

## Technical Management Team

# 1998 Water Management Plan For The Federal Columbia River Power System

July 30, 1998

*(Final version presented to and approved by the IT at its meeting on August 6, 1998, including necessary changes to reflect the provisions of the 1998 Supplemental BiOp released on May 14, 1998 and the Corps of Engineers' Record of Consultation and Summary of Decision signed on June 24, 1998).*

## I. Introduction

This 1998 Water Management Plan (Plan) describes the measures needed in 1998 to provide the fish passage conditions called for in the National Marine Fisheries Service's (NMFS) Biological Opinion (BiOp) on the operation of the Federal Columbia River Power System (FCRPS) and Juvenile Transportation Program in 1995 and Future Years, and the 1998 Supplemental BiOp. It covers all relevant factors affecting the operation of FCRPS, including federal reservoir and dam operations to augment flows under the BiOp, power generation, turbine outage and spill scheduling; water temperature control; total dissolved gas management and special operation for research and other purposes. The Plan is updated annually by 15 April of each year by the Technical Management Team (TMT). It is consistent with the TMT Guidelines and gives full consideration to the provisions of and effects on the Northwest Power Planning Council's Fish and Wildlife Program, other biological opinions, state and tribal plans and programs, the Endangered Species Act (ESA), the Clean Water Act (CWA), and other relevant operational requirements.

Five appendices are attached:

- Appendix 1: Dissolved Gas Management Plan
- Appendix 2: Emergency Protocols
- Appendix 3: Load Shaping Guidelines for Turbine Operation Outside 1% Peak Efficiency
- Appendix 4: TMT Guidelines
- Appendix 5: Maintenance Schedule Outages of Generating Units

Material that does not reflect full agreement within TMT is shown in a shaded box.

## II. Water Supply Forecasts

Pertinent water supply forecasts issued by the River Forecast Center are summarized in Table 1 for key locations on the Columbia and Snake Rivers. The final observed water supply for 1997 is also given for comparison purposes. The (May final) January - July forecast for the Columbia River at The Dalles is 89.1 million acre-feet (maf), 84% of normal. Runoff forecasts for Reclamation reservoirs above Brownlee are in the 57-82 percent of normal range.

Table 1. 1998 (and 1997) Runoff Volume Forecasts

<b>Location</b>	<b>May Final 1998</b>	<b>% of Normal 1998</b>	<b>Final 1997</b>	<b>% of Normal 1997</b>
	maf	%	maf	%
Libby (Jan-Jul)	5.20	81	8.05	126
Libby (Apr-Aug)	5.06	79	7.85	123
Libby (Apr-Sep)	5.38	79	8.35	123
Hungry Horse (Jan-Jul)	1.61	71	2.98	147
Hungry Horse (Apr-Sep)	1.50	69	3.21	147
Grand Coulee (Jan-Jul)	53.2	84	88.2	139
Dworshak (Apr-Jul)	1.73	64	4.64	172
Lower Granite (Jan-Jul)	25.0	84	49.48	166
Lower Granite (Apr-Jul)	17.4	80	33.53	155
The Dalles (Jan-Jul)	89.1	84	159.00	150
The Dalles (Apr-Sep)	79.9	81	141.06	143
Brownlee (Jan-Jul)	8.90	91	19.25	186
Brownlee (Apr-Sep)	5.99	82	12.42	163

### III. Winter Operations (October 1997 - March 1998)

#### Reservoir Refill

The BiOp states that the Corps of Engineers (COE), Bonneville Power Administration (BPA) and Bureau of Reclamation (Reclamation) shall operate the FCRPS during the fall and winter months, in a manner that provides the following levels of confidence of refill (see Table 2) to April 20 flood control at Grand Coulee, Libby, Hungry Horse and Albeni Falls while meeting the project and system minimum flow and flood control requirements prior to April 20. As a result, during the winter season leading up to the fish passage season of 1998, the Federal projects were operated with best efforts to meet the spring flow objectives recommended in the BiOp. The April 20 flood control date was revised to April 10 upon adoption of the 1998 Supplemental BiOp. It was anticipated the revised reservoir refill date would not be applied until the 1999 season.

A 60-year modeling run is routinely used to predict the expected refill probability of each of the reservoirs involved. The results of the model runs are described in more detail in Section VII, Outlook for Meeting Flow Objectives.

Table 2. Required Confidence Levels for Reservoir Refill (Source: 1995 BiOp)

<b>Libby and Hungry Horse</b>	<b>Grand Coulee</b>	<b>Albeni Falls</b>
75%	85%	90%

The maximum flood control draft varied at each project. The timing of the maximum draft also varied for each project. Table 3 provides the 1998 maximum flood control requirements at each project and the date of maximum draft at each project.

Table 3. Flood Control (FC) Requirements (based on May final forecast)

<b>Projects</b>	<b>Date of Max. FC Draft</b>	<b>Max. FC Draft Elev.</b>	<b>Min. Pool Elevation</b>	<b>Max. Pool Elevation</b>
Mica	31 March	2030.0*	2320.0	2475.0
Arrow	31 March	1401.1	1377.9	1444.0
Duncan	28 February	1812.9	1794.2	1892.0
Libby	15 March	2413.2	2287.0	2459.0
Hungry Horse	30 April	3523.4	3336.0	3560.0
Albeni Falls	30 April	2056.0	2051.0	2062.5
Grand Coulee	30 April	1270.0	1208.0	1290.0
Brownlee	31 March	2049.1	1976.0	2077.0
Dworshak	31 March	1578.0	1445.0	1600.0

(\*) in kaf. Mica flood control evacuation requirements are defined in kaf space required rather than a corresponding elevation in feet.

### Reservoir and Reservoir-Related Operations

**Libby.** Libby was operated to meet power need in the October through December period. The project drafted from elevation 2447 feet on October 1 to near elevation 2412 feet on December 31 to be near the end of December flood control elevation of 2411 feet. The end of January, February, and March flood control evacuation elevations were 2402.7, 2392.3, 2413.2 feet respectively based on each respective water supply forecast. The actual elevations at the end of January, February, and March were 2403, 2393, and 2392 respectively. By March 6, the Libby outflow was reduced to 4,000 cfs, which is minimum flow. The reservoir was unable to refill to the April 15, 1998 flood control point of 2413.2 feet. The actual elevation was 2392.6 feet on April 15. The BiOp's objective is to achieve the April 15 flood control evacuation point with 75% confidence.

**Hungry Horse.** Hungry Horse also operated for power needs in the fall. The reservoir was at elevation 3537 feet on October 1 and drafted to elevation 3521 feet on December 31. Based on each month's successive water supply forecast, the end of month flood control evacuation requirements were 3549.5, 3538.4, and 3533.1 feet at the end of January, February and March, where the actual elevations were 3515, 3509, and 3508 feet. Hungry Horse is evacuated somewhat in December in order to easily reach the April 15 flood control elevation. The April 15 to April 30 flood control evacuation continues to draft the reservoir. Since April inflows to Hungry Horse can be far in excess of the powerhouse capacity, the reservoir is evacuated to the end of April flood control elevation prior to April to avoid spilling at Hungry Horse in April. By March 24 Hungry Horse outflow was reduced to minimum as the unregulated flow at Columbia falls increased. On March 24 the pool elevation was 3505.64 feet. By April 30 the pool had filled to elevation 3519.6 feet. The BiOp recommends 75% confidence of achieving the April 15 flood control evacuation point. In 1998 that elevation was 3531.2 feet, and the end of April flood control point was elevation 3526.7 feet. On April 15 and April 30 the reservoir was at 3511.7 and 3519.6 feet, respectively. Beginning in January, Hungry Horse was operated to meet flow objectives at Columbia Falls.

**Albeni Falls.** During the winter of 1997-1998, Albeni Falls is completing the second year of a three-year test where the winter lake elevation is kept near 2055 feet throughout the winter. Lake Pend Oreille was near elevation 2060.0 feet on October 1 and evacuated to elevation 2055.0 feet by November 20. During December 1997 Lake Pend Oreille operated between elevation 2055.0 feet

and 2055.5 feet. In January the lake began operations between elevations 2055.0 and 2056.0 feet. This operation continued through April 30.

**Grand Coulee.** At Grand Coulee the project operated near elevation 1283 feet through October and November while attempting to assist to establish Vernita Bar protection levels as low as possible. The reservoir ended December at elevation 1274.9 feet. The flood control evacuation requirement on April 15 is elevation 1283.3 feet. Extraordinary drum gate maintenance and repair work was made necessary due to an identified priority need to secure dam safety, and therefore public safety. During the first half of February 1998, Coulee was drafted to elevation 1255 feet, which is the elevation required for the maintenance work. Reclamation's decision involves balancing its responsibilities for public safety with other Federal obligations including the Biological Opinion. This repair work covering all eight drumgates was completed the last week of March 1998.

In System Operation Request 98-4 (dated February 25, 1998) the salmon managers requested that Reclamation accelerate the work on the original four drumgates so that it could be completed by March 15 rather than early April. The concern of the salmon managers was that the actual end-of-April upper rule curve elevation could be much higher than that projected in the February final runoff volume forecast. If that happened, delaying refill would require a dramatic reduction in outflow from Coulee in April when salmon and steelhead smolts were beginning to migrate. The Bureau of Reclamation's response on March 2 was to accelerate the work but increase the scope of the work to include all 8 drumgates and retain the same work period, with the reservoir held at 1255' until the first week of April.

While the work was in progress, several events occurred. The March final runoff forecast declined from the February final and the end of April upper rule curve elevation at Grand Coulee went up to 1270'. During the week of March 22-28, there was an unanticipated runoff event that necessitated heavy spill at Grand Coulee despite storing water to elevation 1258'. As a result, total dissolved gas below the project was well in excess of state standards. After the work was completed, the April final forecast showed an end of April upper rule curve elevation for Coulee of over 1283', which meant that 26' of water must be stored in the project in order to meet the April 20 BiOp elevation. The project operated to provide the Vernita Bar minimum of 65 kcfs, with hourly average flows as low as 64.9 kcfs and was refilling while attempting to meet the April 20 flood control elevation. The project did not achieve this elevation however, and daily average flow in the mid-Columbia below Priest Rapids were 65 kcfs to 135 kcfs. By May 3, FDR Lake was back to its flood control elevation and the project continued to operate for multi-purpose uses.

**Brownlee.** As in the past, the Brownlee operation will be designed to promote spawning, to protect redds, and to assist with juvenile outmigration. In general, Idaho Power Company anticipates actions consistent with the Settlement Agreement, the "Strategy for Salmon," and the National Marine Fisheries Service's "Biological Opinion". In particular, the following is the more specific action. Brownlee was at elevation 1987.9 feet on October 19. The project released 12,000 cfs from October 19 through December 8 to promote fall chinook spawning. Outflow was generally greater than 12,000 cfs from December 9 through the end of the month and the project was at elevation 2072.56 feet on December 31. The end of January, February, and March flood control evacuation points are 2077, 2044.5, and 2049.1 feet, respectively. The observed end of January, February, and March elevations were near 2068 feet, 2050 feet, and 2064 feet, respectively. The April 15 flood control evacuation point is 2069.9 feet and the observed elevation on April 15 was 2069.09 feet. Note that this is not a shifted flood control operation.

**Upper Snake River.** Reclamation's reservoirs in the Upper Snake River basin are operating near storage levels required for 1998 spring flood control objectives. Projects are either releasing their

seasonal minimum flows or passing inflow to maintain flood control space until April. The early January forecasts were significantly below normal, but have shown a steady improvement throughout January. They currently range from 82% to 92 % of average in the Boise, Payette, and Snake above Heise. The cumulative April 1, 1998 flood control requirement in the Boise, Payette, Snake River above Heise Basins is about one million acre-feet of storage space. The outlook is very favorable for having water in storage to provide 427,000 acre-feet for 1998 flow augmentation. However, this water will not be available for release until after it accrues into the storage banks during the spring runoff in April, May, and possibly early June.

**Dworshak.** The Dworshak project had been evacuated to elevation 1500 feet at the end of August 1997 to safely complete grouting work at the dam. The project operated near elevation 1500 through the end of November while the grouting contract continued. On December 1, 1997 the project gave permission to begin refill of the project. This was 15 days earlier than expected. The outflow was immediately reduced to 1300 cfs. By the end of December the reservoir was near 1505 feet. The end of January, February, and March flood control points at Dworshak were 1564.3, 1560.0 and 1578.0 feet, respectively. Although the project continued to release 1300 cfs, the elevations at the end of each of those months were near 1512 feet, 1524 feet, and 1545 feet. The April 15 flood control elevation was 1595.4 feet. The observed April 15 elevation was 1560.2 feet, when outflow was increased to full powerhouse capacity of 9900 cfs for flow augmentation downstream at Lower Granite. Since the project was on minimum flow and having difficulty achieving April 15 flood control point, shifting of flood control between Dworshak and Grand Coulee was not possible in 1998.

**Lower Snake River Projects.** The lower Snake River projects operated within the normal operating range. Ice Harbor flip lip construction was completed.

**Bonneville.** Minimum instantaneous flows of 128.5 kcfs were maintained below Bonneville, starting in early December 1997. This was made at the Salmon managers' request and with the Implementation Team's support to protect incubation of the eggs deposited by an estimated 5,000 spawning (non-listed) fall chinook. Subsequent to this, lower Columbia River chum salmon, which are being considered for listing, spawned in close proximity to the fall chinook. A separate request for spawning and rearing flows for chum was not made subject to technical difficulty in determining what flows should have been.

Subsequent to this request, river flows downstream from Bonneville Dam were maintained at from 190 to 200 kcfs during the time that chum salmon spawned. The chum salmon spawning area, including several individual redds, was mapped in mid-December at a Bonneville discharge of 190 kcfs. Water depth over one of the highest redds, which has been referred to as the index redd, was 2.3 feet. The Fish and Wildlife Service also measured water depth over the index redd at flows of 160 kcfs, 145 kcfs, and 135 kcfs and found them to be 2.3 feet, 0.9 feet, and 2.4 feet at those respective flows. These observations demonstrated that this area is subject to dynamic hydraulic conditions, possibly resulting from a tidal effect, and that modeling is necessary to quantify that effect. The Fish and Wildlife Service installed a water level recorder near the index redd to collect a continuous record of water depths for comparison to Bonneville Dam discharge. Data from the water level recorder showed that the index chum salmon redd was de-watered on March 8 for 2 hours 15 minutes at flows of 146 to 147 kcfs; on March 10 for 5 hours at flows ranging from 141 to 150 kcfs; and on March 15/16 for 16 hours 30 minutes at flows ranging from 149 to 154 kcfs. In SOR 98-5 the fishery agencies had requested instantaneous flows of 160 kcfs in association with spill at Bonneville Dam beginning on March 13 for the release of fall chinook salmon from Spring Creek National Fish Hatchery.

#### **IV. General Spring/Summer Water Allocation Guidelines**

The BiOp provides some overall water allocation guidance regarding spring versus summer flows. The BiOp states that in general, water will be conserved for flow augmentation in July and August, unless doing so would result in significant departures from spring flow objectives (page 102 of the BiOp). To achieve the conservation of water for summer flows, the BiOp states that the water management plan should generally include operation of all Columbia River reservoirs to refill by June 30, with gradual releases to the draft limits through July and August (page 102).

The BiOp also states NMFS' goal for operations of the Columbia River is to operate the FCRPS in such a way that flow objectives are met during the spring chinook migration and reservoirs are full on June 30 (page 96). Having reservoirs full on June 30, when natural runoff declines, results in the greatest amount of water available for the summer migration period (page 96). Having reservoirs at flood control on April 20 increases the likelihood that spring flow objectives will be met and the reservoirs will be full on June 30 (page 96). The April 20 flood control date was revised to April 10 upon adoption of the 1998 Supplemental BiOp. It was anticipated the revised reservoir refill date would not be applied until the 1999 season.

As called for in the 1998 Supplemental BiOp, in years when the April 1<sup>st</sup>, April-to-August 50 Percent Confidence Volume Forecast at The Dalles is less than average, the volume of water available for spring flow augmentation on both the Columbia and Snake Rivers would be constrained, as necessary, to achieve refill of reservoirs by June 30. That is, the use of available reservoir storage would be prioritized for summer migrants.

As defined in the 1995 BiOp (page 101), the purpose of the TMT is to "*advise the operating agencies on dam and reservoir operations to optimize passage conditions for juvenile and adult anadromous salmonids*". In-season adjustments will be made if and when allowed in the BiOp based on real-time conditions to guide the use of water in the Snake and Columbia Rivers with the goal of creating hydrographic conditions that provide the greatest survival for listed salmon (BiOp page 102). Some examples of cases and conditions where the TMT was explicitly given in-season flexibility included the following:

- reservoir draft for flood control (page 95)
- additional storage water release from Brownlee operation, (page 101)
- flood control shift (page 101)
- summer reservoir drafts (page 102)
- actual start/end dates of flow augmentation season (page 103)
- spill at collector projects (page 105)

The actual timing of flow augmentation and refill, and the degree to which the refill objective is met will be determined by the TMT. The TMT will give consideration to stock status, fish migration characteristics, and river conditions. The timing of operations to refill reservoirs may vary with the volume of reservoir inflow.

Operations to refill Libby may result in refill at a date later than June 30 in high flow years and in years when flow augmentation is required for listed Kootenai River sturgeon.

## V. Spring Operations (April-June)

### Spring Flow Objectives at Lower Granite and McNary

The spring flow objective at Lower Granite is based on the April final volume runoff forecast, modified by the May final forecast, and using the sliding scale provided in the BiOp. In 1998, based on the May final April-July runoff forecast of 17.4 maf at Lower Granite (which is greater than 16 maf and less than 20 maf), the spring flow objective is 90.3 kcfs. The spring flow objective at McNary is based on the May final January-July volume runoff forecast for The Dalles and another sliding scale provided in the BiOp. In 1998, based on the May final January-July runoff forecast of 89.1 maf at The Dalles (which is greater than 85 maf and less than 105 maf), the spring flow objective will be 228.6 kcfs.

Table 4. BiOp Spring Flow Objectives (based on May final runoff forecast)

<b>Lower Granite</b>		<b>McNary</b>	
<b>Period</b>	<b>Flows (kcfs)</b>	<b>Period</b>	<b>Flows (kcfs)</b>
4/10-6/20	90.3	4/20-6/30	228.6

Although the BiOp flow objectives are expressed as seasonal, the TMT in-season management process reviews hydrologic conditions and the status of the migrations on a weekly basis. The TMT should also attempt to shape flow augmentation water to the fish migrations on a week-by-week basis in a manner that optimizes benefits to the listed salmon species. This may involve weekly requests for flow levels higher or lower than the seasonal average objective, while still trying to refill by June 30 (BiOp page 102). In making these weekly requests, the TMT will weigh the biological benefits of flows above the seasonal flow objective against the biological benefits to listed salmon that would occur when this water could otherwise be used. Flow management for listed species is TMT's primary goal, but some consideration of the other implications (e.g. economics, other affected species, recreation, etc.) of the alternatives should be given.

Provided that flow augmentation water as identified in the BiOp is available, and absent safety concerns, physical constraints, or conflicting legal requirements, weekly flow requests will be implemented consistent with a June 30 refill goal. During the juvenile migration season (April 20 - August 31), McNary average daily outflow on weekends will be managed to be no less than 80% of the preceding week's average weekday outflow to minimize daily fluctuations.

The goal of the BiOp is for Dworshak, Libby, Hungry Horse, and Grand Coulee to be full on June 30, acknowledging that this may not be feasible under all water conditions (BiOp, page 96). Operations to refill Libby may result in refill at a date later than June 30 in high flow years and in years when flow augmentation is required for listed Kootenai River sturgeon.

Brownlee is expected to operate to guarantee refill to at least 2069 feet by June 7 and full pool by June 30.

The Dworshak project will operate to refill near the end of June. During the period April through June the outflow from Dworshak will be mostly at the minimum flow of 1.3 kcfs, except during periods when it may be at outflows up to 22 kcfs for flow augmentation purposes. The 22 kcfs release corresponds to 120% TDG below the project. This combined with the outflow from Brownlee is expected to result in spring period (April 10 -June 20) average flows at Lower Granite at, or above, the spring flow objective of 90 kcfs as computed based on the May final water supply

forecast. As the unregulated spring weekly average flows are not projected to be less than 85 kcfs, spill at Lower Granite will be provided. Based on this forecast, spill at Lower Granite, Little Goose, Lower Monumental and Ice Harbor will be provided as required by the BiOp, up to the relevant spill caps.

Idaho stresses prioritizing available flow augmentation for the spring migration period. Idaho does not believe the June 30 refill goal should override the need to ensure Lower Granite flows do not drop below 100 kcfs during the spring migration period.

Spring Flow Objective for the Mid-Columbia River

As stated in the 1998 Supplemental BiOp (Pages III-2 to III-7), the NMFS' goal for operations in the mid-Columbia is to operate the FCRPS to match available water to fish movement during the spring and see that reservoirs are refilled by June 30 of each year. The actual timing of flow and the degree to which the June 30 refill objective is met would be determined by the TMT. The TMT, in recommending the shaping of flows in the mid-Columbia, would consider the desire to meet an average flow objective of 135 kcfs at Priest Rapids during the period April 10 through June 30, the desire to refill by June 30, timing, magnitude of the juvenile migration, water temperature, spill and total dissolved gas levels, adult fish and other requirements for improved survival of listed fish. The TMT may consider and implement flows lower than the objective during the early part of the steelhead migration when fewer fish are present, particularly in low flow years. Flows greater than the objective may be provided on a weekly basis during key points in the migration, while acknowledging that lower flows would then need to occur later in the spring migration as a result of the desire to refill reservoirs by June 30 to provide flow augmentation for summer migrants.

Snake Reservoirs at MOP

The lower Snake River reservoirs will be operated within one foot of minimum operating pool (MOP) from April 10 until adult fall chinook salmon begin entering the lower Snake River (late August). However, navigation problems caused by rock outcropping forced Ice Harbor to operate at MOP+1. The operating ranges are shown in Table 5.

Table 5. Lower Snake River Reservoirs Operating Ranges

<b>Reservoirs</b>	<b>MOP (ft)</b>	<b>Normal Operating Range (ft)</b>
Lower Granite	733 - 734	733 – 738
Little Goose	633 - 634	633 – 638
Lower Monumental	537 - 538	537 – 540
Ice Harbor	437 - 438*	437 – 440

(\*) This was revised to MOP+1 (438-439) on April 20, 1998.

MOP draft and refill operations will be determined by TMT and done in a manner that provides fish benefits, while avoiding exceedence of state TDG standards, if possible. This will be accomplished through proper timing of the draft at each individual reservoir, proper sequencing of the operation, and controlling the draft rate. Detailed draft operation will be discussed in-season.

### Other Reservoir Spring Operation

Libby began the spring season near elevation 2392 feet. During the period April through June, the project will attempt to refill and meet the sturgeon operation as requested by US Fish and Wildlife. The Corps will attempt to meet 15 kcfs at Bonners Ferry in May and try to deliver a single pulsing operation at Bonners Ferry when the water temperature reached 10 degrees Celsius. Once the pulsing operation has been completed, the project will attempt to meet 21 days of incubation flow at Bonners Ferry of 25 kcfs, and finally refill some time in July. Libby may be drafted to a deeper elevation to provide flows for sturgeon spawning or to meet flow objectives in low flow years in accordance with the BiOp (page 102). Operations to refill Libby may result in refill at a date later than June 30 in high flow years and in years when flow augmentation is required for listed Kootenai River sturgeon.

At Hungry Horse the project is expected to begin April near the flood control point, where the April 15 flood control point is elevation 3531.2 feet. During the period April through June, the project will attempt to refill and meet Columbia Falls minimum flow requirements of 3,500 cfs or greater or local and system power needs.

Albeni Falls will start April near its winter elevation of 2055 feet. The end of April maximum elevation is 2056 feet. Lake Pend Oreille is expected to be full by the end of May.

Grand Coulee was drafted to elevation 1255 feet for drum gate repair beginning mid-February. As soon as practicable, the project began to refill toward the April 20 flood control elevation on April 1. By April 20, FDR Lake was at elevation 1272.8 feet. The end of April elevation was 1276.9 feet. Grand Coulee will operate in the spring to refill and augment flow at McNary as needed. The April 20 flood control date was revised to April 10 upon adoption of the 1998 Supplemental BiOp. It was anticipated the revised reservoir refill date would not be applied until the 1999 season.

Based on the operations described above, the seasonal flow (April 20 - June 30) at McNary may be near 231,000 cfs (per weekly flow projection spreadsheet dated 5/06/98). The COE will operate John Day pool between elevation 262.5 feet (5.5 feet above minimum operating pool) and 264.0 feet from May 1 until August 31. This elevation range will be maintained for as long as possible without impacting irrigators around the reservoir. The pool will be raised as needed to ensure that irrigators are not adversely affected. The John Day pool may also be fluctuated as needed for short duration flood control. Use of the John Day pool to help in controlling TDG conditions downstream from the project will also be considered.

### Spring Spill for-fish-passage

As called for in the 1998 Supplemental BiOp (page III-5), the actual spill levels should be determined each year in the Water Management Plan developed through the Regional Forum. The actual dates of spill should be determined annually by the TMT based on in-season monitoring information. Planning dates for spring spill are April 3 to June 20 in the Snake River; April 20 to June 30 in the lower Columbia River.

A summary of the general guidance on spill requirements and other considerations provided in the 1998 Supplemental BiOp (Pages III-11 through III-17) is listed in Table 6.

Table 6. Summary of Spill Requirements and Other Considerations

<b>Project</b>	<b>Flow trigger</b>	<b>Spill Duration</b>	<b>Recommended Min/Max Powerhouse Capacity <sup>(1)</sup></b>	<b>Spill Cap for 120% TDG <sup>(2)</sup> at the start of the spring season</b>	<b>Other Considerations (per 1998 Suppl. BiOp Appendix C) to prevent eddy formation, improve fish passage, etc.</b>
	<b>Kcfs</b>	<b>hours</b>	<b>kcfs</b>	<b>kcfs</b>	<b>% of flow or kcfs</b>
LWG	85	12 <sup>(4)</sup>	11.5/123	45	
LGS	85	12 <sup>(4)</sup>	11.5/123	60	35% max <sup>(3)</sup> , page C-11
LMN	85	12 <sup>(4)</sup>	11.5/123	40	50% max <sup>(3)</sup> page C-11
IHR		24	7.5/94	75	
MCN		12 <sup>(4)</sup>	50/175	120-160	
JDA		12 <sup>(5)</sup>	50/	180	60% max (for flows up to 250-300) or TDG cap (whichever is less) 25% min (due to eddy) See page C-13
TDA <sup>(6)</sup>		24	50/	230 <sup>(5)</sup>	<sup>(6)</sup> 64% max 30% min (test). See page C-14
BON		24	30 min. (BPA); see page C-14. 60 min. (FPP)	120	50 kcfs min. spill (tailrace hydraulics); 75 kcfs max. daylight hours (adult fallback) See page C-14

1. Max. value is for powerhouse with units operating within 1% peak efficiency
2. Starting value subject to in-season adjustments based on real-time information
3. Levels provided in the 1998 BiOp to prevent eddy formation and maintain good adult passage conditions. May be adjusted in-season by TMT
4. Normally between 1800-0600 hours
5. From 1900 to 0600 from May 15 to July 31 and from 1800-0600 in August at John Day.
6. Spill at TDA is limited to the 1995 BiOp level of 64% (rather than spilling to the TDG cap). Limit to 30% spill for approximately 50% of the 1998 fish passage season (based on additional tests)

The 1998 Supplemental BiOp recommends spilling to a level that is only controlled by the 120% TDG limit, which is somewhat different than the 1995 BiOp. Spill caps to be implemented at all projects during the juvenile spring/summer chinook migration season (April 3 - June 20 in the Snake River and April 10 - June 30 in the Columbia River) are provided in Table 6. The 1998 BiOp (page III-8) also recommends that spill be implemented at all three Snake River collector projects "when seasonal average flows are projected to meet or exceed 85 kcfs". In-season adjustments of the spill caps will be made based on actual TDG levels measured below the projects.

The states have granted comparable standards waivers as in the past, i.e. 120% TDG in the tailrace, 115% in the forebay of the next downstream dam, and a maximum of 125% for no more than 2 hours. However, Oregon, at the February 20 EQC hearing, did not grant a 120% TDG waiver for March 13-23 below Bonneville Dam to implement spill for Spring Creek Hatchery releases. To minimize high TDG conditions throughout the system, a spill priority list will be developed for implementation based on the applicable TDG standards. The list shown in Appendix 1 will be reviewed by the DGT prior to its use. It will then be updated as needed based on real-time as well as predicted TDG data and fish movement and biological conditions.

The BiOp also states that the best condition for an evaluation of the effects and efficacy of spill to improve in river survival would be for a single spill regime to prevail throughout the spring migration season. Therefore, the TMT may recommend that spill occur under certain conditions, including when the number of fish arriving at the projects are significant and when the flows are expected to reach trigger levels during most of the spring season.

## VI. Summer Operations (July-August)

### Summer Flow Objective at Lower Granite and McNary

The seasonal average flow objectives for Lower Granite and McNary dams are shown in Table 7, based on the May final water supply forecast. The summer flow objective at Lower Granite is determined using the BiOp sliding scale and based on the April-July runoff forecast of 17.4 maf at Lower Granite. The flow objective for McNary is a fixed 200 kcfs.

Table 7. Biological Opinion's Summer Flow Objectives

<b>Lower Granite</b>	<b>Lower Granite</b>	<b>McNary</b>	<b>McNary</b>
<b>Period</b>	<b>Flows (kcfs)</b>	<b>Period</b>	<b>Flows (kcfs)</b>
6/21-8/31	50.6	7/1-8/31	200

Although the BiOp flow objectives are expressed as seasonal, the TMT in-season management process reviews hydrologic conditions and the status of the migrations on a weekly basis. The TMT should also attempt to shape flow augmentation water to the fish migrations on a week-by-week basis in a manner that optimizes benefits to the listed salmon species. This may involve weekly requests for flow levels higher or lower than the seasonal average objective. In making these weekly requests, the TMT will weigh the biological benefits of flows above the seasonal flow objective against the biological benefits to listed salmon that would occur when this water could otherwise be used.

Flow management for listed species is TMT's primary goal, but some consideration of the other implications (e.g. economics, other affected species, recreation, etc.) of the alternatives should be given. The interim draft limits specified in the BiOp (page 95) on reservoir elevations through August 31 are 1280 feet at Grand Coulee, 2439 feet at Libby, 3540 feet at Hungry Horse, and 1520 feet at Dworshak (see Table 8), regardless of the June 30 reservoir elevations. Reservoirs are not always required to be drafted to the draft limits (see below). As recognized in the BiOp (page 97), *"operations for anadromous fish [should] not place at risk other portions of the Columbia Basin ecosystem and the resident fish and wildlife that rely on the reservoirs."*

Provided that flow augmentation water as identified in the BiOp is available, and absent safety concerns, physical constraints, or conflicting legal requirements, weekly flow requests will be implemented. During the juvenile migration season (April 20 - August 31), McNary average daily outflow on weekends will be managed to be no less than 80% of the preceding week's average weekday outflow to minimize daily fluctuations.

### Summer Reservoir Interim Draft Limits

In allocating water for use in meeting summer flow objectives, interim limits were placed on reservoir drafts to minimize risks to other fish and wildlife in the Columbia Basin (Table 8).

However, as stated in the BiOp (RPA 1(f), page 102), “the TMT may recommend lower summer reservoir elevations if necessary to meet flow objectives depending on the circumstances of the runoff and the salmon migration (e.g., a low water year that is one in a series of low water years and an outmigrating population of fish that represents a strong year class). In general, lower summer reservoir elevations will only be recommended when the upper rule curve goals were not met on April 20 at Grand Coulee and Albeni Falls, or when The Dalles April-August unregulated runoff is expected to be less than 65 MAF, determined as of June 30.”

Table 8. BiOp Interim Summer Reservoir Draft Limits (in feet) Through August 31

<b>Grand Coulee</b>	<b>Libby</b>	<b>Hungry Horse</b>	<b>Dworshak</b>
1280	2439	3540	1520

At Libby, draft to provide flows for white sturgeon spawning (RPA 1(a)) does not, in itself, preclude drafting below the interim draft limit to meet flow objectives for salmon in accordance with the conditions and process described in RPA 1(f) of the BiOp. The USFWS and NMFS, in coordination with the states and Tribes, will make the best efforts to balance the flow requirements of both species and make recommendations to the TMT. The Corps will evaluate those recommendations consistent with its 1995 and 1997 Records of Decisions, and its 1998 Record of Consultation and Summary of Decision, which state that :

*"The Corps will operate Libby Dam in an attempt to meet the sturgeon flow requirements consistent with existing treaties and laws, and will reduce releases if monitoring identifies potential adverse effects of flooding and/or bank erosion, or if requested to reduce releases by USFWS. If, at the conclusion of the operation for sturgeon, Lake Koocanusa is above elevation 2439 on or before August 31, the Corps may, if necessary lower Libby Reservoir to elevation 2439 by August 31 to meet salmon flow objectives without spilling at Libby."* NMFS does not agree with this interpretation by the Corps and, hence, the above material is shown in a shaded box as a placeholder. As a result, it is anticipated that any decision that would involved drafting Libby below its interim draft limit will have to be resolved at the IT or higher level.

Based on the May final water supply forecasts, 1998 does not have an unregulated runoff less than 65 maf at The Dalles for the April through August period, nor is it one in a series of low water years. On April 20, 1998 Grand Coulee pool was at elevation 1272.8 feet; and Albeni Falls pool, at elevation 2056.1 feet. Corresponding pool elevations on April 30 were respectively 1276.9 and 2055.8 feet. By comparison, the April 30 flood control elevations at those two projects are respectively 1282.4 and 2056 feet. Based on this information, Grand Coulee was unable to achieve its flood control elevation on April 20, or April 30, 1998. Consequently the Bureau of Reclamation may consider draft below the interim draft limit at Grand Coulee in 1998. As of July 22, 1998, these discussions are continuing at the IT level.

#### Upper Snake River Reservoir Operation

Per the BiOp (page 101), “the TMT shall coordinate with Idaho Power Company (IPC) for the provision of additional stored water for flow augmentation from Brownlee Reservoir if necessary to meet the flow objectives at Lower Granite.” TMT will coordinate with IPC the release of a total of 237 kaf during the summer from Brownlee Reservoir in addition to water that might be drafted from Brownlee to deliver 427 kaf from USBR projects in the Snake River. TMT will also coordinate with IPC alternative operations during the summer, fall, and winter to optimize migration and spawning conditions in the lower Snake River and below Hells Canyon Dam. Delivery details of the 427 kaf of Upper

Snake River water will be worked out between the state of Idaho, USBR, IPC, BPA, and the Salmon Managers (See Section VIII for more up-to-date information). The TMT will provide recommendations on the actual delivery of the Reclamation 427 kaf water to optimize downstream migration conditions for migrating listed salmon.

The Bureau of Reclamation plans to use four sources of water for Snake River flow augmentation, as shown in Table 9.

Table 9. Sources of Water for Snake River Flow Augmentation

<b>Source</b>	<b>Acre-Feet</b>	<b>Prospects as of 6/23/98</b>
Oregon	17,847	Reclamation natural flow right (part of Skyline Farms).
Boise	40,932	40,932 af of USBR storage. Additional rentals may be made.
Payette	145,000	95,000 af of USBR storage plus rental pool rentals
Upper Snake	223,221	23,000 af of USBR storage plus rental pool rentals limited to amount needed to complete 427,000 af.

The actual amount of augmentation water provided from each basin will depend on the amounts of water consigned for rentals from the three Idaho Rental Pools. Reclamation plans to make releases in patterns similar to those of 1996 and 1997. Implementing this strategy would result in flows in the range of 1,500 cfs at Milner, 400 cfs above irrigation flow from Lucky Peak, and 1,000 cfs above irrigation flow from Cascade and Deadwood. The Payette water releases will likely be split with a summer and winter release, assuming that Idaho Power shapes flows. Previous Payette seasonal splits have been 60/40 and 50/50 for summer/winter. The 1,500 cfs release past Milner also assumes Idaho Power Company will provide shaping. Releases would generally start when storage releases for irrigation commence. Reclamation will work closely with the appropriate watermaster and other parties on the specific timing and volume of releases. Reclamation will also work with the Idaho Power Company to manage flow augmentation flows through Brownlee.

Inasmuch as the watermasters are agents of the Department of Water Resources, Reclamation assumes that coordination with the watermasters will satisfy the seven-day notice provision in the June 6, 1995 order.

Reclamation, BPA, and Idaho Power Company will coordinate with TMT to manage delivery of flow augmentation from Brownlee.

Other Summer Reservoir Operations

During the July - August period Dworshak will draft to as low as elevation 1520 feet. Note that this depends on the maximum allowable outflow. The maximum outflow without exceeding 110% TDG is 14 kcfs.

As best possible, Brownlee may be used to delay Dworshak drafting below 1580 feet until early to mid-August.

The state of Idaho and CRITFC recommend a Dworshak draft only to a maximum of 1535 feet by the end of August to allow use of approximately 15 feet of storage (200 kaf) for release in the fall and early winter to aid adult steelhead and fall chinook conversions.

It is expected that Brownlee will operate to guarantee refill to 2059 feet by the end of September.

Based on the Brownlee and Dworshak operations described above, the seasonal summer flow (June 21 - August 31) at Lower Granite is expected to be 46 kcfs on average (per weekly flow projection spreadsheet dated 5/06/98).

In 1995, 1996 and 1997, the Libby-Arrow swap has been executed, which made it possible for Libby to stay full many more weeks into the summer. The potential for repeating this beneficial, volume neutral operation will be reexamined in 1998, subject to concurrence from Canada. The exchange, if it occurs, will be fully documented.

Albeni Falls will be full by the end of May and will pass inflow through July and August.

Grand Coulee is expected to be full by the beginning of July. The Grand Coulee summer draft limit is ten feet to elevation 1280 feet. The BiOp stated this draft limit may be exceeded if needed to meet the flow objective at McNary.

#### Summer Spill for-fish-passage

As called for in the 1998 Supplemental BiOp, the actual spill levels should be determined each year in the Water Management Plan developed through the Regional Forum. The actual dates of spill should be determined annually by the TMT based on in-season monitoring information. Planning dates for summer spill, where applicable, are the same as in the 1995 BiOp. Summer spill requirements/limitations would be as shown previously for spring spill. Summer spill is only required at Ice Harbor, John Day, The Dalles and Bonneville.

During the fall chinook migration season (June 21 to August 31 in the Snake River, and July 1 to August 31 in the Columbia River), the Corps is prepared to implement the 1998 BiOp by spilling up to the 120% TDG at all non-collector projects (Ice Harbor, John Day, The Dalles and Bonneville). Spill periods are 24 hours at Ice Harbor, The Dalles and Bonneville, and 1800-0600 (May-July) and 1900-0600 (August) at John Day.

The action agencies do not propose any change from the operation for transporting juvenile summer migrants that was described in 1995 RPA Measure 3. The action agencies propose to continue evaluating fall chinook transport. As before, the transportation collector projects should be operated to maximize collection and transportation (i.e., no voluntary spill except as needed for approved research) during the summer migration. In general, the switch from spring to summer spill operation will occur on or about June 20. In practice, the TMT has the discretion to make the switch earlier or later based on monitoring of in-river conditions. When more favorable spring-like flow and temperatures either end before or extend after June 20, the actual date to end spill at collector projects should be modified, continuing to spread the risk of transport versus in-river passage for spring migrants so long as favorable flow and temperature conditions persist.

Current spill caps for the 120% TDG level were listed in Table 6.

Spill for-fish-passage will be subjected to the state standards for TDG as determined by the spill caps to be adjusted in-season based on actual TDG readings.

## VII. Outlook for Meeting Flow Objectives in 1998

A 59-year (1929-1987) monthly flow computer simulation was made by the COE Power Branch in January, February and March based on the updated 1998 runoff forecasts at Lower Granite and The Dalles. The model simulation provides an estimate of the expected flows at Lower Granite and McNary for any of the 59 years having the January--July runoff volume as the water supply volume forecasted for 1998. When more reliable information becomes available, the results of the 59-year monthly study are superceded by weekly flow projections made more specifically for 1998 (see below).

Study assumptions for the March 1 computer simulation run are as follows:

- Stream flows were adjusted based on the March final water supply forecast using the January-July volume. August unregulated flows were adjusted using the same ratio as in previous periods;
- Starting elevation: Treaty projects use 90-day values (Mica, Arrow, and Duncan). Other projects use actual 28-Feb-98 2400 hours data. For Corra Linn (1738.48) use Queen Bay's value (1742.06);
- April 15 – August 15 run on target flow (kcfs):

<b>Projects</b>	<b>Apr2</b>	<b>May</b>	<b>Jun</b>	<b>July</b>	<b>Aug1</b>	<b>Aug2</b>
Lower Granite	96	96	81	51	51	51
McNary	233	233	233	200	200	200

- Dworshak: minimum flow 1,300 cfs Jan-Apr 15, no flood control on Apr 15, try to meet summer flow objective at Lower Granite and be on Aug 30 target elevation of 1520 ft, Jun-Aug maximum release of 14,000 cfs to help reach exactly elevation 1520 ft on August 30;
- Canadian project fixed operation using actual Treaty storage values; plus 1 maf storage in Arrow on March 30. Use 90-day values from B.C. Hydro. Change Duncan Aug 15 to Aug 30 to 1892.0. Change Mica Aug 15 and Aug 30 to 2469.8. Change Arrow Aug 15 to 1440.0 and Aug 30 to 1444.0.
- Arrow March elevation is 1283.2; Apr 15 and Apr 30 run on target outflow of 20,000 cfs; May elevation 1408.6.
- Operating on new flood control curves from Jan-Apr 30 at Libby, Hungry Horse, Dworshak, and Grand Coulee;

Grand Coulee Jan-Aug run on new flood control target:

Month Ends	Jan	Feb	Mar	Apr1	Apr2	May	Jun	Jul	Aug1	Aug2
Elevation Ft	1260	1255	1258	1264	1270	1280	1290	1290	1285	1280

- Hungry Horse run on target outflow 2500 cfs from Jan-Apr. Jun-Dec still run on Columbia Falls requirements. Libby passing inflow 4000 cfs in Apr 15 and Apr 30.

- Albeni Falls May elevation = 2060.0
- Brownlee new operation:  
 Jan-Apr run on new flood control  
 May-Aug run on new target elevations:

May	Jun	Jul	Aug1	Aug2
2069	2077	2077	2063	2049

The analysis produced a wide range of flow conditions as a result of meeting the necessary system requirements for flood control, power, Libby sturgeon operation, and the BiOp seasonal flow objectives summarized above (see Table 10).

Table 10. Expectations for Meeting 1998 Seasonal Flow Objectives  
 (based on 1929-1987 monthly simulation - 59 years, and March final water supply forecast)

<b>Lower Granite</b>		
Periods:	4/10-6/20 (71 days)	6/21-8/31 (72 days)
Seasonal Flow Objective, kcfs	96.6	51.3
Projected Seasonal Average, kcfs	92.2	47.4
No. Years Seasonal Objective is Met	*22 (37%)	*18 (31%)
No. Years Ave. Flows > Seas. Objective:		
Apr1/Apr2/May/June	01/17/35/24	
June/July/Aug1/Aug2		59/10/00/00
<b>McNary</b>		
Periods:	4/20-6/30 (71 days)	7/1-8/31 (62 days)
Seasonal Flow Objective, kcfs	233.4	200
Projected Seasonal Average, kcfs	232.3	135.3
No. Years Seasonal Objective is Met	*55 (93%)	*0 (0%)
No. Years Ave. Flows > Seas. Objective:		
Apr2/May/June	04/26/40	
July/Aug1/Aug2		03/00/00

As stated earlier, more reliable flow projections are made starting in late March, using the results of the SSARR run adjusted as needed to meet the seasonal flow objectives at Lower Granite and McNary. According to the weekly flow projection spreadsheet dated 3/30/98, the forecasted seasonal average flows are as follows:

Lower Granite: 4/10 - 6/20: 89 kcfs; 6/21 - 7/31: 39 kcfs  
 McNary: 4/20 - 6/30: 229 kcfs 7/01 - 7/31: 184 kcfs

## **VIII. Upper Snake River Operations**

The outlook is very favorable for having water in the Upper Snake River basin storage to provide 427,000 acre-feet for 1998 flow augmentation. However, the majority of this water will not be available for actual delivery into Brownlee Reservoir until after it accrues into the Upper Snake storage banks.

An interim plan for the delivery of the 427-kaf flow augmentation water was proposed by the BOR to State of Idaho (Office of the Governor, and Idaho Department of Water Resources) in early May 1998. Full agreement is expected to be reached between all parties, including Idaho Power Company and Idaho Department of Fish and Game at least seven days prior to actual releases, which may be requested as early as June.

Given the near to below normal water supply forecast for most of the Snake River basin, Reclamation is planning to use four sources of water for flow augmentation listed earlier in Table 9.

## **IX. Brownlee Operations**

As in the past, it is expected that Idaho Power Company (IDPC) will operate Brownlee in a manner that promotes spawning, protects redds, and assists with juvenile outmigration. In general, IDPC anticipates actions consistent with the Settlement Agreement, the Strategy for Salmon, and the National Marine Fisheries Service's Biological Opinion. The more specific actions already referred to above include.

- Spring Operation: Brownlee will operate to guarantee refill to at least 2069 feet by June 7.
- Summer Operation: Brownlee will operate to guarantee refill to 2059 feet by the end of September.

## **X. 1998 Canadian winter/spring/summer operations**

Canadian Treaty projects will operate consistent with the 1997-98 DOP (Detailed Operating Plan). The Operating Rule Curve for the whole of Canadian Storage shall be the sum of the Operating Rule Curves for each of Duncan, Arrow, and Mica. Mica will operate consistent with the Mica Project Operating Criteria table as shown in the DOP.

During the January, February, and March period, the January through July water supply forecast at the Dalles triggered BC Hydro to store 1 maf into the Arrow lakes above its Energy Content Curve but not above its flood control upper limit as described in Exhibit D of the PNCA Operating Procedures. The storage was complete by mid-April. A small portion of the storage was released during May. Approximately one half of the storage will be released in June, and the remainder in July.

Provisions are in place in the DOP to provide for the optimal balancing of the storage of water in Libby and Arrow reservoirs, considering mutually beneficial power and nonpower objectives. Under these provisions, water may be stored in Libby at a rate up to 10 kcfs accompanied by an equal and concurrent release from Arrow reservoir. Storage and/or release rates may be modified at the appropriate reservoir should such modifications be necessary to protect fish or accommodate other operating constraints. Water stored at in the Libby Account will be released later, according to a schedule agreed to by the U.S. and Canadian parties, and taking into account the project considerations on Canadian Treaty and Libby reservoirs as well as operation of

Kootenay Lake under the International Joint Commission order.

## **XI. NTS Operation during the Fish Passage Season**

During the storage period April 20 through July 5, 1998, water may be stored into Mica Active storage space by BPA and/or BCH consistent with the Non-Treaty Storage Agreement. Stored water will be released during the return period, July 6 through August 31, 1998. The intent is to release all of the water stored by BPA and one-half of the water stored by BCH during the July/August period. However, water releases will not occur such that they cause spill at Mica or Revelstoke, or create flooding downstream of Arrow Dam.

## **XII. Water temperature**

Water quality standards have been developed by the states and tribes under the authority of the federal Clean Water Act to restore and maintain the chemical, physical, and biological integrity of the waters of the United States. High water temperature is a basin-wide issue involving tributaries and mainstem watercourses and impoundments. The TMT recognizes that water temperature is important to the survival of fish and other aquatic life forms, and will recommend that every effort be made to meet the state and tribal water quality standards in the mainstem.

### 1998 Actions

Timely summer drafts of cold water from Dworshak, as done in the 1997 season, will be considered in 1998 to lower water temperatures in the lower Snake River. This will be accomplished in close coordination with the U.S. Fish and Wildlife Service and Idaho Department of Fish and Game to ensure that the water temperature requirements of the Clearwater River fish hatcheries are taken into account. Also, water temperature requirements associated with rearing conditions in the Clearwater River will be considered in cooperation with the Nez Perce Tribe. In the past, a release temperature of 50 degrees F has been found acceptable by all parties. Unless otherwise agreed to by U.S. Fish and Wildlife, Idaho Department Of Fish and Game, and the Nez Perce Tribe, use of a similar water temperature level is anticipated for 1998.

The need for decreasing water temperature in fishways will be considered based on the results on-going mainstem adult passage studies. Real-time temperature monitoring in the lower Columbia and lower Snake Rivers will be continued as a part of the on-going, system-wide total dissolved gas monitoring program. Temperature monitoring in adult fishways will also continue.

Additional activities for 1998 may also emerge as a result of on-going consultations and discussions between EPA, the states of Oregon, Idaho and Washington, and the Corps in an effort to develop a long-term strategy regarding water quality standards for TDG and water temperature.

## **XIII. Total Dissolved Gas Management**

Given the below-average runoff forecast, spill is expected to be mostly voluntary during the 1998 fish passage season. Spill will occur as called for in the BiOp subject to the 115%/120% TDG limits. Per the 1998 BiOp, The Dalles will spill up to 120% TDG cap or up to 64% of the flow (30% of the flow on alternate days), whichever is lower.

This limitation is met by limiting spill to an appropriate cap depending on the project's propensity to create TDG. This spill cap will be adjusted in-season based on actual TDG readings. A spill

priority list will be developed and implemented, based on relevant information, including real-time and predicted TDG, flow, biological monitoring, and fish movement.

Management options are limited. More water can be stored in the reservoirs behind the dams; the quantity of spill can be shifted to various periods within the day; more water can be put through the turbines; spill can be shifted within the system to avoid excessive local concentrations; spill can be transferred outside the system; and spill bays can be used more effectively. The TMT will work with the Dissolved Gas Team (DGT) to explore other tools available to the TMT for TDG reduction across the season.

Beside the spill priority list, changing the spill from a crown to an uniform pattern, avoiding the use of spillway bays without deflectors, and allowing turbine units to operate outside their 1% peak efficiency flow range are additional management options. Proper scheduling of service and maintenance time tables, identifying additional energy loads to serve, and displacing available thermal projects that are serving the same loads also help relieve the need for spill.

Normal operations and others that are required by research, construction, unit maintenance and services, etc. at COE and Reclamation projects will be managed to avoid causing TDG saturation levels above state standards to the extent feasible.

The COE and Reclamation will continue to monitor dissolved gas in the forebay and tailwater areas of all their mainstem Columbia and Snake Rivers projects and make them available to all interested parties through the TMT homepage. Other dams where spill is frequently scheduled will also be monitored. Winter monitoring may also be implemented below selected projects to establish baseline data. The COE will continue to develop and test regional dissolved gas abatement strategies and monitor their effects on the ecosystem in the framework of overall water resources management.

Appendix 1 provides more detailed information and discussions on total dissolved gas management in 1998.

#### **XIV. Transportation**

All fish collected at Snake River dams will be transported. This is a change from previous year's operations. The objective of transport is "not recommending any specific proposition to limit transported fish. Rather, we [ISAB] were recommending that transportation not be maximized..." See 1998 Supplemental BiOp, page III-8.

In the 1998 Supplemental BiOp NMFS has determined that the moratorium on spring collection and transportation from McNary adopted in 1995 should be continued in 1998. No change in operations is proposed for juvenile fish transportation during the summer migration.

#### **XV. Other TMT-related Items**

This section covers issues that are not project specific but seasonal in nature, including summary hydrographs, planned unit outages, scheduled maintenance, field operations for research, and general technical criteria for issue resolution.

Summary Hydrographs at Lower Granite and McNary

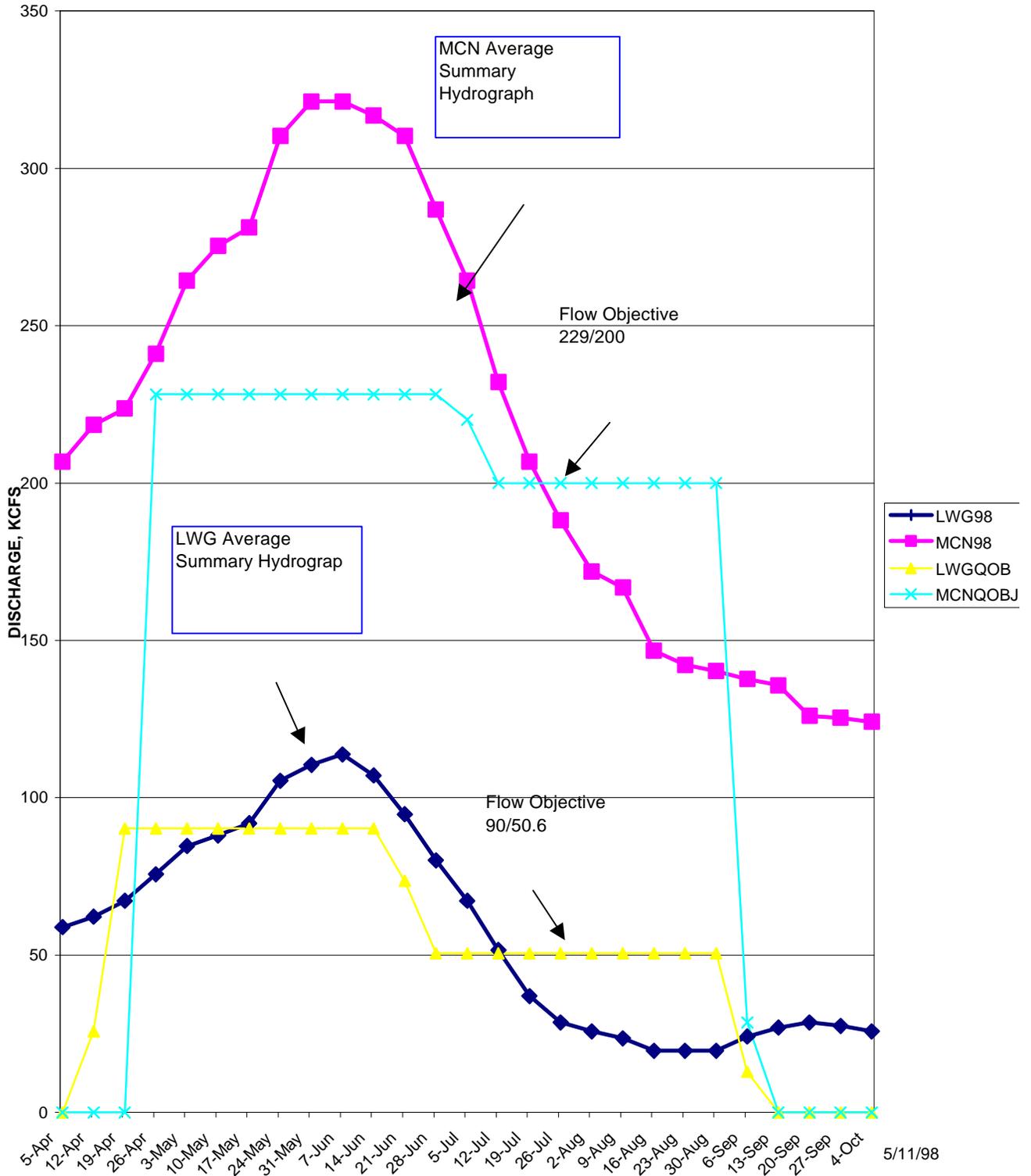
The weekly flow ordinates of the 1998 summary hydrographs for Lower Granite and McNary are provided in Table 11. Weekly flow values are derived from average hydrographs adjusted to reflect April-September runoff forecast.

Table 11. 1998 Summary Hydrographs at Lower Granite and McNary (in kcfs)  
Apr-Sep. Runoff = 19.7 maf at LWG and 79.9 maf at TDA

<b>Week Ending</b>	<b>LWG1998</b>	<b>MCN1998</b>	<b>LWGOBJ</b>	<b>MCNOBJ</b>
5-Apr	59	207	0	0
12-Apr	62	218	26	0
19-Apr	67	224	90	0
26-Apr	76	241	90	228
3-May	85	264	90	228
10-May	88	275	90	228
17-May	92	281	90	228
24-May	105	310	90	228
31-May	110	321	90	228
7-Jun	114	321	90	228
14-Jun	107	317	90	228
21-Jun	95	310	74	228
28-Jun	80	287	51	228
5-Jul	67	264	51	220
12-Jul	52	232	51	200
19-Jul	37	207	51	200
26-Jul	29	188	51	200
2-Aug	26	172	51	200
9-Aug	24	167	51	200
16-Aug	20	147	51	200
23-Aug	20	142	51	200
30-Aug	20	140	51	200
6-Sep	24	138	13	29
13-Sep	27	136	0	0
20-Sep	29	126	0	0
27-Sep	27	125	0	0
4-Oct	26	124	0	0

(\*) in kaf

### 1998 SUMMARY HYDROGRAPHS AT LOWER GRANITE AND MCNARY



### Operations for Research and Other Activities

Project operations planned in conjunction with the activities listed below will be discussed and coordinated at the weekly TMT meetings as needed. In general, conduct of research at mainstem projects will be subordinate to the higher priority of ensuring the best possible downstream passage conditions for listed species. Details of project operations for fishery purposes at Corps projects are provided in the COE Fish Passage Plan. Special operations with potential impact to project performance are listed in Table 12. Implementation details may need to be worked on a case-by-case basis, based on specific river operation requirements for the specific activity and real-time river conditions.

Table 12. Anticipated special operations for fishery research and other activities

<b>Project</b>	<b>Activity</b>	<b>Operational Requirements</b>	<b>Start/End Date</b>
Bonneville Project	Spring Creek Hatchery Release	Day/Night Spill	3/13 – 3/23
	Squawfish Radio Tracking	Sluice gate closures (3 hours, 5 times)	4/1 – 7/15
Bonneville First Powerhouse	Prototype Surface Collector	Unit outages for installation of SBC	1/15 – 3/1
		Unit outages to a) install, b) repair, & c) remove transducers	a) February b) 1 unit, 4 days c) 8/15 – 9/15
		Change entrance widths Units 3 & 5 off	Every 2 or 4 days 4/13-7/15
	Prototype ESBS Testing	Install VBS & ESBS	Jan - Feb
		Shakedown test (Unit 8 outages)	March
		Testing (unit 8 outages)	4/15 – 7/15
	Unit 6 Rehab Testing	Unit calibration and index testing (unit outages)	August - October
	PIT Tag Detection Facilities	Infrequent system adjustments	1 – 2 hours
Bonneville Second Powerhouse	Hydroacoustic Evaluation of Smolt Passage	Unit outages to a) install, b) repair, & c) remove transducers	a) 3/15 – 3/28 b) 1 unit, 4 days c) early August
		Alternating sluice chute operation	4/13 - 7/15
	Temporary PIT Tag Detection	Infrequent system adjustments	1 – 2 hours
The Dalles	Spill Evaluation	Alternating 30% and 64% spill	4/19 – 7/18
	Hydroacoustic & Radio Telemetry Evaluation of Smolt Passage	Unit outages to a) install, b) repair, & c) remove equipment	a) 3/16 – 3/27 b) 3 units, 4 hours, 12 times c) 7/21 – 8/1
		Spillway outage to a) install, b) repair, & c) remove equipment	a) 3/15 – 4/11 b) 1 bay 12 times c) 7/21 – 8/15
John Day	FPE Evaluation	24-hour spill	4/20 – 7/31

	Hydroacoustic & Radio Telemetry Evaluation of Smolt Passage	Unit outages to a) install, b) repair, & c) remove equipment	a) 4/6 – 4/11 b) 1 unit 4 hours, 12 times c) 8/3 – 8/14
		Spillway outage to a) install, b) repair, & c) remove equipment	a) 3/15 – 4/11 b) 1 bay 12 times c) 7/21 – 8/15
	ESBS Evaluation	Unit outages for installation and testing (Unit 7)	5/1 – 8/3
McNary	Evaluation of VBS and Flow Control Devices	Unit outages for testing & units 4 & 5 operated at 80 MW for part of the time	4/24 – 7/31
Ice Harbor	Near-Field Gas Dynamics Study	Spill up to 75,000 cfs	3/4 – 3/10
Little Goose	Near-Field Gas Dynamics Study	Spill up to 60,000 cfs	2/19 – 2/23
	Evaluation of Gatewell Debris Handling Improvements	Periodic unit outages for gatewell dipping	4/27 – 5/29
Lower Granite	Surface Bypass Collector Evaluation	Unit outages to a) install equipment, b) test and c) remove equipment	a) 1/1 – 3/31 b) 4/13 – 5/29, 7/1 – 7/16 c) 8/15 – 9/15
	Hydroacoustic and Radio Telemetry Evaluation	Unit outages to a) install equipment, b) test and c) remove equipment	a) March b) 4/1 – 7/16 c) 8/15 – 9/15

The list of Northwest Power Pool 1998 Maintenance Schedule Outages of Generating Units is provided in Appendix 5.

Action Agencies General Technical Criteria for Issue Resolution

The TMT guidelines provide general directions on the dispute resolution process but refer to the TMT to develop more specific and more technical decision-making. While the TMT's overall objective is to implement the BiOp as a package, operational issues may arise when dealing with borderline conditions that warrant more detailed discussions. Summarized below are some issues that had been discussed at length, and the criteria used to resolve them at the TMT, IT or EC levels. To ensure consistency and expediency, the TMT will address and attempt to resolve reoccurrence of similar issues using precedence as a guide.

- QUESTION: Under what circumstances can stream flows be augmented over and beyond the BiOp seasonal flow objective level? ANSWER: Normally, when (1) the reservoirs providing the additional flow (Grand Coulee, Libby, Hungry Horse and Dworshak) are still above their respective interim summer reservoir draft limits (elevations 1280, 2439, 3540 and 1520 feet respectively), and (2) it can be demonstrated there will be a positive impact on fish travel time and overall survival. Note that such an operation is within the project owners and operators' discretionary authority from an overall ecosystem management standpoint.

- QUESTION: When could a turbine unit operate outside its 1 percent peak efficiency flow range? ANSWER: (1) when TDG below the project(s) involved is (or is projected to be) at the 130 percent level or higher, (2) it can be demonstrated that such an excursion would decrease TDG by at least 2 percent saturation, and (3) there is agreement that this risk associated with higher spill and higher TDG is less than the risk of direct injury to juvenile passing through the

powerhouse. Note that in the past only turbine units at John Day and McNary demonstrated any potential reduction in TDG by operational excursions outside the 1 percent peak efficiency.

- QUESTION: When should the Lower Snake pools be allowed to be operated outside their respective MOP operating range? ANSWER: (1) TDG in the lower Snake River must be at least at 120 percent or higher (or projected to be at or exceed that level), (2) the resulting reduction in spill should lead to a TDG reduction in saturation level of at least 2 percent, and (3) operational flexibility exists to allow reservoir drafting back to within the MOP as needed.

- QUESTION: Under what temperature conditions should fish collection and handling be curtailed or discontinued? ANSWER: (1) when scroll-case temperatures are approaching 70 degrees F and expected to stay at that level for more than two days, or (2) when fish survival conditions are being affected in collection and handling facilities, or (3) upon recommendation from the Emergency Team or the Salmon Managers.

- QUESTION: When is zero or minimum nighttime flow tolerable? ANSWER: (1) when water temperature is less than 68 degrees F, (2) temperature increase resulting from the operation is projected to be less than 2 degrees F, (3) when the expected daily passage of listed adult fish is less than xxx [USFW do you have this answer?] at the project(s) involved, and (4) when the operation is to occur outside of the juvenile migration season (April-August), because of delay in fish movement resulting in increased mortality due to predation and/or improper arrival timing at the estuary.

- QUESTION: When is pre-emptive reservoir draft to control high total dissolved gas saturation a reasonable operation? ANSWER: (1) when TDG are (or are projected to be) at 130 percent or above for an extended period (2 weeks or more) and the expected TDG reduction is no less than 5 percent TDG, and (2) the impact on reservoir refill to provide flow augmentation volume is not expected to be significant (no less than 80 percent refill probability).

- QUESTION: When is there a potential for flood control shift from Brownlee to Grand Coulee? Describe the operation and the benefit, constraints and alternatives of such an action. The Corps is prepared to temporarily shift Dworshak system flood control requirements starting with the initial April-to-July volume forecast prepared on January 1, if the April forecast predicts runoff at Dworshak of 3.2 maf or less and if space is available at Grand Coulee and Reclamation will accept the shift. The flood control space will be returned to what it would have been otherwise at both Grand Coulee and Dworshak by April 30. The Corps will compute the ability to transfer system flood control requirements from Brownlee to Grand Coulee, subject to the availability of space at Grand Coulee and the acceptance of the shift by Reclamation. NMFS will need to coordinate a proposal for the shift that is acceptable to Idaho Power Company and the action agencies. The flood control storage that may be shifted from Brownlee to Grand Coulee will be returned to achieve what it would have been otherwise by April 30.

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- **APPENDIX 1: 1998 Total Dissolved Gas Management Plan**
- **APPENDIX 2: Emergency Protocols**
- **APPENDIX 3: BPA's System Load Shaping Guidelines for Operating Turbines Outside 1% Peak Efficiency**
- **APPENDIX 4: TMT Guidelines**
- **APPENDIX 5: Northwest Power Pool 1998 Maintenance Schedule Outages of Generating Units (G:\rcc\tmt98\wmp-app5.doc)**