

III. RESERVOIR REGULATION

SYSTEM OPERATION	PROJECT OPERATION	Mica	Revelstoke	Keenleyside	Libby
Bonnars Ferry	Duncan	Kootenay Lake	Birchbank	Hungry Horse	Columbia Falls
Kerr	Albeni Falls	Grand Coulee	PUDs	Yakima	Jackson-Palisades
Ririe	American Falls	Little Wood	Owyhee	Boise	Malheur
Payette	Weiser	Powder	Brownlee	Dworshak	Spalding
Lower Snake	Mill Creek	Willow	John Day	Upper Deschutes	Chief Joseph-Bonneville
Vancouver	Willamette	Western Washington			

The reservoir system in the Northwest is made up of Federal, municipal, public, and privately owned dams and reservoirs. Regardless of ownership major projects are operated in accordance with the Pacific Northwest Coordinating Agreement. This agreement coordinates the seasonal operation of the system projects for the best use of their collective reservoir storage, and along with some of the other agreements that affect project operation. In this chapter, however, the regulation of the system as a unit is described followed by the regulation of the operation of individual projects, and the effects upon key gages, in downstream order and chronologically from the beginning of the operational year.

The coordinated system of reservoirs is listed in [Appendix C](#). Daily project operations are shown on charts in [Appendix D](#). Charts 5-30 show the storage and streamflow hydrographs from July 1, 1999 through September 30, 2000, for major storage projects, Charts 31-56 present the annual hydrographs for flood storage projects, hydrographs of the spring freshet are shown in Charts 57-79, Chart 80 shows The Dalles discharge hydrograph for regulated and unregulated conditions, Charts 81-84 are the control point hydrographs for the Willamette Basin, Charts 85-88 are the reservoir hydrographs for Section 7 projects, and Charts 89-92 are summary hydrographs for the four key stations.

A. SYSTEM OPERATION

The operating year began with the coordinated reservoir system officially filling to 99.87% of storage capacity on August 1, 1999. As a result, first year firm energy load carrying capability (FELCC) was adopted for the 1999-2000 operating year.

This year's observed peak flow at The Dalles was 374.6 kcfs on 23 April 2000 with a corresponding unregulated peak of 449.6 kcfs on 27 May 2000. Last year's observed peak was 379.3 kcfs.

B. PROJECT OPERATION

The operation of the individual projects is discussed in downstream order, beginning at the headwaters of the Columbia River. Operation of each project is generally discussed chronologically beginning in the summer or early fall of the preceding water year. Exceptions will be noted by including the calendar year. The locations of these projects are shown on the maps in Chapter I, pages 5 through 8.

1. Mica Project

Kinbasket Lake was formed by the construction of Mica Dam near the Big Bend on the upper Columbia River in east-central British Columbia. The project was constructed as part of the Columbia River Treaty between the United States and Canada and is owned by BC Hydro and Power Authority (BCH or BC Hydro) and is operated primarily for power and flood control. This year's operation is graphically shown on [Chart 5](#) and [Chart 57](#).

The Mica Reservoir (Kinbasket Lake) level was at elevation 2461.4 ft on 31 July 1999, 13.6 ft below full pool elevation of 2475 ft. The corresponding Mica Treaty storage account was 95 percent of full at 3369.4 ksfd (6.7 Maf) on that date.

The local inflows into Mica reservoir averaged about 54,600 cfs in August, reducing to 20,000 cfs in September and about 6,900 cfs by the end of December 1999. Mica Treaty storage continued to fill during August, reaching full storage of 3529.2 ksfd (7.0 Maf) on 10 August 1999. The Mica Reservoir started to draft in early September as turbine discharges exceeded inflows. The Mica Treaty under-run of 420 ksfd on 31 August was reduced in September, reaching a minimum of 17.3 ksfd on 17 November increasing again with a year-end under-run at 634 ksfd on 31 December 1999.

Actual Mica discharges increased through August 1999 and averaged 75 percent of the maximum turbine capacity. This corresponded to an average discharge of about 32,000 cfs in August. The September and October discharge averaged 36,100 cfs and 35,800 cfs, respectively. In November, the average Mica discharge was 25,000 cfs and in December, 17,800 cfs. The reservoir drafted 8.8 ft in September, 15.6 ft in October, 7.5 ft in November and 7.2 ft in December reaching an elevation of 2434.2 ft by calendar year end. At that time, the B.C. Hydro Non-Treaty Storage was about 393 ksfd, or 35 percent of full, with Treaty storage at 2514.4 ksfd (about 5.0 Maf), or 71 percent of full.

In early January, February, and March 2000, the inflows averaged about 4,800 cfs for each month, gradually increasing in April to 7,500 cfs before the start of the spring freshet in May. Mica powerhouse discharges for January and February averaged around 33,000 cfs for each month with Mica generation decreasing over the rest of winter 2000. The reservoir drafted by about 120 ft during the period to elevation 2394.8 ft by 29 February with Treaty Storage at 1395.2 ksfd and Mica Treaty overrun of about 280 ksfd on that date. The B.C. Hydro NTSA was at 416.9 ksfd at the end of February. During March and April, the Mica Reservoir was drafted an additional 10 ft and reached its lowest level for the 1999-00 year of 2384.5 ft on 27 April 2000, 11.0 ft higher than the low level in the previous year. Mica Treaty storage was drafted to its minimum of 231.6 ksfd (0.4 Maf) on 30 April with a flex overrun for Mica of about 69 ksfd.

In March and April, the Mica turbine discharges averaged 14,500 and 9,700 cfs, respectively with an average of about 9,000 cfs in May and 12,000 cfs in June 2000. The corresponding plant generation was 34 percent and 22 percent, respectively of plant capacity during March and April. With the start of the spring freshet in May, Mica discharges remained low until July, and the reservoir refilled by 35 ft to elevation 2419.9 ft at the end of June. At the end of May, the Mica Treaty under-run (definition of under-run and overrun see Canadian Treaty Storage Operation first paragraph) had increased to 198 ksfd. The Mica Treaty discharge was 10 kcfs for the months of May, June and July, allowing Treaty storage to refill to 3330.9 ksfd (6.6 Maf; 94 percent of full) by 31 July. Inflows increased in May, June and July averaging about 21,000, 45,000 and 63,000 cfs, respectively. Actual Mica discharges during May, June and July averaged 9,000, 12,000 and 15,000 cfs resulting in a Mica Treaty overrun of 22 ksfd and a reservoir elevation of 2451.3 ft by the end of July 2000. The corresponding plant generation was about 35 percent of plant capacity in July 2000. The August inflows averaged about 37,000 cfs but had receded to about 21,000 cfs by month end. The Mica Treaty storage reached full at 3529.2 ksfd on 15 August 2000 with the reservoir at elevation 2457.8 ft, 17.0 ft below full pool. The Mica reservoir elevation on 31 August 2000 was 2455.2 ft (about 20 ft from full pool).

The peak daily inflow was 81.6 kcfs on 7 July 2000, with a corresponding outflow of 1.1 kcfs. Maximum daily outflow was 39.2 kcfs on 2 Sep 2000. The January-July runoff was 9,342 kaf or 114% of normal. The April-September runoff was 11,877 kaf, 102% of normal.

2. Revelstoke Project

The Revelstoke project, located in southeastern British Columbia on the Columbia River between Mica Dam and Arrow Lakes, is owned by BC Hydro and is operated primarily for power generation. This year's operation is graphically shown on [Chart 6](#).

During the 1999-00 operating year, the Revelstoke project was operated as a run-of-river plant with the

reservoir level maintained generally within 3.0 ft of its normal full pool elevation of 1880 ft. During the spring freshet, March through July, the reservoir operated as low as elevation 1876.5 ft, within its maximum draft range of 5.0 ft, to provide additional operational space to control high local inflows. Changes in Revelstoke storage levels did not affect Treaty storage operations.

3. Keenleyside Project (Arrow Reservoir)

The Arrow Lakes are two tandem natural lakes on the Columbia River in southeastern British Columbia whose surface elevations are controlled by Keenleyside Dam. At normal operating elevations the land area between the lakes is flooded, creating a single lake. This project was constructed as part of the Columbia River Treaty between the United States and Canada for flood control and downstream power generation. Construction of the dam was completed in 1969. The dam is owned and operated by BC Hydro and Power Authority. The Arrow Lakes Power Company owns the powerhouse that is currently under construction. In March 1999, Columbia Basin Trust and Columbia Power Corporation as joint venture partners under Arrow Lakes Generating Station, initiated construction of a powerhouse with two 85-megawatt turbine and generator units. The first unit was put into operation in February 2002, and the second unit will be put into operation later that year. This year's operation is graphically shown on [Chart 7](#) and [Chart 58](#).

The reservoir drafted through August and September and reached elevation 1432.4 ft by the end of September. The Arrow Treaty storage was 6.4 Maf or 90 percent full at the end of September.

Arrow discharges decreased over the autumn months from an average of 62,000 cfs in September to 46,000 cfs in October and 44,000 cfs in November. The discharge increased to an average of 56,000 cfs in December. Average inflows were 51,000 cfs in September, 46,000 cfs in October dropping to 28,000 cfs by December 1999. The Arrow Reservoir drafted to elevation 1423.3 ft by 31 December 1999 with the Treaty storage at 2916 ksfd (5.8 Maf) or 81 percent of full on that date.

During the period 21 December 1999 to 17 January 2000, Arrow outflows were reduced to between 50,000 cfs and 55,000 cfs to maintain lower river levels during the whitefish-spawning period that could be sustained through the period of emergence in February and March. To achieve the January level of flows, B.C. Hydro exercised an option to store up to 400 ksfd under the Whitefish Provisional Draft Agreement over the first 16 days of January. During the latter part of January, outflows from Arrow averaged about 73,000 cfs, decreasing in February to 51,000 cfs, and then reducing to about 40,000 cfs in March. From 21 to 29 March 1999, the outflows from Arrow were progressively reduced from 45,000 cfs to 20,000 cfs and continued at that level through April and May to meet objectives for rainbow trout spawning. In exchange for the rainbow trout protection flows in the spring, the U.S. exercised an option, under the Non-Power Uses agreement signed in December, to store up to 1 Maf in Arrow by late April 2000 for Flow Augmentation objectives. The Flow Augmentation storage was subsequently released during May.

In this operating year, the Columbia River Treaty Operating Committee agreed to use the Arrow Local Method for determining the Mica and Arrow Variable Refill Curves between January and June 2000. Compared to the Total Method, the Arrow Local Method recognizes Mica outflows in excess of those from operating Mica to the Variable Refill Curve (VRC) when computing Arrow's VRC, and on average, results in lower VRC's at Arrow during January through April. In both cases, the Arrow reservoir is targeted to be full on 31 July. The Arrow Local Agreement was signed in December 1999, with the expectation that power benefits realized in excess of those expected by the Total Method would be shared equally between BPA and B.C. Hydro. Multi-year TSR studies have indicated that the expected power benefits occur during average-to-low water conditions. However, because of the unusually high relative energy prices during the summer as compared to the winter of year 2000 there were no power benefits realized.

Arrow Reservoir reached its lowest level for the year at 1393.9 ft on 4 April 2000. Arrow Treaty storage account reached its minimum at 502 ksfd (0.99 Maf) or 14 percent of full on 28 March 2000. During April

and May, the Arrow discharge was maintained at about 20,000 cfs to prevent rainbow trout spawning at higher river levels. Arrow discharge was maintained above 20,000 cfs until 20 June 2000. During the last 10 days of June flows were reduced to 14,000 cfs when the backwater effects of higher Kootenay River flows provided adequate river levels for rainbow trout protection at Norns Creek Fan, a prime spawning location for rainbow trout.

The Arrow fisheries operations were conducted under the terms of two Operating Committee agreements, “Operation of Treaty Storage for Enhancement of Mountain Whitefish Spawning for the period of 1 September 1999 through 30 April 2000” and “Operation of Treaty Storage for Non-power Uses for 1 January through 31 July 2000”. These agreements enabled the Arrow project flows to be adjusted to reduce impacts to whitefish and rainbow trout redds. With the low discharge in April and May, and the start of the spring freshet with high inflows in May, the Arrow Reservoir rose to elevation 1398.4 ft by 30 April, 1414.6 ft by 31 May, and 1435.8 ft by 30 June 2000. Arrow reservoir levels remained below the Treaty flood control curve levels throughout the operating year.

The Arrow discharge was increased substantially in July as Arrow Treaty storage neared full and the reservoir reached its highest elevation, 1443.9 ft, on 25 July 2000. The Arrow Treaty storage content reached full (7.1 Maf) on 2 August 2000. The Coordinated Columbia System was on proportional draft during August 2000. As a result, Arrow Treaty storage was drafted to 3346 ksfd, (6.6 Maf; 94 percent of full) at the end of August.

The Arrow Lakes Power Company project at Keenleyside Dam began full construction of a powerhouse on 15 March 1999. The powerhouse will contain two generating units: each is expected to be 85 MW capacity. Construction of the powerhouse may be complete as early as November 2001.

The peak daily inflow was 92.3 kcfs on 22 May 2000, with a corresponding outflow of 30.3 kcfs. The unregulated peak inflow was 151.8 kcfs on 24 July 2000. Maximum daily outflow was 78.5 kcfs on 27 July 2000. The January-July runoff was 20,941 kaf or 99% of normal. The April-September runoff was 24,582 kaf, or 96% of normal.

4. Libby Project (Lake Koocanusa)

Lake Koocanusa and Libby Dam, on the Kootenai River in northwest Montana, were constructed as part of the Columbia River Treaty with Canada and are operated by the Corps of Engineers for power, flood control, and recreational benefits. The lake extends northward from the dam near the town of Libby, 60 river miles to the international border and another 30 miles (at full pool) into British Columbia. This year's operation is graphically shown on [Chart 8](#) and [Chart 59](#).

Libby inflow in August 1999 was 151 percent of normal, the third highest for the period 1928-1988. Outflow ranged from 8,000 to 22,600 cfs to keep the project from filling and spilling. A peak reservoir elevation was reached on 9 August of 2458.97 ft, essentially a full pool. A 1999 Libby/Arrow storage exchange agreement was consequently not required to maintain reservoir levels. Due to the abundance of water in the Columbia Basin system, the resulting end of month elevation in August was 2455.63 ft, 3.37 ft from full and 16.63 ft above the 1995 Biological Opinion interim draft limit of elevation 2439 ft.

For the majority of September 1999, outflows were held steady at 12,000 cfs as the project began a slow draft to the 31 December 1999 flood control elevation of 2411.0 ft. Outflows were reduced to 10,000 cfs on 16 September for transmission line testing, and releases were brought back to 12,000 cfs for the remainder of the month until 26 October, when the outflow was reduced again for transmission line work.

Outflow was maintained at 12,000 cfs through 4 November, when the decision was made to reduce outflow to 8,000 cfs. At the time of the decision the November inflow was near 125 percent of average,

where inflow was about 5,800 cfs, and the reservoir had evacuated to elevation 2437.65 ft. The operational strategy was to slow the evacuation and target elevation 2411 ft on 31 December 1999 to meet the recommendations of the National Marine fisheries Service 1995 Biological Opinion. The Libby basin experienced a significant storm on 13 and 14 November and inflow increased to as high as 40,000 cfs on 14 November. This storm caused the November month average inflow to be 265 percent of average, or 12,300 cfs for the month average, the largest November inflow in the 60-year period of record. The outflow from Libby had to be increased to powerhouse capacity outflow near 25,000 cfs to evacuate to elevation 2411 ft by 31 December.

Outflow near full powerhouse capacity continued through December except for a few periods of reduction for power, or to capture and tag burbot in the Kootenai River downstream of Libby. With concurrence of the National Marine fisheries Service, the elevation of Libby reservoir was 2408.1 ft on 31 December 1999. This was 2.9 ft below the flood control elevation of 2411 ft.

The January 2000 final water supply forecast was 6.87 Maf (108 percent of normal) for the April through August period. The end of January flood control evacuation requirement was elevation 2370.9 ft. Outflow near powerhouse capacity was needed for most of January to reach this elevation. The water supply forecast in February was 107 percent of normal. In order to achieve the end of February flood control evacuation, outflow averaged 16,700 cfs during February. In March, the water supply forecast sagged slightly to 6.68 Maf, or 105 percent of normal. The end of March flood control evacuation requirement was 2331.3 ft. By early March, the 95 percent confidence of refill curve at Libby on 15 April was near elevation 2339 ft. Since inflow to the project was near 4,000 cfs and minimum outflow is 4,000 cfs, the USACE decided to operate to target the 15 April 95 percent confidence of refill curve. On 14 March the outflow was reduced to 4,000 cfs to target the 15 April refill curve. On 31 March, Lake Koocanusa was at elevation 2337.1 ft, and on 15 April the reservoir was at elevation 2342.6 ft.

Libby continued to release 4,000 cfs until 6 June 2000. When outflow was increased to meet the operation requested by the US Fish and Wildlife Service (USFWS) for sturgeon. The USFWS initially requested 19 days of release of full powerhouse from Libby. The June final water supply forecast was 6.96 Maf (109 percent of normal). At the start of the operation, Lake Koocanusa was at elevation 2403.8 ft, and was expected to refill to near elevation 2452 ft in July.

In ongoing discussions with USFWS it was agreed to release full powerhouse capacity for 17 days, followed by a slow ramp down to a flow that would not harm listed bull trout in the Kootenai River. Although 9,000 cfs was the preferred bull trout minimum flow, the USFWS agreed to 8,000 cfs in year 2000 as the June precipitation did not materialize, and the lake was not refilling as expected.

By 3 July 2000, the sturgeon operation was complete and Libby was releasing 8,000 cfs for bull trout. Lake Koocanusa was at elevation 2421.3 ft on 3 July, about 20 ft below expectations. Because of failing water supply forecast Lake Koocanusa reached its maximum elevation of 2436.33 ft on 15 August, 22.67 ft below full. Outflow of 8,000 cfs for bull trout continued through 21 September when the reservoir reached elevation 2332.9 ft. Outflow was slowly reduced to 6,000 cfs and the reservoir ended September at elevation 2432.3 ft

The peak daily inflow was 39.4 kcf on 23 May 2000, with a corresponding outflow of 4.0 kcf. Maximum daily outflow was 25.0 kcf on 13 June 2000. The January-July runoff was 5820 kaf or 91% of normal. The April-September runoff was 5837 kaf, 86% of normal.

5. Kootenai River at Bonners Ferry

The Kootenai River at Bonners Ferry, Idaho, a major control point for the flood control operation of

Libby Dam, is located 82 miles downstream of Libby Dam. Its stages are affected by both river flow and by backwater from Kootenay Lake. Libby Project provides flood control for Bonners Ferry. This year's operation is graphically shown on [Chart 60](#).

The peak-regulated stage was 1,757 ft on 15 June 2000. Libby was releasing 25 kcfs at the time of this peak. The unregulated peak stage would have been 1,765 ft, well above the 66.5 ft bankfull stage. The January-July unregulated runoff was 8144 kaf, 92% of normal, while the April-September unregulated runoff was 7925 kaf or 89% of normal.

6. Duncan Project

Duncan Dam and Lake on the Duncan River, a tributary to Kootenay Lake in southeastern British Columbia, was constructed as part of the Columbia River Treaty between the United States and Canada. The project is owned and operated by BC Hydro and, although it has no on-site power-generating facilities, it is operated for downstream power generation and for flood control. This year's operation is graphically shown on [Chart 9](#) and [Chart 61](#).

During the month of September, Duncan discharged an average of 5,300 cfs to maintain Kootenay Lake levels and Kootenay River flows. The project discharge averaged 6,400 cfs in October, 2,000 cfs in November and about 2,100 cfs in December. The Duncan Reservoir level was at elevation 1866.8 ft (69 percent of full) on 31 December 1999. The Duncan reservoir remained at or below the flood control curve throughout the operating year.

During January 2000, the Duncan discharge was increased to about 8,300 cfs. The reservoir was drafted throughout February and March, and reached its lowest level for the year at elevation 1794.3 ft (0.3 ft above empty) on 30 March 2000.

The Duncan discharge was reduced to minimum (100 cfs) on 9 May and remained at that level during most of June to allow refill of the reservoir. The reservoir reached elevation 1825.7 ft by 31 May and elevation 1861.4 ft by 30 June. Duncan remained on minimum discharge until 21 July and increased thereafter to slow the rate of reservoir refill. The reservoir reached full pool elevation of 1892.0 ft on 31 July 2000, and started to draft gradually in the later part of August.

Duncan passed inflows during early August 2000, but the discharge was increased later in the month to manage the Kootenay lake elevations at close to the maximum levels permitted under the IJC Order. In doing so, the Duncan reservoir drafted to elevation 1886.5 ft by month end. After 31 August 2000, the Duncan discharge was increased to raise the Kootenay Lake elevation up to the September IJC limit of 1745.42 ft, and gain increased operating efficiencies at Kootenay Canal and Corra Lynn.

The peak daily inflow was 14.9 kcfs on 18 July 2000 with a corresponding outflow of 100 cfs. Maximum daily outflow was 12.3 kcfs on 1 August 2000. The observed January-July volume runoff was 1830 kaf, or 100% of normal. The April-September runoff volume was 2290 kaf or 102% of normal.

7. Kootenay Lake

Kootenay Lake is a large natural lake on the Kootenay River in southeastern British Columbia that has most of its inflow regulated by Libby and Duncan dams. The seasonal regulation of the lake level is governed by rules established by the International Joint Commission (IJC) as agreed upon by the United States and Canada. Outflow from the lake is discharged through a series of instream powerhouses and/or diverted to the offstream Kootenay Canal Plant before it joins the Columbia River below Brilliant Dam near Castlegar, British Columbia. Although Corra Linn Dam, the project immediately downstream from the lake, controls the lake level, a constriction in the river channel at Grohman Narrows, between the lake and the dam, limits

the maximum project outflow both during periods of high flows and when the lake approaches its minimum level. This year's project operation is graphically shown on [Chart 10](#) and [Chart 62](#).

For the month of September, the Kootenay Lake discharge was adjusted to keep the downstream Brilliant plant at full load while meeting the system generation demand. In September, October, November and December, the lake discharge averaged 22,900, 22,000, 30,200 and 35,300 cfs respectively. Over these four months, the month-end lake elevations varied between 1744.5 and 1744.9 ft. The Kootenay Lake had a year-end elevation of 1744.5 ft on 31 December 1999. The reservoir did not exceed the maximum IJC elevation of 1745.32 ft through to 7 January 2000.

Beginning in January, the Kootenay Lake level rose initially to 1744.8 ft and then reduced to 1743.7 ft by month end. The reservoir discharges were kept slightly above the inflows during February-March to stay below the IJC limits. The reservoir level at the end of March 2000 was 1738.6 ft. The reservoir reached a minimum level of 1738.5 ft on 3 April 2000, rising gradually thereafter with the start of the spring freshet. The inflows peaked on 15 June at 66,200 cfs. The Kootenay reservoir discharges were then also increased, and the outflows from Duncan reduced to minimum, to reduce the Kootenay reservoir level rise in the summer of 2000. Kootenay Lake discharges peaked on 26 June at 48,900 cfs.

Kootenay Lake reached its peak level for the year at elevation 1748.2 ft on 29 June 2000 about three days later than the previous year. The reservoir level gradually dropped due to receding runoff, and due to reduced Libby discharges in July 2000. Kootenay Lake drafted in these months with the lowest summer reservoir elevation of 1742.9 ft occurring on 16 August. The Kootenay Lake level at Nelson dropped below the Nelson gauge IJC elevation of 1743.32 ft on 14 August and the lake operation remained constrained until 31 August as required by the IJC Order for Kootenay Lake. During the balance of August, outflows from Libby remained low and Duncan discharges were adjusted to manage Kootenay operations until the end of August. Discharges from Kootenay Lake averaged 35,500 cfs in July and 23,800 cfs in August 2000. The lake discharges in September were adjusted to keep Brilliant at full load without spill, while restoring operational head at Corra Linn and Kootenay Canal.

8. Columbia River at Birchbank

The Columbia River at Birchbank, British Columbia, includes the effects of regulation of all the Columbia River Treaty Projects. Its flow is regulated by the use of storage in Kinbasket, Arrow, Koocanusa, Duncan, and Kootenay Lakes, the first four being the Treaty Projects. This is the portion of the Grand Coulee inflow contributed by the Columbia and Kootenay rivers. The Flathead/Pend Oreille River enters the Columbia River downstream of the Birchbank gage. This year's operation is graphically shown on [Chart 63](#).

The observed daily peak flow at Birchbank was 118.2 kcfs on 27 July 2000 and the unregulated peak flow was slightly over 200.2 kcfs on 3 July 2000. Bankfull and flood stage is 225 kcfs. The unregulated January-July runoff was 38936 kaf, or 100% of normal. The unregulated April-September runoff at Birchbank was 42852 kaf, or 98% of normal.

9. Hungry Horse Project

Hungry Horse, a Section 7 Project on the South Fork Flathead River near Kalispell, Montana, is owned and operated by the Bureau of Reclamation for flood control, power, recreation, and fisheries. This year's operation is graphically shown on [Chart 11](#) and [Chart 64](#).

On October 1, 1999, the water surface elevation was 3544.45 ft after filling to elevation 3560.61 on July 26. The summer of 1999 was fairly wet so Hungry Horse was drafted to elevation 3554.27 by August 31, as flow augmentation was met most of the summer. Hungry Horse was drafted slightly throughout the fall to

meet the 3,500 cfs minimum flow requirement at Columbia Falls. After an average fall, the forecast dropped slightly in January through April. It reached its lowest level on April 3 at 3502.12 ft, 58 ft from full. A significant amount of runoff occurred in April, after the April 1 forecast which reduced the snowpack considerably. Due to the high April runoff it was decided that the May 1 flood control space requirement should be reduced, so Hungry Horse was allowed to start refilling in April. The reservoir reached its maximum elevation of 3558.35 ft on June 30. The peak observed inflow of 19,493 cfs occurred on May 23, and the maximum outflow was 8,314 cfs on April 24. Due to an early runoff, and a dry summer, natural flows at McNary were low throughout the summer. Releases for Biological Opinion operations started the first of July before the reservoir had the opportunity to fill completely. Target flows at McNary not met. By September 30 the reservoir was at 3535.97. A kokanee spawning flow of at least 3500 cfs was provided at Columbia Falls for the entire year.

10. Flathead River at Columbia Falls

Discharges on the Flathead River at Columbia Falls gage record the combined flows of the North, Middle and South forks of the Flathead River. The flows on the North and Middle forks are uncontrolled and Hungry Horse Dam regulates those of the South Fork. This year's operation is graphically shown on [Chart 65](#).

January - July volume runoff for the tributary basins above Columbia Falls was 88% of normal. The year's peak discharge of 32.9 kcfs occurred on 23 May 2000. The Hungry Horse outflow was about 1588 cfs during the peak flow. The unregulated peak was 52.7 kcfs on the same day. Flood stage at Columbia Falls is 14 ft and major flooding does not occur until 16 ft.

11. Kerr Project (Flathead Lake)

Flathead Lake is a natural lake, the level of which is controlled by Kerr Dam. The dam was sold by Montana Power Company to PPL Montana LLC (effective 17 December 1999) and licensed for operation of power, flood control, and recreation. Spring refill of Flathead Lake is coordinated with the Corps of Engineers' Reservoir Control Center to control flooding of the agricultural lowlands between Kalispell and Flathead Lake. This area is prone to flooding if the lake reaches its full level at a time when the river flow is high. Specifically, flooding begins if the lake level reaches elevation 2893 ft, coincident with the river flow being above 45 kcfs. This year's operation is shown on [Chart 12](#) and [Chart 66](#).

After the 1999 runoff, Flathead Lake was maintained in its top foot, 2892.0-2893.0 ft through November 5. The lake was then gradually drafted throughout the autumn and winter months for power and flood control, reaching its minimum for the winter, elevation 2883.96 ft on 23 March 1999. On 15 April, project elevation was 2884.67 ft. Per the Memorandum of Understanding Agreement (date 1962, revised 1965) between the Corps and Montana Power, Kerr will endeavor to reach 2883 ft on 15 April for flood control. It goes on to say there is a natural channel restriction at the outlet of the lake that reduces the outflows at low lake levels and this elevation might not be attained every year. Inflows below Kerr were 71% of normal between October 99 – September 00. The Corps coordinates with Montana Power to refill Kerr in a controller manner during the spring freshet. The Corps requested Kerr remain on free flow through 8 May for flood control. Outflows were about 21 kcfs and the lake elevation was 2877.7 ft. On 10 May the Corps told Kerr they no longer needed to spill and flows were reduced to 14.4 kcfs. The project refilled to 2890.17 ft for the Memorial Day weekend and 2892.5 ft on 12 June. The project operated in its top half foot (2882.5 ft – 2883 ft) through Labor Day.

The peak seasonal inflow was 29.7 kcfs on June 24. The maximum discharge was 28.5 kcfs on June 18. Average monthly discharges were 16.2, 18.4 and 12.8 kcfs for May, June and July respectively.

The unregulated peak inflow would have been 52.1 kcfs on 24 May 2000. The unregulated January-July

runoff into Flathead Lake was 87 % of normal. The unregulated April-September runoff was 85% of normal.

12. Albeni Falls Project (Lake Pend Oreille)

Lake Pend Oreille is a natural lake, whose outflow and lake level are controlled by constrictions in the outlet channel and by Albeni Falls Dam, a Corps project that is operated for flood control, power, and recreation. The dam is located 29 miles downstream of Lake Pend Oreille on the Pend Oreille River. Although the dam controls the lake level, the river channel between the lake and the dam limits the project outflow during both high flow periods and when the lake is near its minimum level. Inflow to Albeni Falls Dam is affected by the regulation of upstream impoundments, namely Hungry Horse and Flathead Lake (Kerr Dam) on a seasonal basis, and by two Washington Water Power projects, Noxon Rapids and Cabinet Gorge, on a daily basis. This year's operation is graphically shown on [Chart 13](#) and [Chart 67](#).

The annual autumn drawdown of Pend Oreille Lake began immediately after Labor Day and the lake was drafted to elevation 2060 ft on October 1. The lake continued drafting in October and November, with the discharge averaging 16.7 kcfs in October and 18.8 kcfs in November. At the end of October and November, the lake elevations were 2055.3 ft and 2053.4 ft, respectively. In 1995, the Northwest Power Planning Council approved a five-year experiment to test the effect of variations in the lake level on the productivity of kokanee in Lake Pend Oreille. For the winters of 96-97, 97-98 and 98-99, the lake was drafted to 2055 ft rather than the normal 2051 ft. The experiment also called for the lake to be drafted to 2051 ft in the winters of 99 – 00 and 00 which is its normal winter time elevation. However, in October 1999 the Corps was sued by a private party trying to keep the Corps from drafting to 2051 ft in the winter of 99 – 00. A settlement was reached to not draft below 2053 ft for the winter. The maximum flood control rule curve elevations for January, February and March were 2060 ft, 2060 ft and 2056 ft, respectively. The project stayed at or below these elevations through March. The lake was filled to 2059.05 ft by the end of May. In early June, flows were increased slightly to slow down the refill rate of the lake and assist Grand Coulee in refilling as on 9 June Lake Roosevelt was still about 30 ft from full. Pend Oreille Lake reached 0.5 ft of full on June 15. A peak observed inflow of 53.2 kcfs was reached on 18 June.

Unregulated peak inflows peaked at 74.9 KCFS on 26 May 2000. Project discharges averaged 41.9 and 42.4 kcfs in May and June, respectively. Peak discharges were 52,100 cubic ft per second on June 19. The project was maintained in its summer operating range, 2062.0-2062.5 ft, from June 15 through September 13. The unregulated January-July runoff was 15.6 Maf, 81 % of normal, while the April-September runoff was 11.4 Maf, or 80% of average.

13. Grand Coulee Project

Grand Coulee Dam and Franklin D. Roosevelt (FDR) Lake are owned by the Bureau of Reclamation and operated for flood control (under Section 7 of the 1944 Flood Control Act), power, irrigation, recreation, fisheries, and navigation. The project includes Banks Lake, an irrigation/pumped storage reservoir. This year's operation is graphically shown on [Chart 14](#) and [Chart 68](#).

On October 1, 1999, FDR Lake was at elevation 1285.3 ft and was drafted to elevation 1272.1 ft by December 31. The reservoir was drafted to reach its May 1st flood control elevation of 1243.3 ft. There was a surge of early runoff in April, then lower inflows in May, so Coulee continued to draft to provide flows for fish emergence in the Hanford Reach. The reservoir reached its lowest elevation of the year at 1233.9 ft on May 19 then started refill. Due to a dry spring and summer, FDR only refilled to elevation 1286 ft on July 16. As the water year turned out to be below average, there were several requests to draft to elevation 1278 ft in early August to meet flow augmentation targets at McNary that were denied. FDR was actually drafted to 1280.4 ft by August 31. The maximum daily outflow for the year was 202,300 cfs occurring on April 24.

The seasonal spring flow objective (260 kcfs April 20 - June 30) at McNary was not met either on a seasonal basis, with April 18- June 30 average flow of 243 kcfs, or on a weekly basis after the week of May 7. The summer seasonal flow objective (200 kcfs July - August) at McNary was not met either on a seasonal or weekly basis, with July - August seasonal flow averaging 153 kcfs. The summer objective was not met on a weekly basis either with the highest weekly flows occurring the week of July 9 at 179 kcfs. The lowest elevation reached at FDR reservoir for ESA operations was 1280.4 ft on August 31. The reservoir refilled to elevation 1285.5 ft by September 30.

14. Mid-Columbia PUD Projects

Five run-of-river projects located on the mid-Columbia River in central Washington are operated by three separate Public Utility Districts (PUD's) primarily for power, flood control, fishery, and recreation. The five projects, in downstream order, are Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids and the three Public Utility Districts are those of Douglas, Chelan, and Grant counties. Although these PUD's operate the projects, 14 utilities, in addition to the three PUD's, split ownership of the generation output of these plants. Article 34 of the Federal Energy Regulatory Commission licenses for these projects states that some flood control space be provided, as instructed by the Corps, to replace lost valley storage under certain flood potential conditions but was not required this year. The operation of these projects is summarized in the flow of the Columbia River at Priest Rapids, Washington as shown on [Chart 89](#).

The unregulated peak flow was 312.5 kcfs on 16 June 2000, and the observed peak was 241 kcfs on 25 April 2000.

Numerous special operations occurred at these projects to assist in the downstream passage of juvenile anadromous fish during the 2000 out-migration, including FERC-required spill. These include: during autumn, a coordinated effort was carried out to operate Priest Rapids to encourage fish to spawn at lower levels in the Vernita Bar area; from mid-October to late November (the primary spawning period), daytime flows were held as low as possible in an attempt to reduce the subsequent minimum flow necessary to protect redds until emergence of fry in early spring. The protection level established for WY 2000 was 60 kcfs. Special flow operations were also required of Priest Rapids Dam in March, September and October for Navy nuclear reactor compartment offloadings at Hanford, Washington. This is described in paragraph 34, Chief Joseph, McNary, The Dalles, and Bonneville Projects.

15. Yakima Project

The 5 storage reservoirs in the Yakima Basin in Eastern Washington were operated by the Bureau of Reclamation during the October 1999 through September 2000 period (Water Year 2000) for irrigation, fish and wildlife enhancement, flood control, power, recreation and safety of dam concerns. This year's operation is graphically shown on [Chart 31](#) and [Chart 32](#).

The October through September natural flow for the Yakima River at Parker was 3.42 MAF, about 101 percent of the 1961-1990 average. The peak daily observed flow of 12.5 kcfs occurred on December 19, 1999, and the peak daily unregulated flow of 18.1 kcfs occurred on November 26, 1999. Some bypassing of reservoir inflow was necessary, from April through June, to maintain flood control space based on forecast runoff.

Total 2000 Water Year precipitation (total as recorded at 5 reservoir sites) was 232.88 inches, 101 percent of average. The Yakima basin snow-pack (Yakima Project's 6th and largest reservoir) was above normal, averaging 120% of normal during the 7 months, December through June, of snow season.

The system reached maximum storage for the year on June 12, 1999 at 1,047,670 AF, and was placed on

storage control on July 1, 2000. From mid-July the runoff in the Yakima River Basin was average until the end of irrigation season. All entitlement water users received a full water supply during the 2000 irrigation season (March 15 to October 22). The Project storage on September 30, 2000 was 371.2 kaf, 105 percent of average.

Based on the Total Water Supply Available (TWSA), during July 1 to October 31, the Yakima River Basin was managed to provide target flows of 400 cfs for Yakima River @ Parker, and 400 cfs for Yakima River @ Prosser. These flows are provided for by law in the document "TITLE XII -- YAKIMA RIVER BASIN WATER ENHANCEMENT PROJECT, Section 1205."

The Yakima reservoirs were operated to enhance both fish spawning conditions during September to mid-October 1999 and incubation/rearing levels mid-October 1999 through March 2000. The bypassing of reservoir inflows to maintain flood space requirements or power rights, supported incubation/rearing level flows for the rest of the season. Incubation/rearing releases from reservoirs included 2.9 kaf from Keechelus, 48.6 kaf from Cle Elum, and 17.7 kaf from Rimrock. The below normal incubation/rearing releases from Keechelus were due to safety of dam concerns which required early bypassing of storage inflow to maintain monitoring elevations on the reservoir and to control the refill rate.

In 2000, both fish spawning enhancements, Mini-Flip-Flop and Flip-Flop operations were executed in the Yakima River Basin. The Mini-Flip-Flop operation requires increasing outflows from Kachess Reservoir and decreasing outflows from Keechelus Reservoir to supply the demands in the Easton Reach of the Upper Yakima River. This provides for low spawning flows in the Yakima River above Lake Easton. The incubation/rearing level flows required during the winter are then supported by releases from Keechelus Reservoir. The Mini-Flip-Flop operation was implemented during the week of August 25-31, 2000.

The Yakima River to Naches River, Flip-Flop operation was executed for the 19th consecutive year. It involved drawing storage from Keechelus, Kachess, and Cle Elum Reservoirs to meet all Yakima River diversions in June, July, August, and the first few days of September. During these months Rimrock and Bumping reservoirs were used only to meet the Naches and Tieton River diversions. In September, when low stages of river flows were required in the Yakima River from Easton to the mouth of the Teanaway, the Yakima River reservoirs were set to meet only the spawning flow levels. Also in 2000, up to 400 cfs was routed around that reach via the Kittitas Canal at Wasteway 1146. The Yakima system below the confluence of the Naches River, as well as the Naches and Tieton diversions, was met with releases from Tieton and Bumping reservoirs. These flows were provided for spring Chinook salmon under a 1980 court order. The flip-flop operation was implemented during the period of September 1-9, 2000, providing a longer, more environmentally friendly ramping down of flow levels in the upper Yakima River.

In 2000, spawning flows were set at 100 cfs at Yakima River near Crystal Springs, 300 cfs in Yakima River below Easton Dam, and 300 cfs in the Cle Elum River below the reservoir. Due to the fisheries spawning cycle throughout the Yakima River Basin, incubation/rearing flow levels were established the last week of October 2000 providing for 300 cfs at Yakima River below Easton Dam, and 300 cfs in the Cle Elum River below the reservoir.

16. Jackson - Palisades Project

Active storage in the Snake River Basin above Heise, Idaho, includes 847 kaf in Jackson Lake and 1,200 kaf in Palisades Reservoir (a Section 7 project) for a combined total of 2,047 kaf. The system is operated as a multipurpose unit for flood control, irrigation, recreation, fish and wildlife, and power production. Discharge measurements from Jackson Lake are gaged at the Snake River at Moran, Wyoming, and from Palisades Reservoir at the Snake River near Irwin, Idaho. Flood regulation curves are designed to maintain flows at Heise at or below 20.0 kcfs. This year's operation is shown graphically on [Chart 33](#), [Chart](#)

34, [Chart 69](#), and [Chart 70](#).

The October through July volume runoff above the Snake River near Heise, Idaho, gage was 3,990 kaf, 83 percent of the 30-year average from 1971 to 2000. The unregulated peak flow at the Heise Gage was 26,804 cfs on May 27, and the peak regulated flow was 15,668 cfs on May 31. Flood regulation curves are designed to maintain flows at Heise at or below 20,000 cfs. Flood control releases from Jackson Lake Dam began in late April. Releases were gradually increased to 3,000 cfs in mid May then to 5,750 cfs on May 31. Starting June 5 the release was steadily decreased to 1800 cfs by the end of June. Maximum reservoir elevation was 6768.90 on June 14. Maximum reservoir content was 844,450 acre-ft.

Flood control releases to make space in Palisades Reservoir began March 2 and increased to 15,273 cfs by May 29. Starting June 5 releases were decreased and reached 10,000 cfs by the end of July. Releases reached the peak release for the year of 15,304 cfs on June 1. Palisades Reservoir maximum elevation was 5619.18 on June 14. Maximum reservoir content was 1,186,569 acre-ft.

Maximum combined content of the two reservoirs was 2,031 acre-ft on June 14. After the below average runoff in 1999, contents in Jackson Lake and Palisades reservoirs were 1,552 kaf on October 1, 1999. Storage increased slightly through the winter until flood control rule curves dictated that flood control space be evacuated. Snow accumulation on the watershed above Palisades Dam was 88% of normal on April 1. April through July runoff was 74% of the 30-year average. September 30 content was 900 kaf, 318 kaf below the 30-year average content on September 30.

17. Ririe Project

Ririe Reservoir is a Section 7 project on Willow Creek in eastern Idaho that is owned and operated by the Bureau of Reclamation for the joint uses of irrigation, flood control, recreation, and fish and wildlife. Its active capacity of 90.5 kaf includes exclusive flood control space of 10.0 kaf. This year's operation is graphically shown on [Chart 35](#).

The October through June runoff into the reservoir was 51,169 acre-ft, 48 percent of average. The peak daily inflow was 582 cfs on April 19. The maximum release was 401 cfs on October 6 during the drawdown after the 1999 irrigation season. The maximum release during the irrigation season was 105 cfs on May 7th. The maximum content was 73,399 acre-ft on May 22. Storage at the end of the water year was 54927 acre-ft, 11081 acre-ft above the average.

18. American Falls Project

American Falls Dam is a Section 7 project that has an active capacity of 1,673,000 acre-ft and is operated primarily for irrigation, power, and flood control. During the irrigation season American Falls Reservoir is operated to meet irrigation needs in the Snake River downstream from American Falls Dam. The Snake River near Shelley gage is approximately 73 miles upstream of American Falls Dam and is the control point for flood regulation in American Falls Reservoir. The Snake River near Blackfoot gage, approximately 46 miles upstream of American Falls Dam, is the control point for irrigation releases from upstream reservoirs. This year's operation is graphically shown on [Chart 36](#), [Chart 37](#), [Chart 38](#), and [Chart 71](#).

American Falls releases were reduced to 3,500 cfs in late October due to dry conditions and remained there until late December. Releases were increased to 7000 cfs by the end of December and remained at that level through most of January. During the last week in January and the first week in February the releases were reduced to 2000 cfs. Flows remained at approximately 2,000 cfs until the beginning of March. During March, flows were increased to 3,000 cfs to fill Lake Walcott. During April, May and June releases were gradually increased to 13,000 to driven by irrigation demands. Starting the first week in August releases was

steadily reduced to about 6,000 cfs by the end of September due to diminishing irrigation demands. Maximum storage during the year was 1,675,482 acre-ft on April 17. Reservoir contents on September 30 were 127,388 acre-ft, which is 387,460 acre-ft below the 30-year average.

19. Little Wood Project

Little Wood Reservoir has an active capacity of 30,000 acre-ft. Although it was originally constructed by Little Wood Irrigation District for exclusive irrigation use, it has been designated as a Section 7 project since enlargement by the Bureau of Reclamation and is now operated also for flood control. The Little Wood River at Carey gage, approximately 3 miles downstream from the dam, is the control point for reservoir operations. This year's operation is graphically shown on [Chart 39](#).

The October through July runoff into the reservoir was 73920 acre-ft, 59 percent of the average. Maximum daily inflow was 469 cfs on April 9 and peak daily discharge at the Carey gage was 472 cfs on April 5.

Little Wood Reservoir was allowed to fill starting in mid October with essentially no flood control space being evacuated. The discharge was shut off in late October. In late March the release was increased to about 400 cfs with some fluctuation during April to regulate the fill. During May and June releases averaged about 250 cfs. Starting in early July the release steadily declined with irrigation demands and reached 40 cfs by the end of September.

The reservoir filled April 30 and remained full until May 5. Maximum reservoir content was 29,972 acre-ft on May 2. The storage at the end of September was 3,165 acre-ft, 3,358 acre-ft below the average.

20. Owyhee Project

Although constructed by the Bureau of Reclamation as a single-purpose irrigation reservoir, Owyhee Reservoir has an active storage capacity of 715 kaf and can provide significant incidental flood protection along the lower Owyhee River and further downstream along the Snake River from Nyssa, Oregon to Weiser, Idaho. Most of the largest floods from this basin result from winter rain on snowpack over frozen ground. This year's operation is graphically shown on [Chart 40](#).

The runoff this year was below average. The December-June runoff volume was 345 kaf, 47% of average. The peak mean daily inflow was 3,922 cfs on April 4, 2000 and the peak daily outflow was 280 cfs on April 29, 2000. The reservoir reached a maximum content of 634 kaf on April 23, 2000. The Owyhee net inflow for the period of June through September was 58% of average.

21. Boise Project

The Boise Project, Arrowrock Division, is a three-reservoir system including Anderson Ranch, Arrowrock, and Lucky Peak reservoirs with a combined total active storage capacity of 974 kaf. Anderson Ranch and Arrowrock, Section 7 projects, are operated by Reclamation while Lucky Peak is a Corps project that is regulated in close cooperation with the two upstream projects. Seattle City Light retrofitted a powerhouse for Lucky Peak. This system is operated as a multipurpose unit for flood control, fish and wildlife, power production, recreation, and irrigation. The Boise River at Glenwood Bridge gage is the control point for the flood control operation of the system. This year's operation is graphically shown on [Chart 41](#) and [Chart 72](#).

Seasonal runoff in the Boise Basin for the period of April 1, 2000 through July 31, 2000 was 1,070 kaf, 76% of average. The release from Anderson Ranch Reservoir was maintained at the minimum release of 300 cfs from the end of irrigation season until early March. Through March and April the release was maintained at about 1,600 cfs. During most of May the release was reduced to 600 cfs to insure filling. On June 6,

releases from Anderson Ranch Reservoir reached a seasonal maximum release of about 2,100 cfs.

The release from Lucky Peak Reservoir was reduced to 240 cfs at the end of the irrigation season and maintained there until early March. Releases were gradually increased during March and reached a discharge of about 3,000 cfs near April 1. Releases reached a maximum of 5,500 cfs on April 29. The peak flow of the Boise River at the Glenwood Bridge gaging station was 3,300 cfs on April 19, 2000. Flood stage at the Glenwood station is 7,000 cfs. The Boise reservoir system filled on June 9, 2000 and remained full through June 17.

Forty thousand acre-ft of water was released from Boise River reservoirs between mid-June and late August for salmon flow augmentation.

22. Malheur Project

Beulah (Agency Valley Dam) and Warm Springs Reservoirs were originally constructed and operated as single-purpose irrigation reservoirs. Since the construction of Bully Creek Reservoir in 1962, all three of these Section 7 reservoirs are operated for multipurpose benefits and have a combined active capacity of 281 kaf. The Malheur River is similar to the Owyhee River in that the major floods are usually caused by rain on frozen and snow-covered ground. The Malheur River at Vale gage is the control point for flood control operation of the reservoirs, with the primary goal of limiting flows to 8000 cfs. This year's operation is graphically shown on [Chart 43](#), [Chart 44](#), and [Chart 45](#).

The Malheur Basin experienced a below average water supply year in 2000. December through June runoff at Warm Springs Reservoir was 80% of average and inflow on the North Fork at Beulah Reservoir was 82% of average. Warm Springs Reservoir reached a maximum storage volume of 182 kaf on April 29, 2000. End of year content was 43 kaf. Beulah Reservoir filled and reached a maximum storage content of 60 kaf on April 13, 2000. End of year carryover storage in Beulah Reservoir was 11 kaf. Bully Creek Reservoir filled and reached a maximum storage volume of 30 kaf on April 16, 2000 and the end of year carryover storage volume was 11 kaf.

23. Payette Project

The Payette River reservoir storage system includes Cascade and Deadwood reservoirs that have a combined total active storage capacity of 815 kaf. These reservoirs were originally constructed by Reclamation for irrigation and power purposes, but now are also operated informally for incidental flood control. The control point for flood control operation of these projects is the Payette River near Horseshoe Bend streamgage at river mile 60.8. A second key streamgage is the Payette River near Emmett at river mile 38.4. Approximately 65% of the drainage basin above Horseshoe Bend is unregulated. This year's operation is shown on [Chart 42](#) and [Chart 73](#).

Runoff in the Payette Basin was below average in 2000. The April through July runoff volume, measured at Horseshoe Bend was 1,296 kaf, 79% of the 30 year average. At Cascade Reservoir the runoff volume for the same period was 450 kaf, 87% of average, and at Deadwood Reservoir the corresponding runoff volume was 98 kaf, 73% of average. Peak daily inflow into Cascade Reservoir was 4,568 cfs on May 23, 2000 and the peak inflow into Deadwood Reservoir was 930 cfs on May 23, 2000.

The peak flow of the Payette River near Emmett, Idaho was 7,418 cfs on May 26, 2000. Flood stage is 16,000 cfs at Emmett.

Cascade Reservoir filled on May 28, 2000 and was maintained at full pool through June 19, 2000. Deadwood Reservoir filled on May 25, 2000 and remained full until June 25, 2000.

A total of 145,000 acre-ft was obligated for release for salmon flow augmentation. About 90,000 acre-ft of water was released from Cascade and Deadwood reservoirs between mid-June and the end of August. The remaining 55,000 acre-ft of water was released in September 2000. Some of the water released from Cascade Reservoir for this purpose is water conveyed downstream from Payette Lake.

24. Snake River at Weiser

Snake River at Weiser flows are highly regulated by upstream irrigation diversions and reservoir storage operations previously discussed in this chapter. These operations normally result in a fairly smooth hydrograph at Weiser. This year's operation is graphically shown on [Chart 46](#) and [Chart 74](#).

25. Powder Project

Phillips Lake is formed by Mason Dam on the Powder River in eastern Oregon, is owned by Reclamation, and is operated by the Baker Valley Irrigation District as a multipurpose project with 17 kaf for exclusive flood control, 21 kaf for joint use, and 52.5 kaf for active conservation use, for a total active capacity of 90.5 kaf. The control point for flood control regulation is the Powder River at Baker City streamgage, which should be controlled to 500 cfs, if possible. This year's operation is graphically shown on [Chart 88](#).

The Powder River basin had an average runoff year in 2000. April through July runoff was 55 kaf, 103% of average. Phillips Reservoir reached a maximum storage volume of 71,702 acre-ft on May 24, 2000.

The peak flow of the Powder River at Baker City, Oregon was 366 cfs on August 1, 2000.

26. Brownlee Project

The Brownlee, Oxbow, and Hells Canyon Dams are owned and operated by Idaho Power Company (IPC). These tandem projects are operated in accordance with a single license issued by the Federal Energy Regulatory Commission that requires operation for flood control and navigation, in addition to power. Specifically, this license requires that Brownlee, the only one of the three projects with significant storage, provide a minimum of 500 kaf of flood control space by February 1 of each year. By March 31 the reservoir is to provide an additional 500,000 acre-ft if necessary to help control flooding in the Lower Columbia, as determined by the Corps of Engineers. The license does, however, have a provision for a partial waiver of this requirement in dry years or for increased space in wet years. The Corps of Engineers examined the Brownlee flood control operations in 1987 and again in 1998. The 1998 procedure is currently being used. The FERC license also requires adequate navigation depths be maintained below Hells Canyon Dam. Spring refill of Brownlee is coordinated with the Corps of Engineers Reservoir Control Center for flood control. This year's operation is graphically shown on [Chart 15](#) and [Chart 75](#).

At the beginning of the Water Year, Brownlee was at elevation 2039.7 ft. The lake was drafted to elevation 2027.2 ft by October 18 to create space in the reservoir so a portion of the inflow could be stored while discharge from Hells Canyon could be maintained 11 - 13 kcfs to encourage fall chinook salmon to spawn at a low elevation in the downstream channel during the late October through December 6 time frame. The goal was to fill the lake near the end of the spawning operation. The lake was filled to 2062.2 ft on 6 Dec and continued to fill to 2075.2 ft on January 3 (2077 ft is full). The Hells Canyon discharges were then maintained above 12 kcfs until fry emergence in the spring.

In November 1998, the Corps sent IPC a new procedure for determining the annual draft of Brownlee for

flood control that delivers the same level of flood control and provides a smoother real-time operation than the current procedure. In December 1998 IPC sent the Corps a letter approving the new procedure. This new procedure was submitted in the PNCA Data Submittal for use in WY 2000.

The February water supply forecast for Brownlee for the April-July period was 63 percent of the 1961-90 average. Based on this forecast and the forecast at The Dalles the Corps notified IPC that 265,000 acre-ft of flood control space (elevation 2056.7) be available at Brownlee by February 28, 248,000 acre ft of flood control storage space be available (elevation 2058.1 ft) by March 31 and 211,000 acre ft of flood control space be available (elevation 2061.3) by April 30. Because of the low volume forecast in the Columbia basin, the Corps also notified IPC that Brownlee's entire March 31 flood control requirement could be shifted to Grand Coulee and that a lesser amount could be shifted by April 15. The Corps notified IPC if shift was elected, Brownlee's space requirement still had to be met by April 30. The April final volume forecast increased over the January forecast and required a flood space requirement of 270,000 acre-ft (elevation 2056.2 ft) by April 30. The actual elevation on that date was 2055.93 ft. Idaho Power Corporation was targeting to refill Brownlee to 2060 ft by the end of May. Lower Granite flows were sagging in early May. To augment Lower Granite flows, BPA reached an agreement with Idaho Power to increase Hells Canyon flows above 20 kcfs from May 10 – 15. This slowed the refill down and the project filled to within 1' of full (2076 ft) on June 13. Between June 13 and July 22, Idaho Power drafted Brownlee to 2050 ft and satisfied the requirements for delivering the Biological Opinion water volumes from Brownlee (237 KAF) and the Upper Snake pass-through water. The Salmon Managers submitted a System Operating Request, asking Idaho Power to continue drafting Brownlee beyond July 22 to provide additional Snake River Flow. Idaho Power continued to draft Brownlee through July 28, then reduced flows on July 29 to 8.9 kcfs to pass inflow and start getting back energy from Bonneville Power Administration (per agreement in May, discussed above). Brownlee was drafted to 2042.5 ft on July 28.

The regulated peak inflow was 34,473 cfs on 15 April 2000 and the unregulated peak inflow was 61,327 cfs on that same day. Maximum daily outflow was 34,518 cfs on 26 April 2000. The April-July observed Brownlee inflow was 4372 kaf, or 75 percent of the 1961-90 average.

27. Dworshak Project

Dworshak Lake and Dam are located on the North Fork Clearwater River near Orofino in west central Idaho. This headwater project was constructed and is operated by the Corps of Engineers for power, flood control, fishery, navigation, and recreation. This year's operation is graphically shown on [Charts 16 and 76](#).

Dworshak was drafted to 1526.6 ft by the end of August 1999 for salmon flow augmentation. The project was drafted to 1520 ft on September 14 and from September 15 – January 5, the project released minimum outflow of about 1.5 kcfs between 1 September 98 and 6 January 99. The end of December elevation was 1537.86 ft, well below the Upper Rule Curve elevation of 1558 ft. Outflows were increased on 6 January in response to the volume forecast. The January – March monthly average outflows were 4 – 8 kcfs while targeting end of month flood control elevations which included a flood control shift of about 131 KAF from Dworshak to Grand Coulee at the end of March. Flood control shift is allowable under certain conditions, and in this dry water year a shift of as much as 1140 KAF at the end of March was allowed, as long as the actual end of April flood control elevation was reached. The shift was requested by the Salmon Managers in an effort to save some water in Dworshak and use it after March to augment Lower Granite flows. For most of the month of April, the project released about 15 - 16 kcfs that included 4 - 5 kcfs spill. On May 5, outflows were gradually reduced as the TMT reached consensus to start emphasize refill rather than Lower Granite flow augmentation. May average outflows were 4.5 kcfs that included maintaining minimum flow of 1.5 kcfs from May 13 – May 31. On May 31 the Dworshak National Hatchery requested 52 – 53 degree water from the project starting June 1 to facilitate fish growth. The project raised the selector gates on the water temperature control structure to accommodate this request. Outflows remained at about 1.5 kcfs through June 13 when the pool reached 1594.4 ft (5.6 ft from full). Outflows were increased to 4.8 kcfs and were adjusted throughout the month in an attempt to reach full on June 30 at the request

of the Salmon Managers. The project reached 1598.6 ft on June 30. There was much discussion at TMT on what to do with Dworshak water in July. The State of Idaho, Nez Perce Tribe and CRITFIC wanted to save some Dworshak water for September in order to cool down the Snake River water for adult migrants. They wanted to ramp up flows at Dworshak starting in mid-July. The Salmon Managers wanted to ramp up flows at Dworshak the first week in July and use all the Dworshak flow augmentation water (down to 1520 ft) in August for migrating juveniles. The Technical Management Team could not reach consensus on the Dworshak operation, so the decision was raised to the Implementation Team level. The Implementation Team recommended releasing 47-degree water and full load (9400 cfs) and then increasing discharge up to 110% gas if the Lower Granite temperature exceeded 68 degrees. Flows were increased above full load starting July 8. Dworshak outflows averaged 11.7 kcfs during August. The flows were gradually reduced over the month of August to draft the project to 1520.07 ft by the end of the month. Starting September 1, flows were at the minimum flow that facilitated refill and produced total dissolved gas at less than 110%. This flow remained throughout the rest of the Water Year and ranged from 1.5 – 1.7 kcfs. The project was at minimum flow as it was targeting its end of December Upper Rule Curve elevation of 1558 ft.

The peak daily inflow was 24.5 kcfs on 14 April 2000, while outflow at the time was 16,000 cfs. The peak daily outflow was 16.2 kcfs that was on 13 April 2000. The January-July runoff volume was 3485 kaf, 98% of normal, while the April-July runoff was 2675 kaf, or 99% of average.

28. Clearwater River at Spalding

The streamgage on the Clearwater River at Spalding in west-central Idaho measures the portion of the inflow to Lower Granite Dam that originates in the Clearwater River Basin. It is also used as a flood control point in the operation of Dworshak Dam. This year's operation is graphically shown on [Chart 77](#).

The observed peak flow at Spalding this year was 42,898 cfs on 4 April 2000. Dworshak was releasing 10,800 cfs on this date. The unregulated peak flow during the flood season was 54,060 cfs on 23 May 2000, well below the flow at flood stage of 111,600 cfs.

29. Lower Snake Project

Lower Granite, Little Goose, Lower Monumental, and Ice Harbor are run-of-river projects on the lower portion of the Snake River in southeastern Washington. Lower Granite and Little Goose have 5-foot forebay operating ranges, and Lower Monumental and Ice Harbor have 3-foot ranges. All four projects are operated by the Corps of Engineers for navigation, hydropower, fishery, and recreation. This year's operation is graphically shown on [Chart 78](#) and [Chart 90](#).

During the summer of 1999 the projects had been operating at (MOP) to improve conditions for juvenile fish migration. The theory of the MOP operation is to lower the pools to increase the water velocity and facilitate faster downstream juvenile fish passage.

Ice Harbor returned to its normal operating range on September 1, 1999. Lower Monumental and Little Goose projects returned to their normal operating ranges on September 5 and September 12, respectively. The Salmon Managers typically request Ice Harbor, Little Goose and Lower Monumental projects refill about 1 September to submerge fish ladder entrances at upstream projects and facilitate adult fish passage.

Lower Granite returned to its normal pool operations on November 15, 1999. There is no project immediately upstream of Lower Granite and therefore no fish ladder entrance to submerge. The emphasis at the project is juvenile fish passage.

Between April 5 and April 10, Ice Harbor, Lower Monumental, Lower Granite and Little Goose were drafted to MOP or MOP + 1 ft for juvenile fish migration, as required by the Biological Opinion. Required nighttime spill was initiated at Lower Monumental, Lower Granite and Little Goose on April 4, April 7 and April 10, respectively and continued through June 20. Required around the clock spill was initiated at Ice Harbor on April 4 and terminated August 31 (lasted longer than the other Lower Snake projects because Ice Harbor does not have fish collection system). Spill was maintained at the 120% gas cap level, and was adjusted based on actual data. Spill adjustments were made for fish barge traffic at Lower Monumental and Lower Granite when requested by towboat personnel to aid in safe navigation. Fish transportation by truck was initiated on 27 March at Lower Granite and on 3 April at Little Goose and Lower Monumental. Barging at these three Snake River projects began on 8 April and ended on 21 July at which time transport mode reverted back to trucking. Trucking ended 31 October at all the Lower Snake projects. Fish bypass systems were used until 6 December.

The April-July unregulated runoff to Lower Granite was 17163 kaf, or 79 percent of normal. The regulated peak flow into Lower Granite was 116,000 cfs on 23 April 2000, and the unregulated peak was 153,465 cfs on 24 May 2000.

30. Mill Creek Project

Mill Creek Dam is a Corps of project on Mill Creek, east of Walla Walla, Washington. This is an off-stream project into which high flows are diverted for flood control and recreation. The reservoir (Bennington Lake) has an active storage capacity of 8,200 acre-ft, which can be used for flood control and recreation. Its annual operation is graphically shown on [Chart 47](#).

There were no flood control operations at Mill Creek this year. Bennington Lake began refilling for recreation on March 24, 2000 and reached its conservation pool elevation of 1205 ft on April 14, 2000 (Chart 47). Bennington Lake's elevation remained near 1205 ft until June 15. From June 15 through September 30, 2000, seepage and evaporation losses caused drawdown of Bennington Lake to elevation 1194.1 ft.

31. Willow Creek Project

Willow Creek Dam at river mile 52.4, together with the City of Heppner Flood Warning System, constitutes the Corps of Engineers flood protection provided for the urban reach of Willow Creek through the city and immediately north of Heppner in north-central Oregon. The dam is a 154 ft high roller-compacted concrete structure with an ungated spillway. The 14,091 af of storage space below the ungated spillway crest, 2113.5 ft, is allocated to flood control, irrigation, and minimum flow maintenance. The lake is held at 2063.0 ft in the winter and 2076.5 ft in the summer to provide for flood control. This year's operation is graphically shown on [Chart 48](#).

32. John Day Project

Lake Umatilla was formed by the construction of John Day Dam on the Columbia River. The Corps operates the project primarily for power, flood control, and navigation. The lake has approximately 500 kaf of active storage in its full operating range, 257.0-268.0 ft. Historically, the Corps generally operated the lake in the elevation range 260.0-265.0 ft from November through the spring runoff. Following the spring runoff, and continuing until mid-October, the lake was normally operated in its top three ft, 265.0-268.0 ft. However, in recent years the lake has been operated at lower levels in accordance with the Endangered Species Act in an attempt to improve juvenile spring/chinook salmon passage through the reservoir. From April 20-September 30 there is a 1.5-foot operating range while the normal operating range during this period is 262.5-264.0 ft. The lower elevation limit is adjusted to meet irrigation needs. Between September 30 and April 20 there is a 2.5-foot operating range of 262.5-265.0 ft. In addition, at any time during the year the lake can be operated

257.0- 268.0 ft for flood control. This year's operation is graphically shown on [Chart 17](#).

While there were no flood control operations at John Day in Water Year 00, there were special operations set up for several different parties. There were special operations for goose hunting (9 October – 23 January) and goose nesting (March 10 – June 1). The requested operation for hunting was to operate in the top foot of the operating range on Mondays, Wednesdays, weekends and holidays. The requested operation for nesting was to operate in the top foot of the range at least once every four days for 6 to 8 daylight hours. There were also special operations set up involving specified turbine operations, flow, tailwater and forebay ranges for fish and dissolved gas research. Contractors also requested special operations to hold the forebay low to facilitate work in the pool. Between April 20 and September 30 the forebay was operated in a 1.5 foot operating range per the Biological Opinion. The range started out 262.5 ft – 264 ft and subsequently was raised two times to facilitate the irrigators. June 6 – July the range was 262.8 ft – 264.3 ft and July 7 – September 30 the range was 263 ft – 264.5 ft.

Spill for juvenile fish passage occurred at John Day between during the spring and summer. Spill levels were set in accordance with the Corps' Fish Passage Plan for 2000. See Section G., Fishery Operations for additional information.

33. Upper Deschutes River Project

This multiple-reservoir system is composed of six reservoirs: Prineville and Ochoco reservoirs (both Section 7 projects) on the Crooked River (a mid Deschutes Basin tributary) and Crane Prairie, Wickiup, Crescent Lake, and Haystack reservoirs on the upper Deschutes River. Including Haystack, which is an offstream re-regulating reservoir, the combined total active storage capacity is 559 kaf. This year's operation is graphically shown on [Chart 49](#) and [Chart 50](#).

Crescent Lake storage at the beginning of the water year was 77 kaf. Storage peaked for the season at 86.4 kaf on June 14, which is essentially full. Carryover storage at the end of the year was 63 kaf. The maximum combined Wickiup and Crane Prairie storage of 250 kaf was reached on April 18. Combined storage at the end of the year was 127 kaf.

Prineville Reservoir entered the water year with a carryover of 99 kaf (103% of average.) Winter flood control space was maintained by releasing a stream resource maintenance flow typically ranging from 70 cfs to 160 cfs until late March, when higher flood control releases began to be necessary. Peak storage of 151.7 kaf, 102 percent of active capacity, was reached on April 9. The maximum inflow was approximately 2700 cfs on April 5; maximum release was 2320 cfs on April 9. The reservoir had storage of 85.8 kaf (89% of average) at the end of September.

Ochoco Reservoir entered the water year with a carryover of 13.7 kaf. The outlets were closed following irrigation season and all inflow was stored until early April, when flood control releases were initiated. Discharges typically ranged from 50 to 70 cfs to maintain flood control space until irrigation draft began in mid May. Heavy snowpack in the Ochoco basin prompted a conservative operation that provided more reservoir space than called for under the rule curves. The potentially high inflows never materialized due to a very dry spring, low soil moisture, and slow melt pattern. The peak inflow for the year was 330 cfs on April 5, and outflow peaked at 136 cfs on June 30. The reservoir nearly filled, reaching a maximum content of 42.2 kaf (95% of capacity) on April 30. Irrigation demand drafted the reservoir during the summer to 18.1 kaf by the end of September.

34. Chief Joseph, McNary, The Dalles, and Bonneville Projects

The Corps operates these run-of-river projects for hydropower, navigation, irrigation, recreation, and fisheries. Chief Joseph is located on the mid-Columbia River in central Washington while McNary, The

Dalles, and Bonneville are on the lower Columbia River, straddling the Oregon-Washington border. Several special operations occur each year at these projects to meet special operational requirements for power production, navigation, recreation, fishery, and construction activities. This year's operation is graphically shown on [Chart 80](#) and [Chart 91](#).

McNary Dam had Biological Opinion flow requirements that varied throughout the spring and summer (see Section G., Fishery Operations). Fish were bypassed during the spring. Fish barging started on 22 June and ended 7 August, when the transportation mode was switched back to trucking. Trucking continued until 28 November. The fish bypass remained in operation through December 14. Also continuing at McNary this year was the offloading and burying of five decommissioned defueled submarine reactor compartments and three decommissioned defueled cruiser reactor compartments at the Hanford Reservation. Three cruiser shipments were made in October 1999. Two submarine shipments were made in March 2000, two in April and one in September. Cruiser reactor compartments differ from submarine reactor compartments because they are a different configuration and are slightly larger. Because the cruiser compartments are bigger, they require a longer offloading period than the submarine compartments. These offloading operations required special operation of the water level behind McNary Dam and Chief Joseph and Priest Rapids Dam discharges to allow barge docking and nuclear reactor compartment unloading at the Port of Benton slip. The duration of the special operations was about 47 hours for a submarine compartment and 55 hours for a cruiser compartment. There were also, special operations at McNary for national level competitive boat races, grounded barges, construction work, waterfowl nesting, and waterfowl hunting occurred throughout the year. At times, these requests conflicted with each other, requiring special coordination.

Special operations at Bonneville included high forebay for Treaty gill net fishing, low forebay for construction work, high forebay for cross-channel swim, low tailwater for lock repair work and juvenile bypass outfall construction and spill to assist Spring Creek Hatchery fish released in passing Bonneville Dam. A high forebay was also needed July – November 2000 to help keep The Dalles tailwater high due to a navigation hazard.

Special tailwater operations at The Dalles were required to facilitate cleanup of a toxic spill at Fifteen Mile Creek in August and September 2000. A high tailwater was also needed for the period July to November 2000 until a high spot downstream of the entrance to the navigation lock was dredged.

Spill for juvenile fish passage occurred at McNary, John Day, The Dalles, and Bonneville during the spring and summer. Spill levels were set in accordance with the Corps' Fish Passage Plan for 2000. See Section G., Fishery Operations for additional information.

The observed peak flow at The Dalles was 374.6 kcfs on 23 April 2000. The Dalles unregulated peak flow was 449.6 kcfs, on 27 May 2000. The unregulated January-July runoff at The Dalles was 118.0 Maf, or 96 percent of normal. The April-August unregulated runoff was 84.2 Maf, or 90 percent of average.

35. Columbia River at Vancouver

The Columbia River Basin reservoir system did not need to be operated for flood control during the winter of 1999-2000. This year's operation is graphically shown on [Chart 79](#).

Flood stage at Vancouver, Washington was not exceeded during the spring runoff in Water Year 2000. The observed peak stage at Vancouver, Washington was 11.4 ft, 4.6 ft below flood stage, on 24 April 2000. As a comparison, in 1964, the flood crest was 27.7 ft and in February 1996, 27.2 ft was reached. The all time record is 31 ft in 1948. Flood stage at Vancouver is 16 ft and a major flood is considered to be at a stage of 26 ft.

36. Willamette Basin Projects

There are 25 dams in the Willamette Valley of western Oregon, eleven of which are single-purpose, hydroelectric plants operated by public and private utilities and are not the focus of this report. Of the remaining projects, the Corps of Engineers (COE) operates eleven storage and two re-regulating reservoirs. The Bureau of Reclamation (USBR) operates one storage project, Scoggins Dam, which is a Section 7 project. The Federal projects are:

Hydroelectric		Non-power
Storage	Re-regulation	Storage only
Hills Creek	Big Cliff	Fall Creek
Lookout Point	Dexter	Cottage Grove
Cougar		Dorena
Green Peter		Blue River
Foster		Fern Ridge
Detroit		Scoggins

These projects are operated for flood control, hydropower (where applicable), irrigation, fishery habitat, and recreation. Since these federal projects are operated as a system to control the flow of the Willamette River, their operation will be discussed as a unit. This year's operation is graphically shown on [Charts 18-28](#), [Charts 81-84](#), and [Chart 92](#).

a. COE PROJECTS

The summer augmentation plan was drafted and sent to interested State and Federal agencies in May. A meeting was held and the plan was presented to the agencies. The augmentation plan called for releases from the projects to be increased to meet downstream minimum flow requirements and target flows recommended by the Oregon Department of Fish and Wildlife. The following target minimum flows, in cfs, for the mainstem Willamette were adopted:

<u>Location</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>September</u>
Albany	6,000	4,500	4,500	5,000	5,000
Salem	15,000	12,500/8,500	6,000	6,000/6,500	7,000

The target minimum flows were met or exceeded in the May through September period. Fall drawdown at the projects was initiated after Labor Day.

b. USBR TUALATIN PROJECT

Henry Hagg Lake was formed by Scoggins Dam on Scoggins Creek, tributary to the Tualatin River near Forest Grove, Oregon. The reservoir has an active capacity of 53.64 kaf and is operated for flood control, irrigation, municipal supply, fish and wildlife, recreation, and water quality. The inflow occurs mostly from winter rainstorms. The year's operation was generally according to flood control regulations and is graphically shown on [Chart 85](#).

Henry Hagg Lake storage at the beginning of the water year was 15.5 kaf, 29 percent of capacity and 60 percent of average. The reservoir was further drafted during the fall to meet late season irrigation demand and provide water quality flows downstream on the Tualatin River, reaching its low for the year of 8.7 kaf on November 9, the lowest recorded storage in project history. Storage began to accumulate when the discharge was reduced to the project minimums beginning in mid November. Storage accumulation reached the flood control rule curve by mid December, when a high-water event forced storage above the curve. After drafting

back to its rule curve, occasional flood control releases ranging up to 700 cfs allowed the reservoir to follow its rule curve and fill by May 1. The peak stage at the Tualatin River near Dilley control point was 17.64 ft on Nov. 26, while Scoggins was on minimum release. The reservoir remained full until draft began in mid June. Storage at the end of the water year was 21.3 kaf. Inflow during the 2000 water year was 86.8 kaf, 95 percent of average.

37. Western Washington Projects

a. HOWARD A. HANSON DAM

Howard Hanson Dam, at mile 64.5 on the Green River, is a flood control and conservation storage project that provides fall and winter flood protection primarily for the lower Green-Duwamish River valley between the cities of Auburn and Seattle. In the spring, over 24 kaf are stored to augment late summer and fall low flows for fishery purposes. The City of Tacoma diverts an average daily discharge of 84 cfs for municipal and industrial water supply at its diversion dam and pipeline, 4.1 miles downstream from Hanson Dam. The year's operation is graphically shown on [Chart 51](#).

b. MUD MOUNTAIN DAM

Mud Mountain Dam, at mile 29.7 on the White River, is a single-purpose, flood control project that is normally empty except during flood control operation, project maintenance, and occasional special regulation for downstream needs. The year's operation is graphically shown on [Chart 52](#).

c. WYNOOCHEE DAM

Wynoochee Dam, at river mile 51.8 on the Wynoochee River, provides flood control for the Wynoochee Valley, water supply for the City of Aberdeen's diversion at river mile 8.1, fishery enhancement, recreation, and irrigation benefits. On July 26, 1995, the project was transferred from the City of Aberdeen to the City of Tacoma. However, the Corps' role in the flood control operation of the project remains unchanged while Tacoma is responsible for all non-flood reservoir regulation duties. The year's operation was generally according to flood control regulations and is graphically shown on [Chart 53](#).

d. ROSS PROJECT

Ross Dam, at mile 105.2 on the Skagit River, is owned and operated by the City of Seattle, Department of Lighting (Seattle City Light). The FERC license for the dam states that evacuation of flood control storage must begin by October 1 and be completed by December 1 to provide storage of 120 kaf above 1592.1 ft. The storage space must remain available until at least March 15 of the following calendar year. The FERC license also gives the Corps limited authority to specify project regulation during a flood emergency. During a flood event, when the unregulated or natural flow in the Skagit River near the town of Concrete is forecast to exceed the major damage level of 90.0 kcfs, the Corps can specify operation of the project. Under this flood control operation, Seattle City Light is permitted to release full powerhouse capacity from Ross Dam provided the flow is regulated by the two downstream projects, Diablo and Gorge, to a maximum outflow of 5,000 cfs. The year's operation was generally according to flood control regulations and is graphically shown on [Chart 54](#).

e. UPPER BAKER PROJECT

Upper Baker Dam is located at mile 9.3 on the Baker River, a tributary of the Skagit River. The FERC license for this two dam hydroelectric project, owned and operated by Puget Sound Energy (PSE), requires Upper Baker Dam to provide 16 kaf of flood control storage space by November 1 for replacement of natural

valley storage eliminated by the project. An additional 58 kaf of flood control storage must be provided by November 15 in accordance with congressional legislation and an agreement between PSE and the Federal Government for reimbursement of power losses due to operation of the additional storage for flood control. When necessary, flood control storage is managed by the Corps from November 1 through March 1 each year. As with Ross Dam, the Corps can specify operation of Upper Baker Dam when the unregulated or natural flow in the Skagit River near the town of Concrete is forecast to exceed 90.0 kcfs. Under flood control operation, PSE is required to maintain a release of 5.0 kcfs from Upper Baker Dam. The year's operation was generally according to flood control regulations and is graphically shown on [Chart 55](#).

f. MOSSYROCK & MAYFIELD DAMS

Mossyrock and Mayfield dams are cooperative regulation and re-regulation projects on the Cowlitz River that are owned and operated by Tacoma City Light, and provide mutually beneficial hydroelectric power generation and authorized Section (7) flood control. Their FERC license gives the Corps the corresponding authority to specify project regulation during major flood events. The flood control plan for Mossyrock is to provide a maximum of 360 kaf of flood control storage between elevations 745.5 and 778.5 ft during the months of December and January. The originally authorized water control diagram requires a gradual drawdown to minimum flood control pool between October 1 and November 30, and allows a gradual refilling to full pool between February 1 and June 1. Storage space of 21 kaf assigned to Mayfield may be substituted at any time for an equal amount in Mossyrock. The year's operation was generally according to flood control regulations and is graphically shown on [Chart 56](#).

The project was operated in accordance with the authorized water control diagram. During October and November of 1999, lake elevations were held some 15 to 25 ft below the authorized flood control evacuation schedule. The most significant flood control operation occurred during the flood event of November 26-28, 1999, with Mossyrock peak inflow at 42,500 cfs on November 27. A peak lake elevation of 758.04 ft occurred on November 29. During this event, maximum outflow from Mayfield re-regulation dam was 19,000 cfs on December 1-3. Lesser flood control events occurred on November 14 and December 19, with Mossyrock inflows at 25,700 cfs and 22,900 cfs, respectively. The corresponding evacuation releases from Mayfield were 9,200 cfs on November 20-24, and 18,700 cfs on December 19-20.

Between the normal filling dates of February 1 and May 31, the reservoir was refilled slowly at elevations that were some 20 to 30 ft below the authorized filling schedule. On June 26, the reservoir reached a maximum annual elevation of 773.2 ft, which was some 5.3 ft below Maximum Conservation Pool elevation. The reservoir was then drafted in the range of between 3,000 and 5,000 ac-ft a day during the period of July through November.

g. SEDIMENT RETENTION STRUCTURE

The Sediment Retention Structure (SRS) is a Corps project on the North Fork Toutle River in southwestern Washington designed to trap Mount St. Helens volcanic sediment by slowing the river flow. The dam was designed with six rows of outlet pipes that allow the water to pass through the SRS and into the outlet channel. The rows of outlets are successively blocked and closed as the sediment deposited in the pool continues to increase.

The uppermost and final tier of outlet conduits, designed to pass inflow as the pool filled with sediment, were closed on April 21, 1998. In its nine years of operation nearly 70 million cubic yards (mcy) of volcanic sediment accumulated behind the Structure. The Toutle River now flows over the spillway as sediment continues to accumulate, to a maximum of 284 mcy, behind the 184-ft high structure. Other conduit-tiers were closed in 1991, 1993, 1994, 1995, and 1997.

38. Oregon Coastal Projects

Out of the 11 dams in the Rogue River Basin of southwestern Oregon, two are operated by the Corps, seven by Reclamation, and two by a private utility. Only the Corps projects, one of the Reclamation projects, and a county owned project are operated for flood control. The Corps reservoirs, Lost Creek and Applegate, with a combined active storage of 390 kaf, are operated for flood control, irrigation, fish and wildlife enhancement, municipal and industrial water supply, water quality, recreation and power (at Lost Creek only). Elk Creek Dam is a partially completed Corps project on Elk Creek, a tributary to the Rogue, five miles below Lost Creek. US Bureau of Reclamation's Emigrant Lake has 39 kaf of storage and is operated for flood control, irrigation, and recreation. Douglas County owns Galesville Dam. The latter two projects are operated under Corps direction, when needed, for flood control.

a. WILLIAM L. JESS DAM AND INTAKE (LOST CREEK LAKE AND DAM)

The year's operation was generally according to flood control regulations and is graphically shown on [Chart 29](#).

b. APPLEGATE DAM

The year's operation was generally according to flood control regulations and is graphically shown on [Chart 30](#).

c. ELK CREEK DAM

The storage area behind the partially completed Elk Creek Dam is dry except for involuntary storage during high water periods.

d. GALESVILLE DAM

The lake was operated according to its rule curve and its operations were in compliance with flood control regulations.

The Lake was operated according to its authorized water control diagram. Operations were in compliance with Corps of Engineers flood control regulations and fulfilled the Section 7 flood control requirements. The year's operation is graphically shown on [Chart 86](#).

Significant flood control operations occurred on January 14, and April 18, with peak inflows of 2,170 cfs, and 940 cfs, respectively. The corresponding rise in reservoir elevation for the January 14 peak was 13.9 ft, with a maximum reservoir elevation of 1856.4 ft, which was 25.1 ft below maximum conservation pool. The reservoir was filled between February 1 and April 30, in accordance with its authorized filling schedule. The lake elevation was held some 1 to 7 ft below its filling schedule during the months of March and April. The maximum lake elevation reached was 1878.7 ft on May 21, with maximum conservation pool elevation being at 1881.5 ft. During the period of July 1 through September 30, reservoir releases averaged 150 acre-ft a day, and were typical of releases during the conservation periods for previous years. The reservoir was drafted to minimum flood control pool by the end of October, in accordance with its Section (7) requirements.

e. EMIGRANT DAM

The lake was operated by Reclamation in accordance with the authorized rule curve as graphically shown on [Chart 87](#). Peak inflows occurred on January 16 and February 28, with mean daily inflows at 225 cfs and 303 cfs, respectively. These resulted in only very small rises in pool elevations, and the reservoir was evacuated back down to appropriate water control diagram elevations immediately following each peak

inflow.

During spring rainstorm activity in the period of April 13-22, inflows rose up and were sustained above the level of above 170 cfs through the dates of April 17-22. The maximum instantaneous peak inflow of 520 cfs occurred on April 18. Reservoir outflows were progressively increased to 80 cfs on April 14, 150 cfs on April 15, and 230 cfs on April 16. The reservoir briefly reached maximum conservation pool elevation of 2241.0 ft during the night of April 14, with no measurable water flowing through the un-gated spillway. The reservoir was drafted down 0.5 ft below the spillway crest by April 17. Outflow was raised to 520 cfs on April 18, and held up at that level during April 18-20, thus drafting the reservoir uniformly to 1.4 ft below maximum conservation pool on April 23. All persistently high storm inflows were successfully passed through the project outlet tunnel. Maximum discharge at the project control point was 1,400 cfs, on April 18, with that control objective being 3,000 cfs.

The reservoir was slowly filled to maximum conservation pool elevation between April 23 and May 3. The reservoir was then lowered back down 0.5 ft, thus providing some extra margin of flood control capability. As typical for water releases during the conservation release seasons for previous years, about 250 acre-ft of water a day was released during the period of June 1 through September 30. The reservoir was drafted some 30 ft below Minimum Flood Control Pool by October 31.