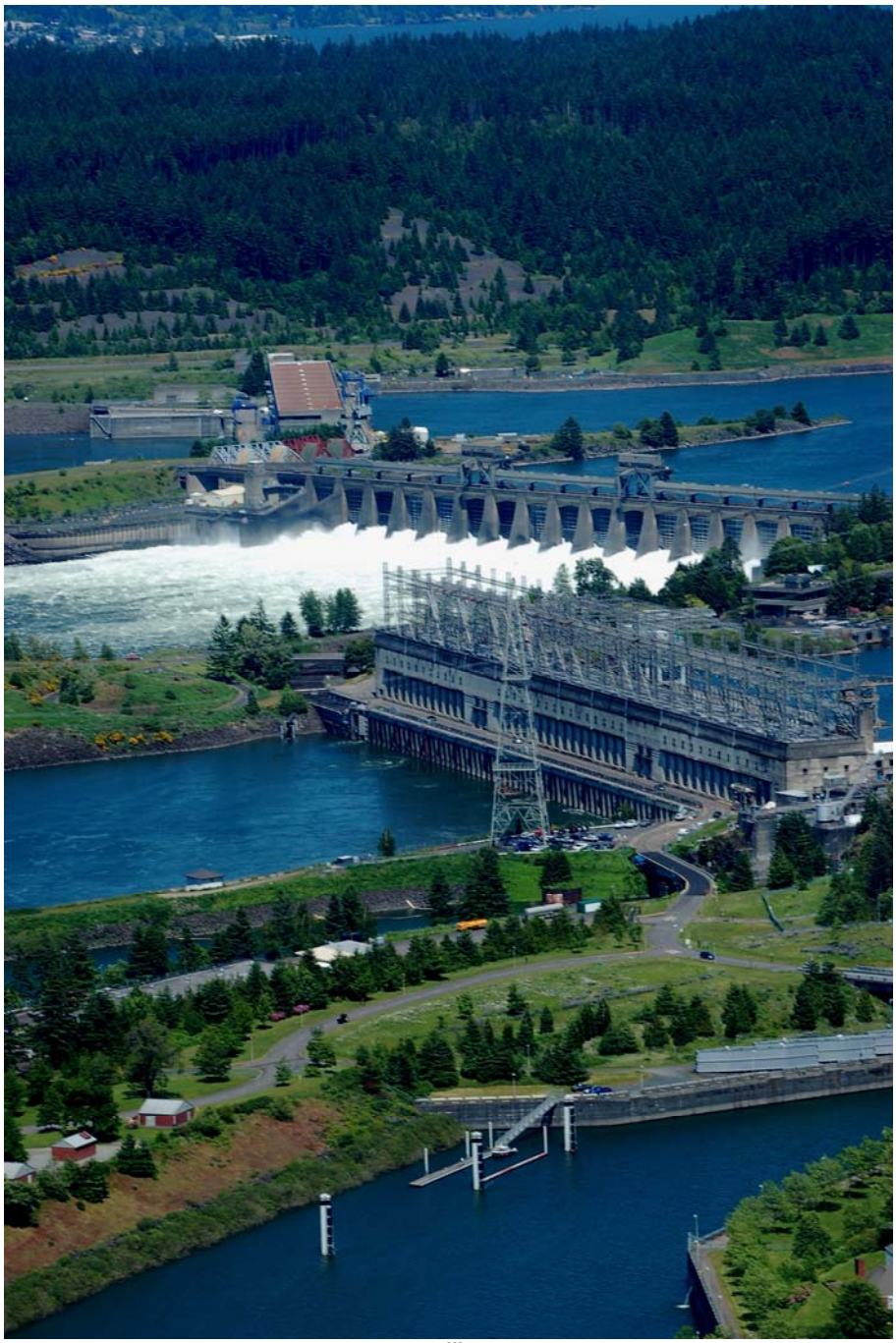
2010 WATER MANAGEMENT PLAN



Bonneville Dam
(Photo courtesy of Dennis Schwartz)

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

Table of Contents

1. Table of Contents

2010 Water Management Plan

2. 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), consult on the effects of the operation of 14 Federal multi purpose hydropower projects in the Federal Columbia River Power System (FCRPS)[1] on listed species[2] with the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS).

The purpose of the Water Management Plan (WMP) is to describe how the AAs plan to implement specific operations identified in the NMFS 2008 Biological Opinion (BiOp) on the operation of the FCRPS during the current water year (October 2009 – September 2010). The AAs are the final authorities on the content of 2010 WMP, although review, comment, and recommendations are solicited from the Technical Management Team (TMT) and NMFS for consideration during preparation of the WMP. Seasonal operation summary updates to the WMP (spring/summer & fall/winter updates) will be prepared by the AAs and distributed to the region through TMT. The system operations contained herein may be adjusted according to water year conditions based on recommendations from the TMT and pending review and coordination with NMFS.

3. Consultation and Legal

3.1. *NMFS's 2008 FCRPS BiOp*

The current WMP reflects provisions contained in the NMFS 2008 FCRPS BiOp (NMFS BiOp) issued May 5th, 2008, and titled "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))." The Corps prepared a Record of Consultation and Statement of Decision (ROCASOD) relative to the NMFS BiOp 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 BiOp, the Upper Snake BiOp, the Corps' ROCASOD, and Reclamation's Decision Document can be found at: http://www.nwr.noaa.gov/Salmon-Hydropower/Columbia-Snake-Basin/Final-BOs.cfm

[1] The FCRPS comprises 14 Federal multipurpose hydropower projects. The 12 projects operated and maintained by the Corps are: Bonneville, The Dalles, John Day, McNary, Chief Joseph, Albeni Falls, Libby, Ice Harbor, Lower Monumental, Little Goose, Lower Granite and Dworshak dams. Reclamation operates and maintains the following FCRPS projects: Hungry Horse Project and the Columbia Basin Project, which includes Grand Coulee Dam.

[2] Species listed as endangered or threatened under the Endangered Species Act (ESA).

3.2. *USFWS's 2000 FCRPS BiOp, the 2006 Libby Dam BiOp, and; the Corps Upper Columbia Environmental Impact Statement*

The USFWS 2000 FCRPS BiOp, "Effects to Listed Species from Operation of the Federal Columbia River Power System" is operative for all the FCRPS projects except for Libby Dam and can be found at: http://www.fws.gov/pacific/finalbiop/BiOp.html.

In February 2006, the USFWS issued a BiOp which amended and supplemented the USFWS 2000 BiOp with respect to the effects of the operations of Libby Dam on the Kootenai sturgeon and the bull trout in the Kootenai River. That document can be found at: http://www.fws.gov/easternwashington/documents/Final%20Libby%20Dam%20BiOp%202-18-06lr3.pdf. That BiOp was the subject of litigation in the U.S. District of Montana (*Center for Biological Diversity and State of Montana et al. v. U.S. Fish and Wildlife Service and Corps*). In September 2008, a settlement agreement was executed and the Court dismissed the case.

The 2006 BiOp recommended operating Libby Dam in accordance with VARQ Flood Control Procedures, the preferred alternative for the operation of Libby Dam described in the Corps 2006 Upper Columbia Alternative Flood Control and Fish Operations Final Environmental Impact Statement (UCEIS).

The Corps signed a ROD on June 6, 2008, documenting the long-term decision to adopt VARQ for Libby Dam flood control and fish operations. The ROD is located at: http://www.nws.usace.army.mil/PublicMenu/documents/VARQ/Final_UCEIS_rod_signed.pdf and describes the implementation of flood control procedures that can be expected at Libby Dam in Water Year 2009 and beyond.

3.3. *Upper Columbia Alternative Flood Control and Fish Operations Environmental Impact Statement (UCEIS) for Hungry Horse Dam*

The NMFS and USFWS BiOps both included a Reasonable and Prudent Alternative (RPA) with a recommendation to implement VARQ FC at Hungry Horse Dam. In response, The UCEIS was completed in April 2006 and Reclamation signed a ROD on September 29, 2009, documenting the long-term decision to adopt VARQ for Hungry Horse Dam flood control and fish operations. The ROD is located at:

http:/www.usbr.gov/pn/programs/fcrps/varq/index.html

3.4. *Action Agencies' 2007 FCRPS Biological Assessment*

In response to the U.S. District Court of Oregon's Order and Remand of the NMFS 2004 FCRPS BiOp, the AAs and NMFS engaged in a collaborative process with regional sovereigns. One objective was to develop a proposed action to submit to NMFS for ESA consultation. The AAs' 2007 FCRPS Biological Assessment (BA) was submitted to NMFS in August 2007 and can be found at:

http://www.salmonrecovery.gov/biological_opinions/fcrps/ba-ca/Executive_Summary.pdf.

3.5. *Reclamation's 2007 Upper Snake BA and BiOp*

In response to the District Court of Oregon's order and remand of the NMFS 2005 Upper Snake BiOp (covering Reclamation's Operations and Maintenance in the Snake River Basin above Brownlee Reservoir) (*American Rivers v. NOAA Fisheries*), Reclamation prepared the 2007 Upper Snake BA, that analyzed its proposed Upper Snake actions consistent with the Court's findings. The BA can be found at:
http://internet.pn.usbr.gov/programs/UpperSnake/index.html.
The BiOp can be found at:
http://www.nwr.noaa.gov/Salmon-Hydropower/Columbia-Snake-Basin/final-BOs.cfm

3.6. *Comprehensive Analysis*

The District Court of Oregon also ordered that Upper Snake remand be integrated with the FCRPS remand to ensure a comprehensive analysis. In order to integrate the Upper Snake and FCRPS analyses, the AAs incorporated information from both river basins into a BA for each species so that a collective or comprehensive conclusion could be made as to the status of each species. These biological analyses are contained in a separate document entitled Comprehensive Analysis of the FCRPS and Mainstem Effects of Upper Snake and Other Tributary Actions (Comprehensive Analysis) (USACE *et al.* 2007). The Comprehensive Analysis can be found at:
http://www.salmonrecovery.gov/biological_opinions/fcrps/ba-ca/index.cfm.

Using the Comprehensive Analysis and both BA documents, NMFS developed the new BiOps with the Supplemental Comprehensive Analysis to address the effects of the operation of the FCRPS and the Upper Snake Projects on ESA listed species. Both final biological opinions were issued on May 5, 2008.

3.7. *Preparation of Plans*

Each fall, the AAs prepare an annual WMP (draft by October 1st and the final by January 1st). The AAs have prepared this WMP for the 2010 water year consistent with the NMFS 2008 BiOp and the USFWS 2000 and 2006 BiOps. This WMP describes how the FCRPS dams and reservoirs will be operated for the 2010 water year (October 1, 2009 through September 30, 2010). At the time of preparation of the draft WMP, very little information is available about the future year's water supply; therefore, it provides only a general description of how the FCRPS will be operated during the upcoming water year. The operations are designed to:

- Implement water management measures in a manner consistent with actions considered in their respective BiOps.

- In combination with other actions or operations identified in the NMFS 2008 BiOp, but not identified in the WMP; meet the biological performance standards specified in the BiOps.

- Meet non-BiOp related requirements and purposes such as flood control, hydropower, irrigation, navigation, recreation, and fish and wildlife not listed under the ESA. For a detailed description of flood control see http://www.nwd-wc.usace.army.mil/report/colriverflood.htm.

- Take into consideration recommendations contained in the applicable Northwest Power and Conservation Council Fish and Wildlife Program and amendments.

The WMP will also include any special operations (such as any special tests, required maintenance, construction activities, flood control procedures planned for the year, etc.) that are known at the time the WMP is developed. These action plans will take into account changes in the operations due to water supply or other factors. As the water supply forecasts become available, the AAs will develop more detailed in-season action plans for the proposed FCRPS project operations that describe planned hydro system fish operations for the upcoming fall and winter (draft by November 1 and final by January 1) and for the spring, and summer (draft by March 1 and final by May 15).

The Corps also prepares a Fish Passage Plan (FPP) each year that provides detailed operating criteria for project fish passage facilities, powerhouses, and spillways to allow for the efficient passage of migratory fish. The FPP contains appendices that describe special operations for fish research studies, the juvenile fish transportation program, operation of units within 1% of best efficiency, spill for fish passage, total dissolved gas (TDG) monitoring, and dewatering procedures. The FPP is coordinated through the Fish Passage Operations and Maintenance Coordination Team (FPOM) and is available on the web at http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/. This WMP addresses strategies to enhance juvenile and adult fish survival through a coordinated set of hydro 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 the following strategies and sub-strategies, as defined in the NMFS 2008 BiOp and USFWS's 2000 and 2006 BiOps.

3.8. *NMFS 2008 BiOp Strategies*

Hydropower Strategy 1—Operate the FCRPS to provide flows and water quality to improve juvenile and adult fish survival.

Hydropower Strategy 2—Modify Columbia and Snake River dams to maximize juvenile and adult fish survival.

Hydropower Strategy 3—Implement spill and juvenile transportation improvements at Columbia River and Snake River dams.

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

3.9. *Non-BiOp Operations*

Each year the AAs implement water management actions that are not part of our ESA obligations, but are aimed at meeting other project requirements and purposes such as flood control, power generation, irrigation, navigation, recreation, and fish and wildlife not listed under the ESA. Table 1 includes fish and wildlife related non-ESA water management actions that may be implemented and the time of year such actions typically occur. These actions are further described below.

Table 1. Non-ESA listed species and period of impact.

Action	Time of Year
Keenleyside Dam (Arrow) mountain whitefish actions	December – January
Keenleyside Dam (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
John Day - waterfowl hunting enhancement	October – January
Bonneville - Tribal fishing	April – September
Bonneville - Spring Creek Hatchery release	April – May

4. Hydro System Operation

4.1. *Priorities*

The NMFS 2008 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 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 Action Agencies have reviewed these strategies and other actions called for in the NMFS 2008 BiOp, and 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 reservoirs (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 timing and shape of the spring runoff may result in reservoir refill a few days before or after the target refill date. For example, a late snowmelt runoff may delay refill in order to avoid excessive spill.
    - Hungry Horse refill by about June 30 to provide summer flow augmentation.
    - Dworshak refill by about June 30 to provide summer flow augmentation.
    - Grand Coulee refill by about June 30 to provide summer flow augmentation.
    - Libby reservoir refill in 2009 may be less likely than recent years as the result of operating in accordance with the VARQ Operating Procedures at Libby Dam with the tiered sturgeon volume as recommended in the USFWS 2006 BiOp. These operating assumptions provide an

approximately 12% probability of Libby refill to within one ft. of full by July 31. This is further described in the Corps' 2006 UCEIS[3].

3. Operate storage projects to be at their April 10 elevation objectives if possible to to provide spring flow augmentation.

4. Provide flow augmentation, from the start of chum spawning in November through the end of chum emergence (approximately April), to maintain sufficient water surface to protect Ives/Pierce Island chum salmon spawning and incubation.

In addition to operations for anadromous fish, the AAs operate the FCRPS projects to benefit listed fish at or near each project or in its reservoir. Reservoirs operate to meet project minimum outflows, to avoid involuntary spill and resulting elevated Total dissolved Gas (TDG), to reduce outflow fluctuations to avoid stranding fish and degrading fish habitat and productivity, to reduce cross sectional area of run-of river mainstem projects to speed juvenile passage and reduce reservoir surface area to moderate temperatures, and to make specific temperature releases from storage projects to improve 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.

As the operating year begins on October 1, the flow objectives are not encountered in the same order as the NMFS 2008 BiOp flow priorities (e.g. decisions need to be made on chum spawning flows first despite the fact that they have a lower priority than spring or summer migration flows). However, the AAs will operate chronologically during the year while attempting to meet the flow priorities as they are outlined in the NMFS 2008 BiOp. Objectives include:

- Operate the storage reservoirs (Dworshak, Hungry Horse, Libby, and Grand Coulee) to achieve the April 10 refill objectives with a high probability. This level varies by runoff forecast. The ability to reach early April flood control levels is affected by how much water was released for flood control, power generation, and fishery flows to support both lower Columbia chum and Hanford reach fall Chinook spawning, as well as minimum flow requirements below the projects.

- Refill the storage reservoirs by about June 30[4] while minimizing spill (except as needed to maintain flood control), in order to maximize available storage of water for the benefit of summer migrants. 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.

[3] Upper Columbia Alternative Flood Control and Fish Operations (VARQ) Environmental Impact Statement.
[4] Libby Dam refill probability is likely to be later into July as defined in the VARQ Flood Control Operating Procedures and supporting effects analysis.

- Manage the available storage to augment summer (July and August) flows in an attempt to meet flow objectives and to moderate water temperature. Libby and Hungry Horse will be drafted to their specified draft limits by September 30, Grand Coulee and Banks Lake will be drafted to their specified draft limits by August 31 to augment summer flows. Dworshak will reach its summer draft limit in September to augment summer flows and to moderate river temperatures. 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.

- These objectives are intended as general guidelines. The NMFS 2008 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 may be insufficient water to accomplish all the objectives addressed in the NMFS 2008 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[5] 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 2008 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 reduce 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 RFC 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

[5] Non Action agencies members of TMT include NOAA Fisheries, State of Oregon, State of Washington, U S Fish and Wildlife Service, State of Idaho, State of Montana, Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Reservation of Oregon, and the Yakama Nation

evaluate the performance of the current forecast procedures. The CRFG will evaluate new forecasting techniques for potential implementation.

4.2.2. Provision of Spring Flows 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 both flow and project refill objectives.

4.2.3. Chum Tailwater Elevations versus Refill/Spring Flows

Providing a Bonneville Dam tailwater elevation level for chum spawning and incubation in the Ives Island complex typically requires flow augmentation from storage reservoirs when reliable flow forecast information is unavailable. Project refill and spring flows have priority over flow augmentation to provide chum tailwater elevations which have to be set in November/December. Although there is an early season Southern Oscillation Index (SOI) based forecast and other early season climate indices that can provide an indication of the upcoming year's water supply, the more reliable water supply forecasts don't start until January. If the tailwater elevation level selected during the spawning season is too high (requiring higher flows and requiring deeper reservoir drafts), there is a risk of drafting below the April 10 elevation objective thereby reducing spring flows if the higher flows are maintained throughout the incubation period. On the other hand, if the flows are reduced during the incubation period in order to refill, then there is the risk of dewatering chum redds. When this conflict arises, project refill and spring flows that benefit multiple ESUs have priority over maintaining the chum tailwater elevations set in December.

4.2.4. Sturgeon Pulse below Libby Dam versus Summer Flow Augmentation

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

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 2008 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 or see TMT homepage at http://www.nwd-wc.usace.army.mil/tmt/documents/wmp.

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 not be used in place of operations outlined in the annual WMP. 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 1 and 2 of 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 resulting from 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.

4.3.3. Emergency Operations for Unlisted 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 2008 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 low runoff conditions 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.

5. Decision Points and Water Supply Forecasts

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 2008 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 Forum (TMT, RIOG, and Regional Executives).

Table 2. Water Management Decision Points/Actions.

	September	Early October	November	Winter (December – March)	Early April	Early May	June	Early July
Operations	• Albeni Falls fall/winter minimum control elevation discussion to support kokanee spawning and incubation	• Assess potential tailwater elevations to support chum spawning below Bonneville Dam • Preliminary discussions of flood control/ project refill strategy • Support for Hanford Reach fall chinook protection operations begins.*(Non-Bi Op Action)* • Consider Kootenai burbot temperature operation	• Early season water supply forecast using SOI	• Determine winter/spring chum flow tailwater elevations below Bonneville Dam • Determine flood control and refill strategies, including any available flood control shifts • Determine final April 10 objective base on FCE's from March Final WSF. Minimum flows from Hungry Horse Dam and minimum Columbia Falls flows are set by April-August forecast	• Spring flow objectives are set by the April final volume forecasts • Determine spring flow management strategy including priority for refill • Determine Juvenile Fish Transport Operations for Lower Snake Projects and McNary • Determine start dates and levels by project for spring spill • Determine start date for Minimum Operating Pool (MOP) at Lower	• Evaluate likely tier for sturgeon water volume • Determine refill start date based on streamflow forecast to exceed Initial Control Flow (ICF) at The Dalles (if this does not occur in April • Use May forecast to determine VARQ refill flows for Libby and Hungry Horse • Use May final forecast to calculate the appropriate volume of	• Summer flow objective at Lower Granite determined by June final volume forecast • Use June forecast to determine VARQ refill flows for Libby and Hungry Horse • Regional technical team recommends shape and timing of Libby Dam sturgeon pulse • Determine summer flow augmentatio n strategy (early June) • Complete Dworshak	• Grand Coulee summer reservoir draft limit determined by July Final April – August volume forecast at The Dalles • Salmon Draft at Libby and Hungry Horse

	September	Early October	November	Winter (December – March)	Early April	Early May	June	Early July
				• Begin discussing spring operations • Begin spring transport discussions • Hanford Reach operations *(non-BiOp action)* discussed, beginning in January • Perform analysis to determine amount of flexibility Dworshak has to operate above minimum flow and still reach spring refill targets • Prepare outlook for meeting flow objectives • Determine end of December flood control	Snake River projects • Determine John Day forebay elevations • Determine refill start date based on streamflow forecast to exceed Initial Control Flow at The Dalles • If required, use April forecast to determine VARQ refill flows for Libby and Hungry Horse	the bull trout flow release from Libby for after the sturgeon pulse through August • Use May final forecast to calculate the appropriate volume of the sturgeon tiered flow release from Libby • Regional technical team recommends shape and timing of Libby Dam sturgeon pulse • May 15 until sturgeon flow begins Libby minimum outflow is 6 kcfs for bull trout.	temperature modeling and determine release strategy • Decision on McNary juvenile fish transportation (late June)	

	September	Early October	November	Winter (December – March)	Early April	Early May	June	Early July
				elevation at Libby, using December SOI–based forecast				
Plans		Develop fall/winter update to the annual WMP		Preliminary work on spring/summer update to the annual WMP	Start operational plans for Libby and Hungry Horse Dams	Libby and Hungry Horse operational plans due		
Forecasts				January, February, and March volume forecasts released by the NWRFC	April final forecast released by NWRFC	May final forecast released by NWRFC	June final forecast released by NWRFC	

5.1. *Water Supply Forecasts*

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

The National Weather Service's Northwest River Forecast Center (NWRFC), Corps Northwestern Division Hydrologic Engineering Branch, Reclamation, and others prepare water supply forecasts to manage the Columbia River. Table 3 below lists the forecasts used to implement actions referenced in the BiOps. Table 4 summarizes the major fish-related reservoir and flow operations by project. More detailed descriptions of each of these operations follow.

Table 3. Water Supply Forecasts Used to Implement BiOp Actions.

Forecast Point	Forecast period	Forecast	BiOp Actions to be Determined
Hungry Horse	April – August Provided by Reclamation	January, February, and March Final	Columbia Falls and Hungry Horse minimum flows
	May – September Provided by Reclamation	January, February and March Final	Sets VARQ flood control targets
		April Final	Sets VARQ flood control targets an VARQ refill flows
		May and June Final	VARQ refill flows
The Dalles	April – August Provided by NWRFC	April Final	Spring flow objective at McNary Dam Juvenile Fish Transport operations at McNary
		May Final	Libby Summer Draft Limit (2,449 ft. by the end of September except for the lowest 20 percent of years, then 2,439 ft. by the end of September). Hungry Horse Summer Draft Limit (3,550 ft. by the end of September except for the lowest 20 percent of years, then 3,540 ft. by the end of September).
		July Final	Summer draft elevation for Grand Coulee (August 31 elevation of 1,280 ft. or 1,278 ft.)
Lower Granite	April – July Provided by NWRFC	April Final	Spring flow objective at Lower Granite Juvenile Fish Transport operations at Lower Snake Projects
Lower Granite	April – July Provided by NWRFC	June Final	Summer flow objective at Lower Granite

Libby	April – August Provided by 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	Volume of water to provide for sturgeon and minimum bull trout flows to begin after sturgeon pulse through August. VARQ refill flows
		June Final	VARQ refill flows

Table 4. Reservoir and Flow Operations for ESA-listed fish species.

Project	Flood Control & Refill	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	May – July Provide USFWS sturgeon volume to augment flows at Bonners Ferry.	Year Round: Observe project ramping rates to minimize adverse affects of flow fluctuations May 15 – Sep 30: Operate to Bull Trout Minimum Flows	Operate to meet flow objectives and refill if possible without jeopardizing flood control	September Draft 10 ft. from full by the end of September (except in lowest 20th percentile water years, as measured by The Dalles May water supply forecast, when draft will increase to 20 ft. from full by end of September)	Fall/winter storage may be used to support chum flows
Hungry Horse	Winter: Operate to VARQ flood control rule curves with a 75% confidence of meeting the April 10 elevation objective Spring: Refill by about June 30 if possible without excessive spill and operate to help meet flow objectives		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	Operate to meet flow objectives and June 30 refill if possible without exceeding TDG limits	September Draft 10 ft. from full (elevation 3,550 ft.) by the end of September except in lowest 20th percentile water years, as measured at The Dalles when draft will increase to 20 ft. from full (elevation 3,540 ft.) by the end of September	

Project	Flood Control & Refill	Sturgeon	Bull Trout	Spring Anadromous	Summer Anadromous	Chum
Albeni Falls	Winter: Operate to standard flood control criteria Spring: Refill by June 30 and operate to help meet flow objectives		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 2,051 ft.. Reach 2,051 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 winter control elevation.			Fall/winter storage may be used to support chum flows

Project	Flood Control & Refill	Sturgeon	Bull Trout	Spring Anadromous	Summer Anadromous	Chum
Grand Coulee	Winter: Operate to 85% confidence of meeting April 10 elevation objective Spring: Refill by about June 30 and operate to help meet flow objectives			Operate to 85% confidence of meeting April 10 elevation objectives to increase spring flows in the Lower Columbia river. Operate to help meet the Spring flow objective at Priest Rapids Dam	July-August: Draft to support salmon flow objectives, not to exceed reservoir draft limit of 1,280 ft (>= 92 MAF July Final forecast at The Dalles) or 1,278 ft. (<92 MAF forecast at The Dalles)[6] August: Operate Banks Lake to draft to elevation 1,565 ft. by August 31 to provide more water for summer flow augmentation	Fall/winter storage may be used to support chum flows
Dworshak	Winter: Operate to achieve April 10 refill objective Spring: Refill by about June 30 and operate to help meet flow objectives				Draft for summer flow augmentation and water temperature reduction, not to exceed reservoir draft limit of 1,520 ft. in September	Fall/winter storage may be used to support chum flows
Lower Granite				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	

[6] These draft limits will be modified as the Lake Roosevelt drawdown component of Washington's Columbia River Water Management Program (CRWMP) is implemented (see Section 6.5.6).

Project	Flood Control & Refill	Sturgeon	Bull Trout	Spring Anadromous	Summer Anadromous	Chum
Little Goose				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				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				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				Flow objective of 220-260 kcfs Operate within 1% of best efficiency	Flow objective of 200 kcfs Operate within 1% of best efficiency	
John Day				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% of best efficiency	
The Dalles				Operate within 1% of best efficiency	Operate within 1% of best efficiency	

Project	Flood Control & Refill	Sturgeon	Bull Trout	Spring Anadromous	Summer Anadromous	Chum
Bonneville				Operate within 1% of best efficiency	Operate within 1% of best efficiency	Provide support to chum if 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. Project Operations

6.1. *Hugh Keenlyside Dam (Arrow Canadian Project)*

6.1.1. Mountain Whitefish

Spawning flow levels are set between 45-55 kcfs beginning the third week in December and continuing through mid-January. Egg protection flows are set 5-15 kcfs lower than the spawning flow from mid-January through the end of March.

6.1.2. Rainbow Trout

Rainbow trout spawning begins in April. Protection levels begin somewhere between 15 and 25 kcfs. The goal is to have stable flows or ever-increasing flows through June.

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 for flood control from January through April using the Storage Reservation Diagram (SRD) developed for VARQ flood control. Hungry Horse began operating using VARQ Flood Control rule curves on an interim basis starting January 1, 2001, based on an Environmental Assessment Findings of No Significant Impacts. Reclamation in coordination with the Corps completed the Upper Columbia EIS in 2006. A ROD was prepared and signed in September 2009.

Hungry Horse will be operated during the winter and early spring 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 Upper Rule Curve (URC) as an upper limit and the Variable Draft Limits (VDL's) as a lower operating limit for the reservoir from January through March. A description of VDL's is provided in Section 7.5. In many years, typically dry years, the previous year's summer draft for flow augmentation and year-round required minimum discharges for resident fisheries will prevent Hungry Horse from reaching the April 10 elevation objective. 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 14 ft. (an approximate flow of 51,000 cubic feet per second (cfs)). 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) in order to maintain the Flathead River at Columbia Falls below 14 ft. if possible. Hungry Horse generally starts reducing discharges when the stage at Columbia Falls begins to exceed 13 ft. (approximately 44,000 cfs).

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 a few days before or after the June 30 target date. 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 NOAA Fisheries BiOp's 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 the migration, attainment of flow objectives, water quality, and the effects that reservoir operations will have on other listed and resident fish populations. Flows 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 (The Dalles April-August <71.8 maf) 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.

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 reporting actual operations by making available pertinent historic elevations and flows as related to Hungry Horse Dam through its current website at http://www.usbr.gov/pn/hydromet/esatea.html.

[7] The lowest 20th percentile as measured at The Dalles (RPA 4 in RPA Table, pg 6 of 98) based on RFC's statistical period, currently 1971-2000, using May final for The Dalles Apr-Aug (RPA 14 in RPA table, pg 15 of 98)

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 5 shows how the minimum flows are calculated[8]. Reclamation Water Supply Forecasts will be provided to the TMT.

Table 5. Minimum Flows at Hungry Horse and Columbia Falls.

April – August inflow forecast (KAF)	Hungry Horse min flow[9] (CFS)	Columbia Falls min flow (CFS)
<1190	400	3,200
1,790 > forecast > 1,190	Interpolate between 400 and 900	Interpolate between 3,200 and 3,500
>1,790	900	3,500

The maximum ramp up and ramp down rates are detailed in Table 6. 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 (Note: 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

[9] 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.

Table 6. 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 (Daily max)**	**Ramp Up Unit (Hourly max)**
3,200 - 6,000 cfs	Limit ramp up 1,800 cfs per day	1,000 cfs/hour
>6,000 - 8,000 cfs	Limit ramp up 1,800 cfs per day	1,000 cfs/hour
>8,000 - 10,000 cfs	Limit ramp up 3,600 cfs per 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 (Daily max)**	**Ramp Down Unit (Hourly max)**
3,200 - 6,000 cfs	Limit ramp down to 600 cfs per day	600 cfs/hour
>6,000 - 8,000 cfs	Limit ramp down to 1,000 cfs per day	600 cfs/hour
>8,000 - 12,000 cfs	Limit ramp down to 2,000 cfs per day	1,000 cfs/hour
>12,000 cfs	Limit ramp down to 5,000 cfs per day	1,800 cfs/hour

6.2.5. Spill

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. 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

Per the 2000 USFWS BiOp, the AAs, the USFWS, NOAA Fisheries, the Kalispel Tribe, and IDFG will meet annually 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 set the winter minimum control elevation (MCE) to ensure winter lake operation addresses the needs of kokanee spawning and hence, threatened bull trout, which feed on kokanee. This interagency coordination on setting the winter MCE for kokanee also takes into consideration

spawning and incubation needs for lower Columbia River chum salmon. A draft decision tree has been developed by the parties to guide selection of the recommended winter elevation to meet these objectives (Figure 1).

6.3.2. 2009-2010 Fall and Winter Lake Elevation

The elevation and date for 2009-2010 minimum control elevation (MCE) was determined at the interagency meeting September 17, 2009, and an SOR was submitted and approved at the September 30 TMT. This year's SOR requests:

- Draft the reservoir no later than November 15, 2008 to an approximate elevation of 2,051 ft for lakeshore spawning kokanee (kokanee are considered forage for threatened bull trout).
- The minimum elevation achieved will be considered the minimum control elevation (MCE) through April 1.
- Operate within a one-half ft. operating range above the MCE until kokanee spawning concludes, or December 31, whichever comes first.
- The end date for kokanee spawning will be determined by end of kokanee spawning (monitored by IDFG) or December 31, whichever comes first.

As discussed at TMT September 30th, November 18th and December 10th, BPA has requested that the Corps operate Lake Pend Oreille within the full flood control flexibility of 2,051 ft. and 2,056 ft., as a means of storing and releasing water to be more responsive to winter power generation demands. This requested operation is for the period following the end of kokanee spawning through April 1st. The Corps is still considering this request. If the request is not implemented this year, Lake Pend Oreille elevation at Hope, Idaho will be regulated between elevation 2,051 ft. and 2,052 ft., insofar as possible, until refill starts after April 1. The Corps may decide to implement this operation in its entirety as requested, or implement a modified operation that utilizes something less than the full flood control range during this time period. Whichever operation is implemented, it will follow the existing project operating constraints.

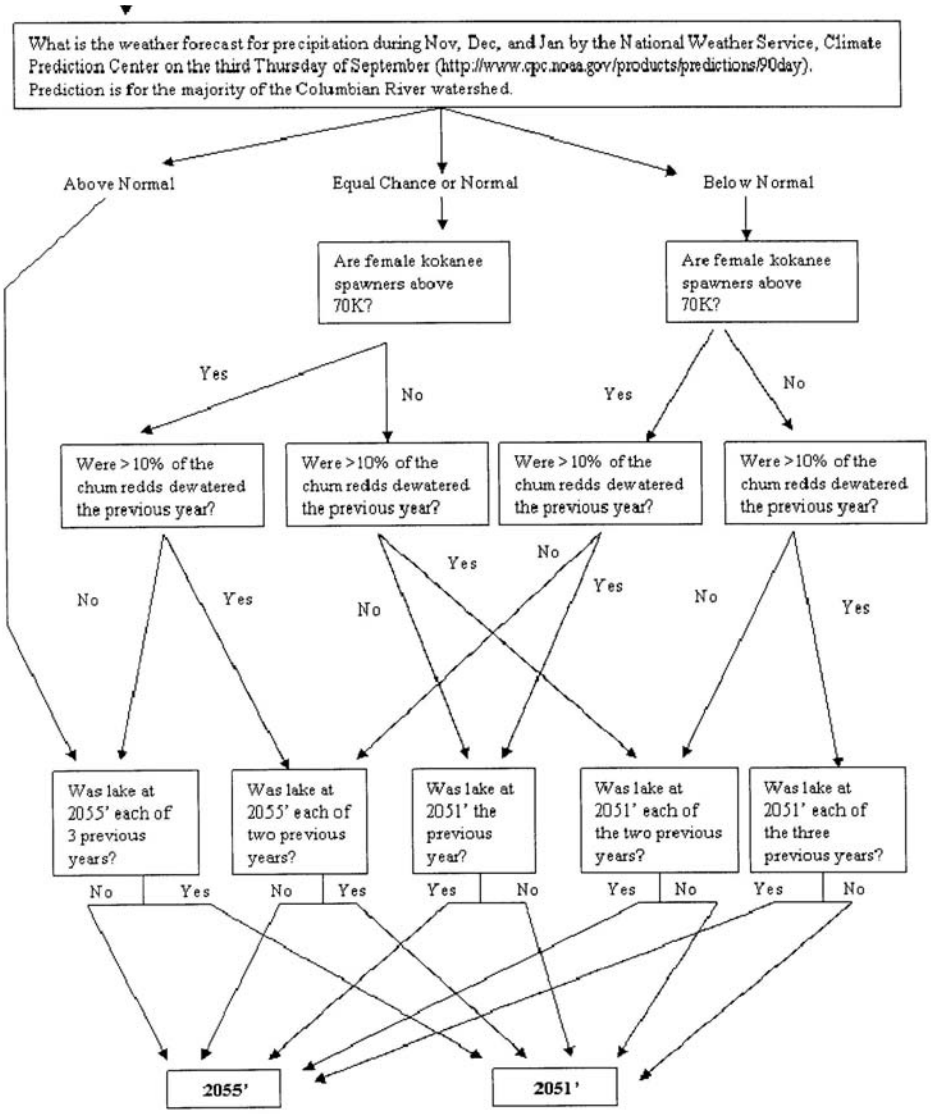


Figure 1. Draft decision tree currently in use (2009) to guide selection of the winter lake elevation for Lake Pend Oreille.

6.3.3. Flood Control Draft

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

6.3.4. Refill

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.

6.3.5. 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*

6.4.1. Libby Dam General Operations

Libby Dam flows will be regulated consistent with existing treaties, Libby Project authorization for public safety, other laws, and the 1938 International Joint Commission order on Kootenay Lake 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.

6.4.1.1. Coordination

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

6.4.1.2. Burbot

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.

6.4.1.3. 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 will guide project operations to meet various purposes, including power production.

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.)

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 (Note: 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).

6.4.2. Flood Control

The Corps will continue to use the new SOI forecast procedure in December to determine the December 31 flood control elevation. In water years where the forecast for the period April through August is less than 5,900 KAF based on the SOI forecast procedures, the end-of-December draft elevation will be higher than 2,411 ft. If the early forecast for April-August is 5,500 KAF or less, the end-of-December target elevation would be 2,426 ft. The end-of-December elevation is a sliding scale between elevation 2,426 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 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.

6.4.3. 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 in the summer. Libby Dam will provide flows for sturgeon and bull trout during spring and for salmon and bull trout during summer, while attempting to minimize a double peak in the June – September period. After adhering to the VARQ flood control guidance and providing the sturgeon flow operation, Libby Dam refill may occur by July 31. During the spring, the AAs will operate Libby Dam to meet its flow and refill objectives. If both these objectives cannot be achieved, the sturgeon flow operations are a higher priority over refill.

When not operating to minimum flows, the project will be operated to achieve a 75% chance of reaching the April 10 refill objective (the exact date to be determined during in-season management) to increase flows for spring flow management.

6.4.3.1. Bull Trout

From May 15 to June 30 and during the month of September, a minimum flow of 6,000 cfs will be provided for bull trout. Volume to sustain the basal flow of 6,000 cfs from May 15 until the start of the sturgeon operation will be accounted for with sturgeon volumes, and in the fall should be drawn from the autumn flood control draft.

Per the USFWS 2006 BiOp, the tiered bull trout minimum flow will be provided from 1 July through 31 August and the period between sturgeon and salmon flow augmentation beginning in September. The bull trout minimum flow may be from 6,000 cfs to 9,000 cfs. Table 7 shows how to determine the bull trout minimum flow during this period.

Table 7. Minimum bull trout releases from Libby Dam July 1 through 31 August (May 15 – June 30 and all of September the minimum is 6 kcfs).

Forecast runoff Volume (MAF*) at Libby	Min bull trout flows 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*

6.4.3.2. 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 2008 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 storage needs for listed bull trout, 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 until the start of the sturgeon operation. 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.

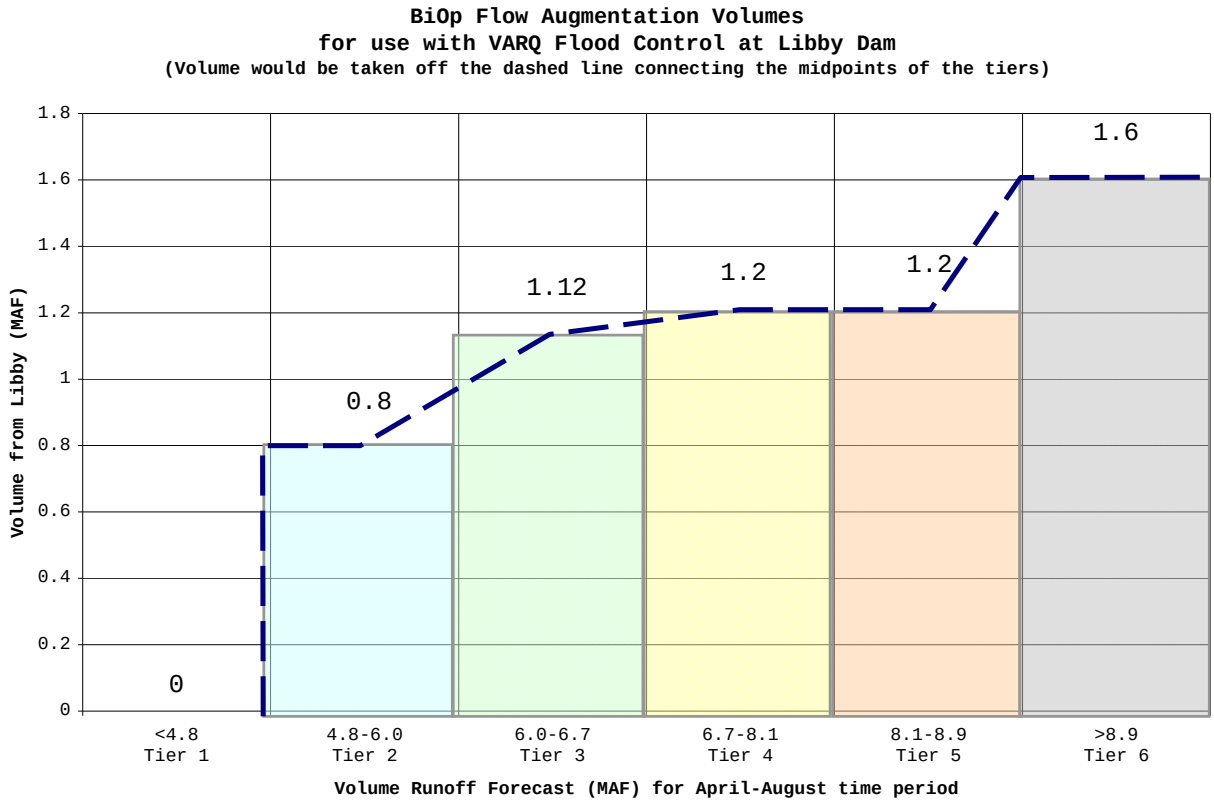


Figure 2. "Tiered" volumes of water for sturgeon flow enhancement to be released from Libby Dam according to the Libby May final forecast of April - August volume. Actual flow releases would be shaped according to seasonal requests from the USFWS and in-season management of water actually available.

6.4.3.3. Spill

In mid-December, USFWS determined that sturgeon habitat objectives were not met in 2008 and 2009. In accordance with this determination and the 2008 USFWS Clarified RPAs, The Corps will, in good faith, perform a spill operation in conjunction with the sturgeon pulse in 2010 taking into account other operational requirements. Spill that induces TDG in excess of 110% is not to exceed 7 days, water temperatures are to be maintained at or above 8° C, and spill will range between 5,000 cfs and 10,000 cfs. TDG shall never exceed 123%.

The spill will occur sometime between late May and late June, depending on water supply forecast, runoff projections, water temperature and reservoir elevation. The Corps will coordinate the timing and other details with the State of Montana, the Service, the Kootenai Tribe of Idaho, the Bonneville Power Administration (BPA), and other regional interests, assuring that conditions remain safe during the spill.

Otherwise, limit voluntary spill to avoid exceeding Montana State TDG standard of 110%, when possible, and in a manner consistent with the AAs' responsibilities for ESA-listed resident fish and settlement agreement.

6.4.3.4. Post Sturgeon Operation

After the sturgeon operation flows will be set to try and refill by July 31, if possible, while trying to minimize double peak. Summer operations will be coordinated through TMT in-season management. A double peak is assumed to be a flow increase and decrease of more than 5,000 cfs within one month. Libby Dam releases will follow ramp rates in the 2006 USFWS BiOp.

6.4.4. Summer Operations

During the summer, the AAs draft Libby Dam within the NOAA Fisheries 2008 and USFWS BiOp's 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 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 and August), the AAs will operate Libby Dam to help meet the flow objectives for juvenile salmon out-migration in the Columbia River. The summer reservoir draft limit is 10 ft. from full by the end of September (except in lowest 20th percentile[10] water years (The Dalles April-August <71.8 maf), 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 Biological Assessment of 2008 from NMFS (Appendix B.2.1). Arrangements for retention of July-September water in Lake Koocanusa are possible under 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.

[10] The lowest 20th percentile as measured at The Dalles (RPA 4 in RPA Table, pg 6 of 98) based on RFC's statistical period, currently 1971-2000, 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. During this time period Grand Coulee is also being operated to support the chum operation (described in detail in Section 7.4) and to achieve an 85% probability of reaching the April 10 elevation objective.

Grand Coulee will be operated during the winter and early spring to achieve an 85% probability of reaching the April 10 elevation objective in order to provide more water for spring flows. This is achieved by operating between URC as an upper limit and the VDL's as a lower operating limit for the reservoir from January through March. A description of VDL's is provided in Section 7.5. 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 not released until the 5th business day of the month, after which the Corp 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. Achieving the April 10 objective based on the March forecast can produce an operation that is neither practicable nor desirable. For example, if there is a increase in The Dalles water supply forecast between the March and April forecast, the April 15 and 30 flood control elevations at Grand Coulee can be significantly lower than previously forecast. These changes can be enough to cause large draft rate exceedances in order to draft Grand Coulee starting at an April 10 elevation that was based on a smaller March water supply forecast. Exceeding Grand Coulee's maximum prescribed draft rate increases the probability for landslides around Lake Roosevelt. In order to alleviate excessive draft rates, starting the draft of Grand Coulee prior to April 10 may be appropriate. This type of operation will be discussed and coordinated through TMT.

Opportunities to shift system flood control requirements from Brownlee and Dworshak to Grand Coulee will also be considered. These shifts may be implemented after coordination with TMT. The purpose of this action is to provide more water for spring flow augmentation in the lower Snake River. This will occur when the shifts will not compromise flood control and they have been coordinated. 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, Oregon.

During the spring, the AAs will operate the FCRPS to help meet the flow objectives and to refill the projects. If both of these objectives cannot be achieved, the TMT will make an in-season recommendation, weighing considerations unique to each particular year and project.

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 be drafted to a minimum elevation of either 1,280 ft. or 1,278 ft. by the end of August depending on the July Final forecast for April through August runoff produced by the NWRFC. 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 drawdown component of Washington's Columbia River Water Management Program (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 1,565 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. There will be some years when the project must be drafted below flood control rule curves to accomplish this work. Reclamation will coordinate such an operation with TMT.

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. Washington's Columbia River Water Management Program (CRWMP)

The Lake Roosevelt drawdown component of Washington's Columbia River Water Management Program (CRWMP) will not reduce flows during the salmon flow objective period (April to August). The CRWMP 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 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 7.4.

6.5.8. Priest Rapids Flow Objective

Grand Coulee will be operated to help meet Priest Rapids weekly flow objective to support fall Chinook salmon spawning and incubation.

6.5.9. Spill

Involuntary spill at Grand Coulee Dam will be managed in coordination with Chief Joseph Dam; see Sec. 6.5. Grand Coulee will be operated to minimize TDG production.

6.6. *Chief Joseph Dam*

Construction of spillway flow deflectors at Chief Joseph Dam was completed in October 2008. A spill test was conducted in April 2009 to characterize the performance of the flow deflectors in reducing TDG production. Spill amount and spill pattern configuration were varied during the test associated TDG levels were measured and recorded. A final report on the test results is expected in early 2010. Information from the report will aid in developing a spill swap plan between Chief Joseph and Grand Coulee dams to help minimize TDG production and reduce the TDG burden that carries downstream through the system.

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. There is no summer flow objective for Priest Rapids Dam.

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 purpose of the following actions is to refill Dworshak as much as possible in order to achieve a high probability of reaching the April 10 elevation objective. During the spring, the AAs will operate Dworshak Dam to meet the flow and refill objectives, refilling by about June 30. The reservoir is deemed to be at "full" at elevations of 1,599 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 and project.

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 2008 BiOp.

6.8.3. Summer Operations

Summer flow augmentation provided from Dworshak may cool water temperatures in the lower Snake River.

During the summer, releases will be made from Dworshak to attempt to maintain water temperatures at the Lower Granite tailrace fixed monitoring site at or below 68º F. Although a previous NMFS 2008 FCRPS BiOp stated the goal was to maintain the forebay at this temperature, modeling and experience have demonstrated that the tailrace temperature is more representative of river conditions and temperature exposure of migrating salmonids. The purpose of this action is to improve water quality (by lowering water temperature) in the lower Snake River.

During the summer, the AAs draft Dworshak within the NMFS 2008 BiOp's 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 the migration, 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 and August) the AAs will operate Dworshak to help meet flow/temperature objectives. The AAs plan to draft Dworshak to 1,535 ft. in August and draft to approximately 1,520 ft. in September. The extension of the draft limit into

September reflects assumes releases of 200 KAF consistent with the agreement with the Nez Perce Tribe and the Snake River Basin Adjudication process.

Maximum project discharge for salmon flow augmentation to be within state of Idaho TDG water quality standards of 110%.

6.8.4. Fall/Winter Operations

After summer fish operations are completed (including the Nez Perce 200 kaf 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.

Dworshak will provide minimum flows, while not exceeding the Idaho State TDG water quality standard of 110%.

Opportunities to shift system flood control requirements from Brownlee and Dworshak to Grand Coulee will be considered periodically between January and April 15. These shifts may be implemented after coordination with TMT. The purpose of this action is to provide more water for flow augmentation in the lower Snake River during late April. A shift will only occur when it will not compromise flood control.

6.9. *Brownlee*

Opportunities to shift system flood control requirements from Brownlee to Grand Coulee will be considered. The shifts could occur between January and April 15. 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. The shifts typically occur in drier years when they will not compromise flood control.

6.10. *Lower Granite Dam*

6.10.1. Reservoir Operations

Lower Granite will operate within 1 ft. of Minimum Operating Pool (MOP) from approximately April 3 until small numbers of juvenile migrants are present (approximately September 1) unless adjusted to meet authorized project purposes, primarily navigation. TMT will provide a recommendation. The purpose of this action is to provide a smaller reservoir cross section to reduce juvenile salmon travel time and reduce flow fluctuations. Elevations may be modified to maintain the minimum navigation channel requirements.

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 2010 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 planning dates for the spring flow objective are from April 3 to June 20. These flow objectives are provided as a biological guideline and will likely not be met through 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. Flow in the Snake River during this period is supported by drafting Dworshak Dam from the April 10 objective elevation to the April 30 flood control elevation while not exceeding the State TDG water quality standard at the project (110 % TDG).

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 planning dates for the summer flow objective are from June 21 to August 31. Summer flow objectives are provided as a biological guideline, despite the likely inability to achieve them. Flow in the Snake River is supported by the summer draft, though tends to follow the natural hydrograph.

6.10.5. Spill Operations

Spill operations for fish passage are defined in appendix E of the 2010 FPP.

6.10.6. Juvenile Fish Transport Operations

Transport operations are defined in appendices B and E of the 2010 FPP.

6.11. *Little Goose Dam*

6.11.1. Reservoir Operations

Little Goose will operate within 1 ft. of MOP from approximately April 3 until small numbers of juvenile migrants are present (approximately September 1) unless adjusted to meet authorized project purposes, primarily navigation. This normally occurs in late August. The purpose of this action is to provide a smaller reservoir cross section to reduce juvenile salmon travel time and reduce flow fluctuations. Elevations may be modified to maintain the minimum navigation channel requirements. The navigation

lock tailwater gage at Lower Granite Dam will be used to ensure minimum navigation channel requirements are met.

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 seasons (April 1 through October 31; see appendix C of the 2010 FPP).

Additionally, during the juvenile migration season, the lower operating limit of unit 1 will be manually re-set as indicated in Table 9.

Table 9. Operating limits for Little Goose turbine unit 1 during the 2010 spill season.

Lower Limit	Upper Limit	Condition
115 MW (~16,000 cfs)*	Varies w/Head	With extended-length submersible bar screens installed
125 MW (~17,500 cfs)*	Varies w/Head	Without extended-length submersible bar screens installed

* Discharges are approximate.

Unit operation control within the Generic Data Acquisition and Control System (GDACS) program tends to balance flows across available operating units. This alternative preferred operation will at times; result in an unbalanced operation where more flow is passing through unit 1 than other available operating units. A greater flow through unit 1 has been shown in the Little Goose general physical model to be very effective in disrupting an eddy that tends to form downstream of the powerhouse along the south shore. Disrupting the eddy optimizes the tailrace conditions for both adult passage and juvenile egress with the temporary spillway weir operating in spillbay 1.

6.11.3. Spill Operations

Spill operations for fish passage are defined in appendix E of the 2010 FPP.

6.11.4. Juvenile Fish Transport Operations

Transport operations are defined in appendices B and E of the 2010 FPP.

6.12. *Lower Monumental Dam*

6.12.1. Reservoir Operations

Lower Monumental will operate within 1 ft. of MOP from approximately April 3 until small numbers of juvenile migrants are present (approximately September 1) unless adjusted to meet authorized project purposes, primarily navigation. The purpose of this action is to provide a smaller reservoir cross section to reduce juvenile salmon travel time and reduce flow fluctuations. Elevations may be modified to maintain the minimum navigation channel requirements.

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 seasons (April 1 through October 31; see appendix C of the 2010 FPP).

6.12.3. Spill Operations

Spill operations for fish passage are defined in appendix E of the 2010 FPP.

6.12.4. Juvenile Fish Transport Operations

Transport operations are defined in appendices B and E of the 2010 FPP.

6.13. *Ice Harbor Dam*

6.13.1. Reservoir Operations

Ice Harbor will operate within 1 ft. of MOP from approximately April 3 until small numbers of juvenile migrants are present (approximately September 1) unless adjusted to meet authorized project purposes, primarily navigation or if alternative reservoir operations are recommended and adopted as part of the Ice Harbor Dam Configuration and Operation Plan, scheduled for completion during 2009. The purpose of this action is to provide a smaller reservoir cross section to reduce juvenile salmon travel time and reduce flow fluctuations.

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 seasons (April 1 through October 31; see appendix C of the 2010 FPP).

6.13.3. Spill Operations

Spill operations for fish passage are defined in appendix E of the 2010 FPP.

6.14. *McNary*

6.14.1. Turbine Operations

To enhance juvenile passage survival, turbines at McNary projects 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 2010 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 planning dates for the spring flow objective will be from April 10 to June 30. The flow objective

is provided as a biological guideline and will not be met through 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 planning dates for the summer flow objective will be from July 1 to August 31. The flow in the summer at McNary is supported by various flow augmentation measures. There is a limited amount of water available for flow augmentation and flow objectives provide guidelines on how the water should be shaped.

6.14.4. Weekend Flows

Weekend flows are often lower than weekday flows due to less electrical 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 2010 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

Transport operations are defined in appendices B and E of the 2010 FPP.

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 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 the Lower Columbia projects 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 2010 FPP).

6.15.3. Spill Operations

Spill operations for fish passage are defined in appendix E of the 2010 FPP.

6.15.4. Goose Nesting

To encourage geese to nest in areas that are not typically inundated by frequent fluctuations in the John Day pool between March and May each year, the pool the reservoir is operated in the top 1 ft. of the range for several hours every 4 days.

6.15.5. Waterfowl Hunting Enhancement

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

6.15.6. 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. Spillwall Construction Operations

The second and final phase of spillwall construction will occur during the 2009-10 in-water work period at the The Dalles Dam. A waiver to extend the in-water work period was approved allowing construction activities to begin September 8, 2009. Strict tailwater elevation limits will be required to provide adequate draft for construction equipment. Tailwater elevation at The Dalles Dam will held held at 76.0 ft. or greater during the entire construction period (September 8, 2009 – April 2010).

6.16.2. 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 (April 1 through October 31; see appendix C of the 2010 FPP).

6.16.3. Spill Operations

Spill operations for fish passage are defined in appendix E of the 2010 FPP.

6.17. *Bonneville Dam*

6.17.1. Pool Elevation Operations

Bonneville forebay elevation will be held between 71.5 and 78.0 ft. to accommodate spillwall construction at The Dalles Dam. This operation will occur from September 8, 2009 until construction is complete sometime in early April 2010.

6.17.2. 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 (April 1 through October 31; see appendix C of the 2010 FPP).

6.17.3. Spill Operations

Spill operations for fish passage are defined in appendix E of the 2010 FPP.

6.17.4. Chum Spawning Operation

In the first week of November (or when fish arrive) Bonneville Dam will begin operating to provide a tailwater (TW) range of 11.3 - 11.7 ft. until spawning ends or December 31. The official project tailwater gage is located on the Oregon side .9 miles downstream of Bonneville Dam First Powerhouse, 50 ft. upstream from Tanner Creek at river mile 144.5 ft.. Generally, the range of outflow from Bonneville Dam required to maintain this tailwater elevation can vary from less than the project minimum discharge of 70 kcfs up to 135 kcfs. This range demonstrates the affect natural conditions downstream of Bonneville Dam have on the water surface. Tides, wind, wave and inflows to the Columbia River downstream of Bonneville Dam are all uncontrolled and difficult to predict.

In addition to the uncertainty of conditions downstream of Bonneville Dam there are just as many variables upstream. Generally, the flow at Bonneville Dam is augmented by storage releases from Grand Coulee Dam. This water takes approximately 24 hours to arrive at Bonneville Dam and must pass through several non-federal dams that can alter the shape of the flow. Also, the amount of unregulated flow into the Columbia River above Bonneville Dam is difficult to predict.

The ability to operate Bonneville Dam to a particular tailwater constraint is contingent on the ability of the hydrosystem to manage all of these variables. The hydrosystem is rarely able to maintain the 11.3 - 11.7 ft. operation throughout the spawning period. Significant fall rain events will typically intervene; therefore the operation must be modified to accommodate these varied conditions. Furthermore, The Dalles spillwall construction activities will place additional constraints on Bonneville pool operational flexibility. The pool will operate at a minimum elevation of 76.0 ft. (measured in The Dalles Dam tailrace) from September 8 through early April 2010. The following is a list of steps that generally captures the progression of the operation as river flow increases until the point where TMT typically convenes to discuss the options ahead.

6.17.5. Chum Spawning Operational Steps

The steps 1 through 6 below describe the transition from complete control of the operation to conditions where the daytime range cannot be managed.

1. Operate Bonneville tailwater elevation (TWE) between 11.3 - 11.7 ft. TW all hours daily.

2. As needed, to pass water in excess of that needed to meet item 1, increase the TWE up to 18.5 ft. anytime between the hours 1700-0600.

3. If item 2 is insufficient to pass excess flow, increase TWE up to 12.5 ft. anytime between the hours of 0600 – 1700daily.

4. If items 2 and 3 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 overwhelm the chum spawning operation for multiple days. These events are usually seen well in advance and the course of action to implement is discussed at TMT. Below are some examples of the conditions where the chum operation cannot be managed within the agreed constraints.

- Conditions downstream of Bonneville produce high TWE regardless of the discharge at Bonneville such as high tides and high inflows to the Columbia River downstream of Bonneville. Bonneville can be discharging the project minimum of 80 kcfs and still exceed the target TWE range.

- Heavy westside precipitation events increase inflow to the Columbia River downstream of Bonneville. This condition combines a low required flow at Bonneville and uncontrolled inflows to the Columbia River above Bonneville. In the absence of storage capacity in the lower river, there is little control over the resulting TWE below Bonneville.

6.17.6. Chum Redd Protection Operation

Historically, by the 3rd to 4th week of December, spawning activity subsides to allow the implementation of the chum redd protection operation. Bonneville operations will shift from chum spawning operations to chum incubation operations where a minimum tailwater elevation of 11.5 ft. will be maintained 24 hours per day as a hard constraint.

6.17.7. Tribal Fishing

To accommodate tribal fishing, the Bonneville pool is normally held between elevation 75.0 and 76.5 ft. during tribal fishing times. Often the pool is held to a 1.5 ft. range.

6.17.8. 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, and if necessary, described in the 2010 FPP and the final 2010 WMP and the spring/summer update.

7. Specific Operations

7.1. *Spill operations general*

7.1.1. TDG Criteria

The Corps will continue to manage spring and summer spill for fish passage to the state of Oregon and Washington's TDG water quality criterion. These levels are referred to as

gas caps. The project maximum flow rate or spill discharge level that meets but does not exceed the gas cap, is referred to as the TDG spill cap. The gas caps are constant, whereas, spill caps may vary daily depending on flow, temperature, and other environmental conditions.

7.1.2. Adjustments to Spill

The TDG level is managed daily in response to changing conditions and adjustments in spill for fish passage will be made to manage the operation consistent with the states' TDG water quality criterion. Power system and other project emergencies, including unplanned/unanticipated facility maintenance or outages, may necessitate temporary adjustments in accordance with established protocols. A more detailed description of spill management operations are outlined in Appendix 4.

Power system and other project emergencies, including unplanned/unanticipated facility maintenance or outages, may necessitate temporary spill adjustments in accordance with established protocols.

The spill rates represented above assume average runoff conditions; however, actual conditions may require adjustments to these spill rates. Actual spill rates may increase above the specified rates resulting in TDG exceedances for several reasons including:

- TDG levels exceed the TDG standard due to exceeding powerhouse capacity at run-of-river projects resulting in spill above the BiOp fish spill levels. This condition type includes: High runoff flows and flood control efforts, BPA load requirements are lower than actual powerhouse capacity, involuntary spill at Mid Columbia or lower Snake River dams resulting in high TDG levels entering the lower Columbia River.

- Planned and unplanned outages of hydro power equipment including generation unit, intertie line, or powerhouse outages.

- TDG exceedances due to the operation or mechanical failure of non-generating equipment. This exceedance type includes: Flow deflectors unable to function for TDG abatement with tailwater elevations above 19 - 26 ft. at Bonneville Dam, spill gates stuck in open position or inadvertently left open, increased spill in a bulk spill operation to pass debris, communication errors, such as teletype were transmitted but change was not timely made or misinterpretation of intent of teletype by Project operator.

- Malfunctioning FMS gauge, resulting in fewer TDG or temperature measurements for setting TDG spill caps TDG exceedances due to uncertainties when using best professional judgment, SYSTDG model and forecasts. This exceedance type includes: uncertainties when using best professional judgment to apply the spill guidance criteria, e.g., travel time, degassing, and spill patterns, uncertainties when using the SYSTDG model to predict the effects of various hydro system operations, temperature, degassing, and travel time, uncertainties

Spill below the specified rates could occur during low runoff conditions when meeting minimum generation levels at a project requires reducing spill rates. This would most likely occur in late July and August. Minimum generation and spill rates are specified in the 2010 FPP. Spill also may be reduced or curtailed to accommodate navigation safety issues or other critical unplanned needs (i.e. health and human safety, dam safety, prevent equipment failure, maintain transmission stability, etc.).

To make adjustments in response to changes in conditions, the Corps will utilize the existing Regional Forum committees. Changes in spill rates when flow conditions are higher or lower than anticipated will be coordinated through the TMT. This could include potential issues and adjustments to the juvenile fish transportation program, or fish passage emergency.

7.1.3. Spillway Operations

Actual hourly spill quantities at dams may be slightly greater or less than specified levels. The AAs will meet the requested spill levels to the extent possible, as described. However, actual spill levels depend on the precision of spill gate settings, flow variations in real time, varying project head (the elevation difference between a project's forebay and tailwater), and other factors. Operations considerations are as follows:

Spill discharge rates: Due to limits in the precision of spill gates and control devices, short term flow variations, and head changes, it is not possible to discharge exact spill rates, or as stated in RCC spill requests to projects that call for specific spill discharges. Therefore, spillway gates are opened to the settings in FPP spill pattern tables which provide discharges that are the closest to the agreed upon spill discharge rate. The spill rates coincide with specific gate settings in the FPP spill tables. Actual spill may be higher or lower than the identified spill rate.

Spill percentages: Spill percentages are considered target spill levels. The project control room operator and BPA duty scheduler calculate spill rates to attempt to be within ± 1% of the target percentage for the following hour. These percentages may not be attained due to low flow conditions, periods of minimum generation, when spill caps limit spill amounts, when spill is curtailed for navigation safety, and other circumstances. Operators and schedulers will review the percentages achieved during the day and adjust spill rates in later hours, with the objective of ending the day with a day average spill that achieves the target.

7.1.4. Minimum Generation

The Corps has identified minimum generation flows derived from FPP tables which specify turbine operation within the ±1% of best efficiency range. These minimum generation flows are approximations and do not account for varying head or other small

adjustments that may result in variations in the reported minimum generation flow values and spill amount. Conditions that may result in minor variations include:

1. Varying pool elevation: as reservoirs fluctuate within the operating range, flow rates through the generating unit change.
2. Generating unit governor "dead band": the governor controls the number of megawatts the unit should generate and cannot precisely control a unit; variations can be ± 1% to 2% of generation.
3. System disturbances: once the generator is online and connected to the grid, it responds to changes in system voltage and frequency. These changes may cause the unit to increase flow and generation slightly within an hour.
4. Individual units may behave slightly differently or have unit specific constraints.
5. Generation control systems regulate megawatts (MW) generation only, and not flow through turbines.

All of the lower Snake River powerhouses may be required to keep one generating unit on line at all times for power system reliability. During low flows, one generator is run at the bottom of the 1% of best efficiency range. All of the Snake River plants have 2 "families" of turbines with slightly different capacities. In most cases one of the smaller units, with somewhat less generation and flow, will be online during these times. At the Snake River dams, the smaller units are generally numbered 1 – 3 and are the first priority for operation during the fish passage season. However, if smaller units are unavailable, one of the larger units may be used. Further, at Lower Monumental, generating unit 1, which is the first priority unit during fish passage, is damaged and cannot operate at the low end of the design range. However, because this unit is a fish passage priority TMT may recommend use of this unit, which will result in higher turbine discharge rates than shown in the Lower Monumental Summer Operation Considerations section below. In addition, Ice Harbor units cannot be operated at the lower end of the 1% of best efficiency range. These units experience cavitation at a generation level somewhat higher than the lower 1% limit, which damages the turbine and can be detrimental to fish. Therefore, Ice Harbor units will operate at their lower cavitation limits, as in 2009.

7.1.5. Low Flow Operations

Low flow operations on lower Snake and lower Columbia projects are triggered when inflow is not sufficient to provide for both minimum generation and the planned spill levels. In these situations, the projects will operate either one unit at minimum generation (Snake River projects) or at minimum powerhouse flow (Columbia River projects) and spill the remainder of flow coming into the project. As flows transition from higher flows to low flows, there may be situations when flows recede at a higher rate than forecasted. In addition, inflows provided by non-federal projects upstream are variable and uncertain. The combination of these factors may result in instances where unanticipated changes to inflow result in forebay elevations dropping to the low end of the MOP. Since these projects have limited operating flexibility, maintaining minimum generation and the target spill may not be possible on every hour.

Also during these low flow operations, additional flow that is passed through a dam as the result of navigational lockages becomes more apparent. This is because the volume of water needed to empty the navigation lock during periods of low flow is a greater percentage of the total flow than it had been earlier in the season. As a result, the official recorded spill percent through the spillway appears to be reduced since it does not include this volume of water needed to empty the navigation lock.

7.1.6. Operations for Transmission Stability

Because projects must be available to respond to within-hour load variability to satisfy North American Electric Reliability Council reserve requirements ("on response"), project operations may result in not meeting hourly spill requirements, mostly at McNary, John Day, and The Dalles dams. In addition to within-hour load variability, projects on response must be able to respond to within hour changes that result from intermittent generation (such as wind generation). During periods of rapidly changing loads and intermittent generation, projects on response may have significant changes in turbine discharge within the hour while the spill quantity remains the same within the hour. Under normal conditions, within-hour load changes occur mostly on hours immediately preceding and after the peak load hours, however, within-hour changes in intermittent generation can occur at any hour of the day. Sometimes, several hours after peak load hours, the project may be decreasing total outflow and generation faster than the corresponding spill decreases causing the percent spill to be slightly higher. Due to the high variability of within-hour load, these "Transmission Stability" hours may have a greater instance of reporting actual spill percentages that vary more than the +/- 1% requirement than other hours.

7.2. *Canadian Storage for Flow Augmentation*

7.2.1. Columbia River Treaty Storage

The purpose of the actions below is to see if more water from Canadian storage projects can be obtained for flow augmentation. One (1) MAF of Columbia River Treaty (Treaty) storage will be requested and negotiated when available with British Columbia (BC) Hydro to be provided and released during the migration season.

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:

- Providing the greatest flexibility possible for releasing water to benefit U.S. fisheries May 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 operating plans.

7.2.2. Non-Treaty Storage (NTS)

BPA will continue to work with BC Hydro to negotiate a non-Treaty storage agreement to provide for storage during the spring with subsequent release in July and August, for flow enhancement as long as operations forecasts indicate that water stored in the spring can be released in July and August.

A study regarding the shaping and release of water behind Canadian Treaty storage projects in July and August was completed in 2001.

7.2.3. Non-Treaty Long-Term Agreement

BPA will seek to negotiate a new long-term agreement on use of non-Treaty space in Canada so long as such an agreement provides both power and non-power benefits for BC Hydro, BPA, and Canadian and U.S. interests. As part of these negotiations, BPA will seek opportunities to provide benefits to ESA-listed fish, consistent with the Treaty. If a new long-term non-Treaty agreement is not in place, or does not address flows for fisheries purposes, BPA will approach BC Hydro about possibly negotiating an annual/seasonal agreement to provide U.S. fisheries benefits, consistent with the Treaty.

7.2.4. Non-Treaty Coordination with Federal Agencies, States, and Tribes

Prior to negotiations of new long-term or annual non-Treaty storage agreements, BPA will coordinate with Federal agencies, States, and Tribes to obtain ideas and information on possible points of negotiation, and will report on major developments during negotiations.

7.2.5. Non-Treaty Storage (NTS) Refill

BPA, in concert with BC Hydro, will refill the remaining non-Treaty storage space by June 30, 2011, as required under the 1990 non-Treaty storage agreement. Refill will be accomplished with minimal adverse impact to fisheries operations.

7.2.6. Releasing Flow Augmentation Storage

Flow augmentation storage will be released to avoid causing damaging flow or excessive TDG in the United States or Canada.

7.3. *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.

7.4. *Bonneville Chum Operations*

The AAs plan to operate the FCRPS to provide flows to support chum salmon spawning, incubation and egress in the Ives/Pierce Islands Complex, Hamilton Creek and Hardy Creek below Bonneville Dam. Also, a significant amount of special reservoir elevation and tailwater condition coordination will occur during the 2009-10 operations period to facilitate the underwater construction portion of The Dalles spillwall.

The Ives/Pierce Islands Complex below Bonneville Dam represents about 10% of the natural spawning area for the ESA listed Columbia River chum. Non-listed lower Columbia River bright fall Chinook also spawn in the area. The NMFS 2008 BiOp recognizes that access to spawning habitat in the Ives/Pierce area is primarily a function of the water surface elevations greater than 11.2 ft. above mean sea level (msl). Managing the water surface elevation with the operation of Bonneville Dam has proven to be an effective means of protecting this spawning area.

Providing spawning access to Hamilton Creek and Hardy Creek is similarly a function of sufficient tailwater elevation but must be coupled with sufficient rainfall events to get the creeks flowing sufficiently.

As addressed in the NMFS 2008 BiOp, chum salmon spawning operations have 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 chum operations; spawning which generally runs from late October through late December, and incubation and egress which runs from late December to early April.

7.4.1.1. Spawning Phase

During the spawning phase of the Bonneville/Ives Island chum salmon life cycle, the tailwater elevation will be held at a minimum of 11.3 - 11.7 ft. during the daylight hours. During night time hours the day time tailwater limits may be exceeded if needed to maintain the established daytime elevation range. This operation is generally requested (per the NMFS 2008 BiOp) to begin by TMT when a significant number of chum salmon present are spawning. Normally this occurs in the first week of November but can occur from late October through mid-November. The flow associated with providing an 11.5 ft. msl tailwater can range between 70 kcfs (Bonneville minimum discharge) and 145 kcfs depending on conditions below Bonneville Dam that have influence over Bonneville tailwater. This is a conservative approach to managing chum spawning which is intended to discourage redd development at higher elevations that cannot be maintained throughout the incubation period. If higher flows materialize, the protection level may be increased or a decision may be made whether or not to protect redds that were placed at

higher elevations. TMT will make adjustments to the tailwater elevation through the TMT process consistent with the size of the spawning population and water supply forecasts.

In order to maintain a stable tailwater elevation of 11.3 - 11.7 ft. during day-light hours, water often needs to be held over at upstream reservoirs. The volume of water held over during the day must generally be released at night. As the distance between Grand Coulee (the nearest storage reservoir) and Bonneville dams is nearly three hundred miles, it can be difficult to maintain a tailwater elevation of 11.5 ft. at all times due to the influence of significant rain events that could occur below Grand Coulee. Research performed in 2005 to assess the impacts of higher flows (day and night) on chum salmon redd development indicated that increases in flows up to 175 kcfs delayed spawning until flows dropped back to base levels (125 kcfs) but did not force fish to abandon their redds and search for new locations. Extra chum spawning flows may be available from Lake Pend Oreille (Albeni Falls Dam) during fall drawdown when drafting to elevation 2051 as part of the planning process for winter draft for kokanee spawning. The SOR for Albeni Falls draft is formulated, usually in September, by the USFWS and IDFG in coordination with NMFS and other concerned parties.

Through TMT, if water supply is deemed insufficient to provide adequate mainstem spawning or continuous tributary access, as appropriate, provide mainstem flow intermittently to allow fish access to tributary spawning sites if adequate spawning habitat is available in the tributaries.

7.4.1.2. Incubation and Egress

Washington Department of Fish and Wildlife (WDFW) will determine when chum spawning is complete; this usually occurs no later than the end of December. Following the completion of spawning, operation is shifted to provide a tailwater elevation (to be determined by TMT) equal to or greater than the elevation of the highest established redds. 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 extends 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 for fish in the gravel. Bonneville typically starts its spring spill around April 10, but a delay in the start of spill may be needed.

Revisit the chum protection level decision 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.

7.4.1.3. Typical Operation Specifications

During an average year, the following operation should begin in the first week of November or when fish arrive in sufficient numbers.

Bonneville project tailwater is held to the elevation range 11.3 - 11.7 ft. between 0600 - 1800 hours. A project tailwater elevation of 11.7 ft. must not be exceeded in any hour. Tailwater will be measured 0.9 miles downstream from the first powerhouse, 50 ft. upstream from Tanner Creek and at River Mile (RM) 144.5. This is the "project tailwater" as opposed to the powerhouse tailwater.

After spawning is declared complete, the TMT establishes a recommended protection level considering the number of redds above the protection level provided during the operation to date. The protection elevation is then held as a minimum not to be gone below in any hour until the end of emergence and egress.

After emergence and egress is declared complete by TMT, chum operations end.

7.4.1.4. General Chum Operation Considerations

Determine if operating Bonneville Dam to meet the minimum effective tailwater elevation of 11.5 ft. or greater can be sustained over the needed duration of November through April given the current water supply forecasts and status of reservoir storage.

Consider implications of augmenting flows for chum on storage water available for spring and summer migrants. Depending upon the current conditions and the water supply forecast, augmenting flows for chum can significantly diminish the stored water available for migration of salmon in the spring.

Evaluate early season forecast to help inform establishment of tailwater elevations below Bonneville. A tailwater elevation of 11.5 ft. is possible in most years.

Minimize the impact to the upstream storage reservoirs by taking advantage of tides, precipitation, increases in incremental flows below Grand Coulee, the flow in the Willamette River and the operation of Bonneville Dam to maintain the tailwater elevation.

It takes a few days for water from Grand Coulee Dam to arrive at Bonneville Dam. Requests to start the chum operation or change the current protection level should take into account the travel time. If managers expect the start of or a change in chum operations to occur over a weekend, the request must be submitted by at least Wednesday of that week.

It is difficult to forecast increase in "local" inflows downstream of Grand Coulee which can raise the daytime tailwater elevation above the planned elevation. High night time spikes in temperature of short duration can be used to discourage redd development in low velocity areas at night. High flows from the Willamette River can raise the tailwater at Bonneville Dam significantly providing low velocity access to some areas in the Ives/Pierce complex. If spawning occurs in these areas, redds may be difficult to protect once the Willamette recedes.

It is not possible to operate the system to provide desired tailwater elevations at spawning areas downstream of the Ives/Pierce complex (i.e. Multnomah Falls/I-205). Any involuntary spill including the use of the corner collector can produce high TDG levels that may impact emerging chum salmon at a very vulnerable stage in their lifecycle.

When spring flows are low and the spill season has begun it might be necessary to delay spill at Bonneville Dam to avoid impacting any emerging chum with excess TDG.

7.4.1.5. 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 and percentage of the total redds which would be affected by the decision
- The percentage of the total chum population that spawned in the creek
- The percentage of the total chum population that spawned at other locations
- The component of the overall population that these redds represent
- 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 listed stocks
- Existence and status of a brood contingency plan

7.4.1.6. Dewatering Options

Consideration of options to minimize the impacts should a decision be made to lower the protection level for the spawning, incubation and egress follow:

1. If water supply conditions indicate that it is not possible to maintain this minimum tailwater elevation at Bonneville Dam, flow will be provided at times during the chum- emergence season to allow juveniles to depart from Hamilton and Hardy Creeks. Details will be set through coordination in TMT.

2. 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.

3. Manage flows below what is necessary for mainstem spawning to discourage redds from being established in the area.

4. Shaping flows in a manner that would discourage redd development above a particular elevation. Reverse load factoring with nighttime discharges more than 75 kcfs over the daytime discharge level have occurred without impacting where chum redds were placed.

5. Shaping flows as low as possible during the day with one or two spikes of flow as short of duration as possible can also discourage redd development.

7.5. *Description of Variable Draft Limits*

Variable Draft Limits (VDL's) 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 VDL's 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.

VDL's 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.

<u>For example, Grand Coulee's January VDL is computed as:</u>

- The expected April 10 Flood Control elevation based on January forecast.
- Minus Feb1-Apr10 inflow volume of 2,424 ksfd (85% statistical inflow volume). This volume data is reduced by Banks Lake pumping
- Plus Feb1 to Apr10 minimum discharge requirement for Vernita Bar.

- Plus expected and realistic upstream refill requirement in Feb1 to Apr10 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, VDL's 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.

7.6. *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 Technical Management Team 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 first completed in April 2003 and updated in December 2003, December 2004, November 2006, and January 2009. The goals of the WQP are as follows:

- To assist in understanding system wide loading capacity and loading allocation by assessing the existing effects at Federal and non-Federal dams and tributaries.
- To provide an organized, coordinated approach to improving water quality, with the long-term goal of meeting water quality standards that the states and Tribes can integrate into their water quality management programs.
- To provide a framework for identifying, evaluating, and implementing reasonable actions for dam operators to use as they work toward reducing temperature and dissolved gas levels.
- To provide a record of the actions that are and are not feasible for structural and operational improvements aimed at improving water quality conditions and meeting water quality standards. This information may provide a basis for future beneficial use and water quality criteria revisions.
- To bring basin wide information into the decision processes regarding dissolved gas and temperature, and to provide technical assessment of a project's relative value in terms of water quality.

• To integrate dissolved gas and temperature work into one process for both Federal and non-Federal dams on the mainstem Columbia River and Snake River system. Over the long term, with a focus on water quality, WQP implementation anticipates that EPA, NOAA, and the Federal AAs will properly integrate with TMDL development and implementation activities on the mainstem and in the sub-basins.

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.

There are three purposes for the Corps to monitor TDG and water temperature in the waters of the Columbia River Basin:

1. Monitor project performance in relation to water quality standards.
2. Provide water quality data for anadromous fish passage at Columbia/Snake mainstem dams.
3. Obtain TDG and temperature data for input into the SYSTDG model used for spill cap management and predicting TDG levels under various spill operations.

The monitoring program is considered an integral part of the Corps' Reservoir Control Center water management activities.

The physical TDG monitoring program includes the QA/QC provisions specified in the "Data Quality Criteria for Fixed Monitoring Stations" completed in 2002 and recommended by the Water Quality Team. This report includes 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. These methodologies are characterized in three parts: calibration protocols (data quality control), data review and corrections (data quality assurance), and completeness of data (a substitute quality assurance program for station redundancy). Each fixed monitoring station will be assessed at the end of the monitoring season against these criteria and a performance report will be included in the Annual Dissolved Gas and Water Temperature Monitoring Report provided to the states of Oregon and Washington.

TDG is the primary water quality parameter monitored since high TDG supersaturation levels can cause physiological damage to fish. Water temperature is also measured because it affects TDG saturation levels, and because it influences the health of fish and other aquatic organisms. Both TDG and water temperature are closely linked to project water management operations (e.g., water released over the spillways, releases through the powerhouses and other facilities, and forebay and tailrace water surface elevations). One component of the Corps' water quality strategy was to take actions necessary to implement the spill program at the dams indicated in the 2000 Biological Opinion,

including obtaining variances from appropriate State water quality agencies. Since 2002, the Corps has provided information to the Oregon Department of Environmental Quality in support of a modification in the TDG standard to spill water over McNary, John Day, The Dalles, and Bonneville dams to assist out-migrating threatened and endangered juvenile salmon smolts. The TDG waiver and adjustment package and TDG monitoring plan of Action for 2010-2014 was accepted by the state of Oregon in June 2009 and the state of Washington is expected to accept it before March of 2010. With Oregon's issuance and Washington anticipated issuance, the Oregon TDG waiver, Washington adjustment and TDG Monitoring Plan of Action will be in effect for five years spanning from 2010 to 2014.

The Oregon water quality TDG criteria specify that TDG levels are not to exceed 120% in the tailwaters as measured as the average of the twelve highest hourly readings in any one day. Oregon no longer includes criteria for TDG in the forebays. The Washington TDG criteria specify that TDG levels are not to exceed 120% in the tailwaters and 115% in the forebays of downstream projects as the average of the twelve highest consecutive hourly readings in any one day. They also specify that TDG levels are not to exceed 125% on a one-hour basis (State of Washington) or on a two-hour basis (State of Oregon). Since the states of Oregon and Washington have different TDG standards, the Corps will manage spill at the Lower Columbia and Snake River projects to the more stringent of the two.

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), which is a supporting document for the WMP. This TDG Management Plan provides detailed definitions of spill, spill conditions, TDG management measures, the rationale and process for setting spill caps, the TDG management policies, and the TDG monitoring program, and modeling. This plan is consistent with both the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (NMFS) Federal Columbia River Power System (FCRPS) Biological Opinions (BiOps).

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 1971 to 2000) using the May final water supply forecast for the April to August period as measured at The Dalles (71.8 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.
- BPA will explore opportunities in future long-term NTS storage agreements to develop mutually beneficial in-season agreements with BC Hydro to shape water releases using NTS space within the year and between years to improve flows in the lowest 20th percentile water years to the benefit of ESA-listed Evolutionary Significant Units (ESUs), considering their status.
- Upon issuance of the FCRPS Biological Opinion, the AAs will convene a technical workgroup to scope and initiate investigations of alternative dry water year flow strategies to enhance flows in dry years for the benefit of ESA-listed ESUs.
- In very dry years, the AAs will maximize transport for Snake River migrants in early spring, and will continue transport through May 31 (see RPA 30).
- BPA will implement, as appropriate, it's 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.
- 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.
- BPA will explore opportunities in future long-term NTS storage agreements to develop mutually beneficial in-season agreements with BC Hydro to shape water releases using NTS space within the year and between years to improve flows in the lowest 20th percentile water years to the benefit of ESA-listed ESUs, considering their status.

10. FCRPS Hydrosystem Performance Standards

The AAs will operate the FCRPS hydrosystem as described in this draft 2010 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. 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 2010 WMP has been coordinated with and reviewed by the TMT. Seasonal action plans will be developed as described in the introduction to this plan. Additionally, operations may be adjusted in-season based on recommendations from the TMT.