III. RESERVOIR REGULATION

SYSTEM OPERATION PROJECT OPERATION Mica Revelstoke Keenleyside Libby Bonners 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

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.

Daily project operations are shown on charts in Appendix C. Charts 5-30 show the storage and streamflow hydrographs from July 1, 2001 through September 30, 2002, for major storage projects, Charts 31-50 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 and 86 are the reservoir hydrographs for Section 7 projects, and Charts 87-90 are summary hydrographs for the four key stations.

A. SYSTEM OPERATION

Flows in the Basin were generally below average until April and the peak runoff for 2002 occurred in June. The observed January through July runoff for the Columbia River above The Dalles was 103.8 MAF, 97.0% of the 30-year average. All U.S. storage projects filled to within 0.5 feet from full in 2002.

This year's observed peak flow at The Dalles was 374.4 kcfs on 6 June 2002 with a corresponding unregulated peak of 606.7 kcfs on 7 June 2002. Last year's observed peak was 169.4 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 2423.8 ft on 31 July 2001, 51.2 ft below full pool elevation of 2475 ft. The reservoir reached its maximum elevation for the year of 2,434.8 feet on 3 September 2001, 40.2 feet below full pool elevation of 2,475 feet. This level was the second lowest annual peak on record. The only year with a lower peak was 1993 at 2,419.4 feet.

Inflow into Mica reservoir was 83 percent of normal over the period August 2001 to December 2001. Over this same period, Mica outflow varied from a monthly average low of 15,900 cfs in November to a monthly average high of 29,300 cfs in December. The reservoir drafted to 2,397.0 feet by 31 December, matching the historical minimum elevation for that date. The Mica project had an underrun of 1,017 ksfd on 31 July 2001. The underrun continued to increase through November, reaching a record 1,730 ksfd by 30 November 2001. The B.C. Hydro NTSA was at 281 ksfd on 31 July 2001 and 386 ksfd on 31 December 2001. The Corresponding U.S. NTSA was at 296 ksfd and 461 ksfd, respectively.

Inflow into Mica reservoir was 101 percent of normal over the period January 2002 to August 2002. Outflow over this same period varied from a monthly average high of 28,300 cfs in January to a monthly average low of 700 cfs in June. The reservoir drafted to its lowest elevation of the year at 2,337.2 feet on 12 April 2002, 3.2 feet below the previous historical low pool elevation of 2,340.4 feet on 23 April 1993. Due to below normal spring temperatures, similar to the preceding year, the freshet was delayed by about one month and inflow did not start appreciably until late May. The reservoir reached the maximum elevation for the year of 2,465.1 feet on 3 September 2002, 9.9 feet below the full pool elevation of 2,475 feet.

The Mica actual discharges were significantly greater than the sum of Mica DOP and NTSA releases from December 2001 through June 2002 due to the flex operation between Mica and Arrow. As a result, the record underrun of 1,730 ksfd recorded on 30 November 2001 was reduced to 45 ksfd by 30 June 2002. The B.C. Hydro and U.S. NTSA on 31 August 2002 was at 618 ksfd and 703 ksfd, respectively.

The peak daily inflow was 108.65 kcfs on June 28, 2002, with a corresponding outflow of .45 kcfs. Maximum daily outflow was 30.02 kcfs on December 4, 2001. The January-July runoff was 10,491 kaf which is 109 percent of normal. The April-September runoff was 12,588 kaf, 101 percent 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 2001-02 operating year, the Revelstoke project was operated as a run-of-river plant with the reservoir level maintained generally within 3.0 feet of its normal full pool elevation of 1,880 feet. During the spring freshet, March through July, the reservoir operated as low as elevation 1,875.3 feet, or 4.7 feet below full pool, 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. 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 in May 2002. This year's operation is graphically shown on Chart 7 and Chart 58.

The Arrow Reservoir reached its maximum elevation for the year of 1,412.1 feet on 3 August 2001, 31.9 feet below full pool of 1444.0 feet. This level was the third lowest annual peak on record, with 1973 and 1977 having lower peak levels of 1,407.6 feet and 1,410.8 feet, respectively. The reservoir drafted through to January 2002, reaching the minimum elevation of 1,386.2 feet on 14 January 2002.

Discharges decreased over the fall months from an average of 49,700 cfs in September to 29,900 cfs in October and 33,000 cfs in November. The discharge increased to an average of 42,700 cfs in December.

The Arrow fisheries operations were conducted under the terms of two Operating Committee agreements, "Agreement on Operation of Summer Treaty Storage For 1 August 2001 through 31 March 2002" and "Operation of Treaty Storage for Nonpower Uses for 1 January through 31 July 2002." These agreements enabled the Arrow project flows to be adjusted to enhance whitefish and rainbow trout spawning and emergence downstream of the Arrow project in B.C.

From 21 December 2001 to 20 January 2002, Arrow outflow was held near 33,000 cfs to maintain low river levels during the whitefish spawning period. This operation reduced the likelihood of eggs being dewatered during the emergence period in February and March. Arrow outflow through the emergence period from 22 January to 26 March was held between 24,000 cfs and 26,000 cfs to help protect deposited eggs. On 28 March, the outflow from Arrow was reduced to 15,000 cfs to meet objectives for rainbow trout spawning under the Non-Power Uses Agreement. During May, Arrow outflow increased to 20,000 cfs, under the same agreement, to help meet non-power flow requirements in the U.S.

The Arrow reservoir drafted to a minimum elevation for the 2001-02 year of 1,386.2 feet on 14 January 2002 and reached a maximum elevation of 1,443.31 feet on 17 July 2002, 0.7 feet below the full pool elevation of 1,444.0 feet.

The peak daily inflow was 100.63 kcfs on June 29, 2002 with a corresponding outflow of 40.17 kcfs. The peak-unregulated inflow was 214.75 kcfs and occurred on June 29, 2002. Maximum daily outflow was 65.25 kcfs on July 19, 2002. The January-July runoff was 21,974 kaf , or 105 percent of normal. The April-September runoff was 24,948 kaf, or 99 percent 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.

Inflow in August 2001 averaged 4,900 cfs, 50 percent of average. Outflow in August was maintained at 6,000 cfs for bull trout. A Libby/Arrow storage exchange agreement for 2001 was not considered beneficial since Libby had failed to refill in the drought. No exchange agreement was made. The 31 August elevation for Lake Koocanusa was 2434.9 ft, 4.1 ft below the BiOp interim draft limit of 2439.0 ft. Outflows in September were held at 6,000 cfs for the whole month. Libby drafted slightly to a lake elevation of 2431.02 ft on 30 September.

Libby outflow was maintained at 6,000 cfs for the entire month of October. Lake Koocanusa was at elevation 2425.97 ft on 31 October. Libby inflow in October remained below normal at 2,700 cfs, 49 percent of average. Precipitation in the Kootenai Division picked up slightly in October and was 2.24 inches, 121 percent of average for the month. Libby discharge continued at 6,000 cfs through 27 November, and was ramped up to 9,400 cfs on 28 November. Flow was increased to draft to the end of December flood control elevation of 2411.0 ft, while taking advantage of the December power market. A few hours after the ramp up on 28 November, Idaho Office of Species Conservation requested a flow of 10,000 cfs from 1 December to 23 December to study burbot migration. The end of November elevation at Libby was 2421.2 ft. Libby inflow in November was 3,160 cfs, 60 percent of average.

Outflows in December were maintained at 9,400 cfs until 23 December. This multi-purpose operation was in response to the Idaho Office of Species Conservation burbot study request and flood control draft requirements. Flows were ramped down to 8,000 cfs over the Christmas and New Years holidays. Lake Koocanusa was at elevation 2410.5 ft on 31 December. Libby inflow in December was 2,500 cfs, 61 percent of average.

Libby outflow averaged 12,900 cfs in January. Outflows were 10,000 cfs until 10 January and then were increased to 14,500 cfs after the January 2002 final water supply forecast was issued and showed the need to increase to meet the 31 January flood control elevation. The January water supply forecast was 6.062 MAF, 97 percent of average. U.S. Fish and Wildlife Service (USFWS) had requested that outflows be maintained between 6,000 and 10,000 cfs for burbot from January through the first week of February. Because flows in that range would not draft the project to the end of January target, USFWS agreed at the 9 January 2002 Technical Management Team meeting that a flat discharge for the remainder of the month would be the preferred alternative given the Corps' flood control requirements. The Corps increased discharge to 14,500 cfs and maintained that flow for the rest of the month of January. Libby inflow in January was 3,300 cfs, 91 percent of average. Libby ended the month of January at elevation 2392.79 ft, 3 ft above the end of month flood control point.

The National Weather Service released the February 2002 early bird water supply forecast on 31 January, which showed a dramatic increase in water supply for Libby. With a forecast of 102 percent of average, 6.360 MAF, Libby would have problems drafting to the end of month flood control elevation even at full powerhouse capacity. Flows were increased from 14,500 to 24,000 cfs by 6 February in anticipation of a higher water supply forecast. The February final water supply forecast came in at 96 percent of average and as a result, the full powerhouse discharges were not needed for flood control. Discharges were reduced to 8,000 cfs over several days following the 2000 BiOp ramp rates. Libby ended the month of February at 2375.8 ft, within 0.2 ft of the 28 February flood control point. Libby inflow in February was 3,200 cfs, 89 percent of average.

Libby outflows were ramped from 8,000 to 4,000 cfs by 12 March and averaged 5,100 cfs for the month. The end of March elevation was 2370.7 ft, 4.3 ft below the required flood control elevation. Libby inflow in March was 2,900 cfs, 73 percent of average.

Libby outflows averaged 4,000 cfs for the entire month of April until 15 May when flows were increased to 8,000 cfs for bull trout. For 2002, USFWS requested a sturgeon pulse that focused on the larvae stage of development. The request was to release 8,000 cfs for bull trout starting May 15 until the start of the Corps' spill test in the third week of June, and then maintain flows at Bonners Ferry, Idaho at 20,000 cfs for two weeks. Due to an increase in the April WSF (95 percent up to 101 percent), the Corps' Reservoir Control Center requested a deviation from the 15 April flood control target and targeted the 30 April flood control refill curve. The end of April elevation was 2378.8 ft. Libby inflow in April was 7,800 cfs, 89 percent of normal. The end of May elevation at Libby was 2412.36 ft. Libby inflow in May was 23,400 cfs, 87 percent of average. Precipitation in the Kootenai Division in May was high at 3.56 inches, 160 percent of average for the month.

With the large amount of precipitation in May, the June early bird water supply forecast showed a large increase at Libby for the April through August period (increased from 100 percent to 114 percent). As a result, Libby flows were ramped up from 8,000 cfs to 18,000 cfs by 6 June. When the final water supply forecast came out at 6.702 MAF, 107 percent of average, the short term models were showing a need to increase further. Libby was then increased up to full load, 26,000 cfs, by 12 June. Temperatures increased in June and inflows rose dramatically. Seattle District was planning on conducting a spill test at Libby per the NMFS 2000 BiOp. Spill for the test began on 25 June and called for increasing amounts of spill over 3 days. The reservoir began filling quickly and it became apparent that Libby would need to spill more water than the test required to avoid filling the project too quickly. After the completion of the spill test on 26 June, spill amounts were increased and the project reached a maximum outflow of 40,000 cfs on 2 Jul. Libby ended the month of June at 2456.8 ft, 2.2 ft from full. Libby inflow in June was 53,600 cfs, 146 percent of normal. Inflows for the water year peaked at 71,900 cfs on 18 June.

Libby continued to spill in the beginning of July since inflows were still high. The project reached a peak discharge of 40,000 cfs on 2 July. Lake Koocanusa reached its peak elevation, 2458.61 ft on 15 July. Inflows began receding and Libby stopped spill for the year on 17 July. For the remainder of July flows were held steady in an attempt to have flat flows, which benefited habitat and food supply for downstream fish, and to draft to 2439.0 ft by 31 Aug. Outflows averaged 25,900 cfs and ranged from 18,800 cfs to 40,000 cfs across the month. The project ended July at elevation 2455.15 ft, 3.85 ft from full. Inflows for July averaged 24,700 cfs, 121 percent of average.

Flows in the beginning of August were maintained at 22,000 cfs to draft to 2439.0 ft by the end of the month. Unit 5 was forced out of service for a few days and Libby reduced to 19,200 cfs, which was full load on the remaining 4 units. On 8 August the U.S. and Canadian Entities agreed to a Libby/Duncan swap of no more than 70 ksfd. Outflows at Libby were adjusted each week to reflect the new end of month target of 2442.3 ft.

Libby ended the month of August at 2441.93 ft, 2.9 ft above the BiOp interim draft limit of 2439.0 ft. The actual amount of water that Libby swapped was 63 ksfd. Inflows for August averaged 7,800 cfs, 77 percent of average. Libby outflows for August averaged 17,300 cfs. Actual runoff for the April through August period at Libby was 7.097 MAF, 114 percent of average. The January-July runoff was 7.180 MAF, 114 percent of average.

5. Kootenai River at Bonners Ferry

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.

During the period September through December 2001, the lake filled in September due to increased Duncan discharge but drafted thereafter to the end of December elevation of 1,742.5 ft. In October, November and December the lake discharge averaged 14,300, 14,000, and 20,400 cfs respectively. Kootenay Lake ended the year at elevation 1742.4 ft. The lake levels remained well below the IJC levels throughout the fall due to low inflows.

For the month of January, Kootenay Lake filled due to an increase in Libby discharge starting 10 January 2002. The reservoir rose to elevation 1,743.4 ft by 31 January and Kootenay Lake discharge averaged 19,700 cfs for the month. Kootenay Lake was drafted during February and March to stay below the 1 April IJC limit of 1,739.32 ft. Kootenay Lake discharge was adjusted to control the reservoir below the IJC limit while meeting system requirements. On 31 March 2002, Kootenay Lake was at its minimum elevation of 1,738.0 ft.

In April, the total inflow into the lake was greater than lake discharge and the lake elevation rose to 1,740.8 ft by the end of the month. Kootenay Lake discharge remained near inflow until 14 April 2002 when the Kootenay Lake Board of Control declared the commencement of spring rise on the Kootenay. Following the declaration of spring freshet, Kootenay Lake was operated in accordance to the IJC lowering formula.

In late May, Kootenay Lake level rose sharply in response to the spring freshet inflow. Inflow peaked at 106,100 cfs on 22 May 2002. Kootenay Lake discharge was increased in accordance with the IJC Order for Kootenay Lake. Discharge from the lake peaked at 81,000 cfs on 30 June 2002. Kootenay Lake reached its maximum elevation for the year of 1,751.2 ft on 30 June 2002, about a month later than the previous year.

Beginning in July, Kootenay Lake levels started to drop due to receding runoff. The reservoir discharge was kept higher than the total inflow into the lake to control reservoir levels slightly below the IJC limits. During the summer of 2002, the level at the Nelson gage did not draft below the trigger elevation of 1,743.32 ft. The lake drafted to 1,744.5 ft by the end of August. Discharges from Kootenay Lake averaged 63,400 cfs in July and 34,900 cfs in August 2002. In September the lake continued to draft and ended the month at 1742.5 ft, well below the IJC limit of 1745.32 ft.

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.

The Duncan reservoir did not refill during 2001, reaching a maximum elevation of 1,875.7 feet, 16.3 feet below full pool on 4 August 2001. For the period of August through December, Duncan discharge varied between 200 cfs and 10,000 cfs to support Kootenay Lake elevations. On 31 December the reservoir reached elevation 1,807.5 feet, 13.3 feet above empty. In January 2002, the project discharge averaged 2,230 cfs. From February through April 2002, Duncan discharge was slightly greater than the average monthly inflows, which gradually drafted the project to near empty by mid-March 2002. On 14 May, discharge was reduced to the project minimum release of 100 cfs to begin refill.

Early season water supply forecasts for Duncan were 94 percent of average for the period of February through September 2002 but these estimates increased gradually to 111 percent by August 2002 due to above average precipitation. Discharge from the project increased from 100 cfs on 10 July 2002 to 10,000 cfs on 15 July 2002. The reservoir reached full pool of 1,892.0 feet on 15 July, temporarily reaching as high as elevation of 1,892.3 feet on 16 July 2002. Due to continued high inflows, project discharge was increased to 14,500 cfs from 17 July to 20 July to control the reservoir elevation. This period of high project discharge combined with high natural flows on the Ladeau River resulted in flood impacts and the temporary closure of a downstream sawmill. Project discharge was reduced to 4,700 cfs by 31 July as inflows receded.

In August, Duncan discharge was increased up to 8,000 cfs as part of a Libby/Canadian storage exchange agreement. The reservoir drafted to elevation 1,885.0 feet by the end of August. During September project discharge was maintained at, or below, 8,000 cfs to facilitate kokanee spawning.

The peak daily inflow was 25.31 kcfs on June 28, 2002 with a corresponding outflow of 120 cfs. Maximum daily outflow was 14.54 kcfs on July 20, 2002. The observed January-July volume runoff was 1349 kaf, 117 percent of normal. The April-September runoff volume was 2494 kaf, 112 percent 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 143.0 kcfs on 13 July 2002 and the unregulated peak flow was slightly over 303.2 kcfs on 30 June 2002. Bankfull and flood stage is 225 kcfs.

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.

Hungry Horse, a Section 7 Project, is owned and operated by the Bureau of Reclamation for flood control, power, recreation, and fisheries. On October 1, 2001, the water surface elevation was 3533.5 feet after filling to elevation 3558.35 on June 30. Hungry Horse was drafted throughout the fall to meet the 3,500 cfs minimum flow requirement at Columbia Falls, which changed to 3,485 cfs following the January 1 forecast, and to 3,370 cfs in February where it remained. Due to dry conditions throughout the winter the reservoir was drafted significantly below flood control to meet the minimum flow requirements at Columbia Falls. The reservoir reached its minimum elevation of 3508.97 on April 7, and refilled slightly to meet its April 30 flood control requirement of 3516.2.

Reclamation drafted Hungry Horse as called for by the new VARQ flood control procedure in 2002. Permanent adoption of the VARQ curve is under consideration, pending the completion of the "Upper Columbia River Flood Control Environmental Impact Study."

Hungry Horse reservoir reached its full pool elevation of 3560.0 on July 13. The peak observed inflow of 27,760 cfs occurred on May 21, and the maximum outflow of 10,025 cfs occurred on June 13. The summer draft was modified for 2002 at the request of the Salmon Managers. This opportunity presented itself due to an unusually late runoff allowing for approximately 125 kaf to be moved into September to benefit resident fish in the Flathead River. The reservoir began drafting for the modified Biological Opinion operations starting the second week in July. Flow rates ranged from 4,000 cfs to 5,500 cfs until July 29, approximately 6,050 cfs from July 31 to August 25, and then about 4,000 cfs until September 20, after which flows were ramped down to meet Columbia Falls minimums. A total of 20 feet of draft was provided for ESA purposes. The reservoir drafted to 3537.15 by September 30. A minimum flow of at least 3,280 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.

The January - July volume unregulated runoff at Columbia Falls was 6844 kaf or 116% of normal, while the April-September unregulated runoff was 6841 kaf or 117% of normal. The year's unregulated peak discharge of 72.7 kcfs occurred on 30 May 2002. The Hungry Horse outflow was about 2.0 kcfs during the peak flow. The unregulated peak was 44.76 kcfs on May 31. Flood stage at Columbia Falls is 14 ft or 48 kcfs and major flooding does not occur until 16 ft or 82.8 kcfs.

11. Kerr Project (Flathead Lake)

Flathead Lake is a natural lake, the level of which has been controlled by Kerr Dam since 1937. The Kerr project was purchased by PPL Montana LLC (effective 17 December 1999) and is licensed jointly to PPL Montana LLC and the Confederated Salish and Kootenai Tribes of the Flathead Indian Reservation. PPL Montana LLC operates the project on a daily basis to provide hydroelectric power, flood control, recreation, and drought management.

Agricultural lowlands between Kalispell, located nine miles upstream of Flathead Lake, and Flathead Lake are prone to flooding if river flows exceed 45 kcfs with Flathead Lake at or near its full elevation of 2893 feet. Winter drawdown and Spring refill of Flathead Lake is coordinated with the Corps of Engineers' Reservoir Control Center to control local flooding and flooding in the coordinated Columbia River system. Coordination between the Corps and PPL Montana is conducted in accordance with the Memorandum of Understanding Agreement (MOA -- date 1962, revised 1965) between the Corps and Montana Power. This year's operation is shown on Chart 12 and Chart 66.

After an extremely low runoff in W.Y. 2001, Flathead Lake entered W.Y. 2002 near elevation 2891 ft, about two feet below full. Lake elevation was maintained at approximately elevation 2891 ft through mid December and then gradually drafted for power and flood control through early April. Drafting of the project was interrupted for a few days in late March when high winds broke loose ice that accumulated in the outlet channel and temporarily restricted the project's ability to draft. The lake reached its minimum elevation of the year, 2883.76 ft, on 6 April 2002. Inflows in mid April in excess of the outlet channel's capability increased Flathead lake elevation to 2884.33 on 15 April. Forecasted runoff volume in April 2002 was near normal. The project was filled to elevation 2891.0 ft on 30 May, 2002. Concern by the Corps for flood potential in the river basin above the lake delayed filling of the Lake until 26 June, at which time the Lake reached 2892.8 ft. In years without flood concerns, Flathead Lake is filled to 2893 ft by June 15.

The observed peak seasonal inflow was 57.2 kcfs on 22 May. The maximum discharge was 47.8 kcfs on 9 June. The unregulated peak outflow would have occurred on 29 June and reached 54.4 kcfs. Average monthly discharges were 13.7, 42.0 and 18.8 kcfs for May, June and July respectively. The unregulated January-July runoff into Flathead Lake was 111 % of normal. The unregulated April-September runoff was 114% of normal.

12. Albeni Falls Project (Lake Pend Oreille)

Lake Pend Oreille is a natural lake, whose outflow and level is 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 2060.9 ft on 1 October 2001. The lake continued drafting in October and early November, with discharge averaging 17.0 kcfs from 1 October to 13 November, at which time the lake reached elevation 2051.3 and drafting stopped. Elevation of the lake was maintained between 2051.0 ft and 2051.5 ft form 13 November to 5 January. In January the operating range was increased to between 2051.0 and 2052.0 ft. This range was maintained to 7 April at which time the lake was allowed to fill above 2052 ft and to continue refilling. From 15 April to 22 April discharge from the project was reduced in order to reduce flooding in the town of Cusick downstream of the project. During this flood reduction operation, the lake filled over 1.1 feet. Pend Oreille Lake reached elevation 2062 ft on 29 June and continuously maintained a level of between 2062.0 ft and 2062.5 ft from 4 July to 18 September at which time the fall drawdown was begun. Lake elevation was 2061.0 ft at the end of September.

Unregulated inflow peaked at 110.5 kcfs on 5 June 2002. The observed peak inflow of 106.4 kcfs was also reached on 5 June. Peak discharge during the year was 94.8 kcfs on 9 June. The unregulated January-July runoff was 15.9 Maf, 104 % of normal, while the April-September runoff was 15.1 Maf, or 108% of normal.

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, 2001, FDR Lake was at elevation 1283.4 and remained above elevation 1280 until January 20. Releases for flood control, power, and salmon drafted the reservoir to its lowest point for the year at elevation 1240 by May 18. FDR refilled to elevation 1289.4 (essentially full) on July 8, and had drafted to 1279.8 by August 30, thus providing 10 feet of draft for ESA purposes as called for in the FCRPS Biological Opinion. The maximum daily outflow for the year was 237,900 cfs, which occurred on July 2.

The lowest elevation reached at FDR reservoir for ESA operations was 1279.8 on August 30. The reservoir refilled to elevation 1287.8 feet 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. 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 generating output of these plants. Article 34 of the Federal Energy Regulatory Commission licenses for these projects stipulates that some flood control space be provided, as instructed by the Corps, to replace lost valley storage under certain flood potential conditions. This space 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 87. The unregulated peak flow was 458.53 kcfs on July 01, 2002, and the observed regulated peak was 273.1 kcfs on July 02, 2002.

Numerous special operations occurred at these projects to assist in the downstream passage of juvenile anadromous fish during the 2002 outmigration, 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 minimum protection level established for WY 02 was 50 kcfs during daylight hours. Special flow operations were also required of Priest Rapids Dam in the fall and spring for Navy nuclear reactor compartment offloading 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 2001 through September 2002 period (Water Year 2002) for irrigation, fish and wildlife, 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 3.59 MAF, about 104 percent of the 1971-2000 average. The peak daily, observed flow of 14 kcfs occurred on April 15, 2002, and the peak daily unregulated flow of 26.6 kcfs occurred on April 14, 2002. No bypassing of reservoir inflow was necessary, from April through June, to maintain flood control space based on forecast runoff except at Bumping Lake Reservoir and Keechelus Lake (lake elevation restricted to 2510.0ft. by Safety of Dams).

Total 2002 wateryear precipitation (total as recorded at 5 reservoir sites) was 246.87 inches, 107.2 percent of average. The Yakima basin snow-pack (Yakima Projects 6th and largest reservoir) was above normal, averaging 119 percent of normal during the 7 months, December through June, of snow season.

The system reached maximum storage for the year on June 29th, 2002 at 1,049 kaf, and was placed on storage control on July 3rd, 2002. Summer runoff in the Yakima River Basin was well below average until the end of irrigation season. The Project storage on September 30, 2002 was 421.5 kaf, 121 percent of average.

All water users received a full water supply during the 2002 irrigation season (March 15 to October 22).

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 (YRBWEP), Section 1205". YRBWEP water purchases raised the Title XII flows by 1 cfs at Parker and Prosser with an additional 35 cfs added to the flows at Prosser under the conditional final order for the Kennewick Irrigation District. The additional 35 cfs is subordinated by power production but is not supported from reservoir releases.

The Yakima reservoirs were also operated to provide fish spawning conditions during September to mid-October 2001 in the upper Yakima River, Cle Elum River and the Bumping River. Incubation and rearing flows were provided from mid-October 2001 through March 2002. No bypassing of reservoir inflows to maintain flood space requirements or power rights supported incubation/rearing level flows. Releases from Keechelus and Kachess Dams were made to only meet incubation/rearing minimum flow requirements during most of the winter. There were times in October and November where natural flow at the Yakima River near Easton was not sufficient to support incubation and rearing flows; flow augmentation was made with releases from Keechelus Lake at those times. Incubation/rearing releases from reservoirs included 14.4 kaf from Keechelus, 0.94 kaf from Kachess, 16.4 kaf from Cle Elum, 12.3 kaf from Bumping and 7.6 kaf from Rimrock. In 2002, spawning flows were set at 100 cfs at Yakima River near Crystal Springs, 180 cfs in Yakima River below Easton Dam, and 180 cfs in the Cle Elum River below the reservoir. Incubation/rearing flows were set at 162 cfs for the Yakima River near Easton and 162 cfs for the Cle Elum River. The Yakima River near Crystal Springs was reduced to 80 cfs and the Yakima River below Keechelus Dam was reduced to 60 cfs for incubation flows. In October (2001) Bumping River flows were reduced to 80 cfs to allow for diminishing storage supply. These flows were provided for spring Chinook salmon under a 1980 court order.

In 2002, both fish spawning operations, 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 period of August 28- September 1, 2002.

The Yakima River to Naches River, Flip-Flop operation was executed for the 22nd consecutive year. The flip-flop operation was implemented during the period of September 1-10th, 2002, providing a longer, more environmentally friendly ramping down of flow levels in the upper Yakima River. It involved drawing storage from Keechelus, Kachess, and Cle Elum Reservoirs to meet all Yakima River diversions in June, July, and 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 are required in the Yakima River from Easton to the mouth of the Teanaway, the Yakima River reservoirs were set to meet the spawning flow levels. In 2002, up to 325 cfs was routed around the Easton reach via the Kittitas Canal to waste-way 1146, in order to keep flows in the Yakima River from Easton to Cle Elum reach moderate. The Yakima River system is below the confluence of the Naches River, as well as the Naches and Tieton diversions, were met with releases from Tieton and Bumping reservoirs.

16. Jackson - Palisades Project

Active storage in the Snake River Basin above Heise, Idaho, includes 847,000 acre-feet in Jackson Lake and 1,200,000 acre-feet in Palisades Reservoir for a combined total of 2,047,000 acre-feet. Palisades is a Section 7 project. The system is operated as a multipurpose unit for flood control, irrigation, recreation, fish and wildlife, and power production. Discharge from Jackson Lake is measured at the Snake River at Moran, Wyoming, Gage and discharge from Palisades Reservoir is measured at the Snake River near Irwin, Idaho, gage. 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 3,242 kaf, 67 percent of the 30 year average from 1971 to 2000. The unregulated peak flow at the Heise gage was 27,326 cfs on June 2, and the peak regulated flow was 13,413 cfs on July 22. Flood regulation curves are designed to maintain flows at Heise at or below 20,000 cfs. However, flood control releases were not required this year since reservoir levels were below flood curve requirements. Maximum reservoir elevation at Jackson Lake was 6,762.29 on June 30, for a maximum reservoir content of 679.7 kaf.

Releases from Palisades Reservoir reached the peak release for the year of 13,125 cfs on July 9. Palisades Reservoir maximum elevation was 5,582.03 on June 11. Maximum reservoir content was 675.7 kaf.

Maximum combined content of the two reservoirs was 1,322 kaf on June 30. After the below average runoff in 2001, contents in Jackson Lake and Palisades reservoirs were 227 kaf on October 1, 2001. Storage increased slightly through the winter. Snow accumulation on the watershed above Palisades Dam was 80% of normal on April 1. April through July runoff was 57% of the 30 year average. September 30 content was 307 kaf, 902 kaf below the 30-year average.

17. Ririe Project

Ririe Reservoir is a Section 7 project that is operated by the Bureau of Reclamation for the joint uses of irrigation, flood control, recreation, and fish and wildlife. The active capacity is 90,500 acre-feet including exclusive flood control space of 10,000 acre-feet. This year's operation is graphically shown on Chart 35.

The October through July runoff into the reservoir was 26.7 kaf, 24 percent of average. The peak daily inflow was 302 cfs on April 15. The maximum release during the irrigation season was 114 cfs on May 14th. The maximum content was 45 kaf on May 27. Storage at the end of the water year was 28.4 kaf, 15 kaf below the average.

18. American Falls Project

American Falls Dam is a Section 7 project that has an active capacity of 1,673 kaf 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 approximately 350 cfs in late October due to dry conditions and remained there until the end of March, when flows were increased to 2,000 cfs to fill Lake Walcott. During April, May and June releases were gradually increased to 12,000 driven by irrigation demands. Starting the first week in August releases were steadily reduced to about 4,600 cfs by the end of September due to diminishing irrigation demands. Maximum storage during the year was 1,457 kaf on April 26. Reservoir contents on September 30 were 56.7 kaf, 458 kaf below the 30 year average.

19. Little Wood Project

Little wood Reservoir has an active capacity of 30 kaf. 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 for flood control. The Little Wood River at Carey, Idaho, 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 53.8 kaf, 54 percent of the average. Maximum daily inflow was 413 cfs on June 1 and peak daily discharge at the Carey gage was 297 cfs on July 15.

Little Wood Reservoir discharge was shut off in mid October following irrigation season and the reservoir filled slowly over the winter with essentially no flood control space being required. May and June releases averaged about 250 cfs. Starting in mid July the release steadily declined with irrigation demands and reached 40 cfs by the end of September. Little Wood Reservoir did not fill this year and maximum reservoir content was 28.7 kaf on May 8. The storage at the end of September was 1.2 kaf, 5 kaf below the average.

20. Owyhee Project

Owyhee Reservoir has an active capacity of 715 kaf and, although it was constructed by Reclamation as a single-purpose irrigation reservoir, it can provide significant incidental flood protection along the lower Owyhee River and along the Snake River from Nyssa, Oregon to Weiser, Idaho. Most of the largest floods from this basin result from winter rains 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 465 kaf, 60% of average. The peak mean daily inflow was 8,283 cfs on April 3, 2002 and the peak daily outflow was 213 cfs on April 17. The reservoir reached a maximum content of 439 kaf on April 24. The Owyhee net inflow for the period of June through September was 64% of average.

21. Boise Project

The Boise Project, Arrowrock Division, is a three-reservoir system composed of Anderson Ranch, Arrowrock, and Lucky Peak Reservoirs with a combined total active storage capacity of 960 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. 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 streamgage 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, 2002 through July 31, 2002 was 1,096 kaf, 78% 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 May. Through May and June the release was maintained at about 600 cfs. During most of July and August the release was maintained at 1,500 cfs and then reduced to 600 cfs in the middle September. On July 16 releases from Anderson Ranch Reservoir reached a seasonal maximum release of about 1,510 cfs.

The release from Lucky Peak Reservoir was reduced to 240 cfs at the end of the 2001 irrigation season and maintained there until March. Releases were gradually increased during April and reached a discharge of about 4,500 cfs in early May. Releases reached a maximum of 4,590 cfs on May 7. The peak flow of the Boise River at the Glenwood Bridge gaging station was 1,330 cfs on May 7, 2002. Flood stage at the Glenwood station is 7,000 cfs; however, no flood control releases were required in 2002. The Boise reservoir system filled to a maximum of 758.5 kaf on June 8 (79% of capacity) and immediately began to draft for irrigation; carryover on September 30 was 205 kaf, 50% of average.

Approximately 60 kaf of water was released from Boise River reservoirs between May and July 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 have been operated for multipurpose benefits. The three reservoirs 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 the Vale, Oregon streamgage is the control point for flood control operation of the reservoirs. 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 2002. December through June runoff at Warmsprings Reservoir was 47% of average and inflow on the North Fork at Beulah Reservoir was 51% of average. Warmsprings Reservoir reached a maximum storage volume of 80 kaf on April 22. The reservoir was essentially drained by August 10, and only 30 af remained on September 30. Beulah Reservoir reached a maximum storage content of 47 kaf on May 1, and it too was empty by August 10. End of September carryover storage in Beulah Reservoir was 0 kaf. Bully Creek Reservoir reached full capacity of 30 kaf on April 28, and the end of September carryover storage volume was 33 af.

23. Payette Project

The Payette River reservoir storage system includes Cascade and Deadwood Reservoirs that have a combined total active storage capacity of 808.4 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. This year's operation is shown on Chart 42 and Chart 73.

Runoff in the Payette Basin was below average in 2002. The April through July runoff volume, measured at Horseshoe Bend was 1,360 kaf, 83% 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 102 kaf, 76% of average. Peak daily inflow into Cascade Reservoir was 7,020 cfs on April 14 and the peak inflow into Deadwood Reservoir was 1,560 cfs on May 31.

The peak flow of the Payette River near Emmett, Idaho was 11,740 cfs on April 15. Flood stage is 16,000 cfs at Emmett.

Cascade Reservoir reached its full storage volume of 648 kaf on June 20. Deadwood Reservoir reached a maximum storage volume of 140 kaf on July 5. September 30 content at Cascade was 373 kaf, and at Deadwood was 54.2 kaf.

A total of 160 kaf was obligated for release for salmon flow augmentation. About 125 kaf was released from Cascade and Deadwood reservoirs between mid-June and the end of August. The remaining 35 kaf will be released in April, 2003. 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 which is on the Powder River in eastern Oregon. The project is owned by the Bureau of Reclamation and 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 streamgage, which should be controlled to 500 cfs, if possible.

The Powder River basin had a below average runoff year in 2002. April through July runoff was 47 kaf, 81% of average. Phillips Reservoir reached a maximum storage volume of 32.5 kaf on June 12, and a carryover on September 30 of 3.9 kaf.

The peak flow of the Powder River at Baker City, Oregon was 296 cfs on May 23.

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, which 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-feet 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 2050.4 feet. Hells Canyon discharge was maintained between 6 - 12 kcfs and averaged 9 kcfs to encourage fall Chinook salmon to spawn at a low elevation in the downstream channel from mid October through mid December. The lake continued to fill during this time and reached a peak elevation of 2072.7 ft by December 16. Brownlee is full at elevation 2077.0 ft. The pool was then drafted for power sales and to maintain Hells Canyon discharges above 12 kcfs until fry emergence in the spring.

The February water supply forecast for Brownlee for the April-July period was 79 percent of the 1961-90 average. Based on this forecast and the forecast at The Dalles the Corps notified IPC that 329,000 acre-feet of flood control space (elevation 2051.1) be available at Brownlee by February 28, 357,000 acre feet of flood control storage space be available (elevation 2048.5 feet) by March 31 and 351,000 acre feet of flood control space be available (elevation 2049.1) by April 30. Because of the low volume forecast in the Columbia basin, the Corps notified IPC that Brownlee's entire flood control requirement from Feb – Apr could be shifted to Grand Coulee which means that Brownlee could have been full on Feb 28 and remained so until April 30. IPC found a flood control shift unnecessary because the reservoirs elevations were consistently below the flood control requirement during the period due to low inflows and releases for redd incubation. The April final volume forecast decreased from the January forecast by 16.3% or 460,000 acre-feet, which required a flood control space requirement of 172,000 acre-feet (elevation 2064.4') by April 30. The actual elevation on April 30 was 2062.1 ft.

Idaho Power Corporation was targeting to refill Brownlee to 2077' by the end of June, and reached elevation 2076.7 ft on June 21 and remained within one foot of full at elevation 2076.0 by June 24. TMT submitted SOR #2002-5 on June 25 requesting that IPC draft Brownlee reservoir up to 16 feet from full pool by July 31 to help maintain a flow objective of 51 kcfs at Lower Granite Reservoir for migrating fall chinook salmon. IPC declined to draft the reservoir early without a shaping agreement from BPA stating that they found the flow request inappropriate and unacceptable. Brownlee reached elevation 2072 ft by July 31. Project inflow averaged 9.4 kcfs from Aug 1 – Sept 30 while outflow averaged 12.6 kcfs during the same period. Brownlee was drafted 30 ft during this period and ended the water year at elevation 2042 ft.

The regulated peak inflow was 29,904 cfs on April 16, 2002 and the unregulated peak inflow was 61,890 cfs on June 7, 2002. Maximum daily outflow was 23,152 cfs on April 23, 2002. The April-July observed Brownlee inflow was 3242 kaf, or 52 percent of the 1971-2000 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 1520.5 feet by the end of August 2001 for salmon flow augmentation. Starting 1 September, flows were reduced to between 1.3 and 1.5 kcfs, which is the minimum flow from the project that produces total dissolved gas at less than 110 percent. Reflecting low inflows, the project continued to draft slightly, reaching a low elevation of 1515.47 feet on 11 October. The Reservoir filled slightly during the rest of the fall and into the winter, while maintaining minimum outflow. Inflows for November through December were below average. End of December elevation was 1523.6 feet. The project continued at minimum flow through January, and reached a temporary peak elevation of 1532.6 feet on February 02. On the first of February flows were increased and the project began to draft, to ensure meeting end of month flood control targets and for system power requirements. Flows were shaped across the week. Dworshak inflows in January were 3.3 kcfs, 101% of normal. Precipitation in January was 4.45 inches, 123% of normal. The February final water supply forecast increased from the January final (108% form 102%). Dworshak ended the month of February at 1513.99 feet, 0.3 feet above the required flood control elevation. The inflows in February were 2.5 kcfs, 51% of normal. Precipitation in February was 2.18 inches, 76% of normal.

In Mid-March TMT decided that they would like to see a Dworshak/Grand Coulee flood control shift, so the project outflows were reduced at Dworkshak. The project had been drafting for flood control, but dropped flows to minimum to begin storing water for the shift. Throughout the month of March, snow was accumulating (precipitation was 3.93 inches, 140% of normal). By the end of March, early estimates were showing a dramatic increase in the water supply. Flow analysis were showing that Dworshak had high likelihood of needing to increase flows above 15 kcfs in April (the maximum flows without exceeding 110% total dissolved gas) in order to draft back to the 10 April flood control elevation. The Corps responded with an increase to full load on Mar 27. In the end, 116 kaf of flood control space was shifted and the reservoir ended the month of March at elevation 1515.5 feet. Although precipitation was above normal for March (140% of normal) the inflows remained low (5 kcfs, 72% of normal) due to low temperatures.

Dworshak inflows in April were 14.8 kcfs, 132% of normal. Outflows averaged 15.1 kcfs for the month of April and the reservoir elevation ended the month at 1513.6 feet, a foot below the end of April flood control elevation. Precipitation for April in the Clearwater Division was 2.24 inches, 84% of normal. Precipitation in the water year Oct01 – Apr 02 was 109% of normal.

Dworshak was held under 1520 feet until May 20, and then began filling. Precipitation for May in the Clearwater Basin was 2.57 inches, 85% of normal. Average inflow in May was 19.3 kcfs, 117% of normal. Project outflows in May averaged 8.3 kcfs. Until late June, project outflow was held at levels meant to hold total dissolved gas below the project to levels not exceeding the State of Idaho's standard of 110 percent. Warm temperatures toward the end of May, combined with strong June precipitation, 2.9 inches or 117% of normal, caused unexpectedly sudden freshet conditions. The project filled to 1599.0 feet, one foot from full, by June 20. Flood control operations started 21 June and continuing to 2 July and caused higher flows and TDG levels to reach a maximum of about 118 percent. Average inflow to Dworshak in June was 20.9 kcfs, 170% of normal. Average outflow in June was 9.3 kcfs with the highest daily outflow being 19.6 kcfs.

The project stayed within the top foot until July 09, at which time the Salmon Managers requested increase in Dworshak flows to support Lower Granite flow objectives. On July 03 TMT requested that Dworshak operate to control temperature of releases to near but not less than 47 degrees F for purposes of cooling temperatures below the project, down to the Lower Granite forebay, in order to benefit juvenile migrating sub yearling Chinook salmon. The temperature operation was continued until August 08 when TMT requested that the temperatures be increased to 48 degrees to help the downstream USFWS hatchery. Dworshak outflows in July and August averaged 12.5 kcfs and 13.3 kcfs. The August 31 midnight reservoir elevation was 1533.9 feet.

On August 13 the TMT received SOR 2002-07, which included a request to provide 10 kcfs outflow from Dworshak through September 10, in order to keep the Lower Granite pool cooler longer into the season to potentially aid migrating adult salmon, and to complete corresponding effectiveness studies. The standard operation pursuant to the Biological Opinion would be to draft Dworshak to elevation 1520 feet by August 31; however the Biological Opinion also allows drafting to 1500 feet for purposes of studying benefits of cooler water flows for migrating adult salmon. TMT concurred on the request, particularly as the 2002 water year would allow sustaining the higher flows without resorting to a deeper draft. The project sustained an average 10 kcfs through September 10. The midnight September 10 elevation was 1520.8 feet.

The peak daily inflow was 34.0 kcfs on May 30, 2002. The peak daily outflow was 19.6 kcfs, from June 23 through June 26, 2003. The January-July runoff volume was 4347 kaf, 123 percent of normal, while the April-July runoff was 3697 kaf, or 140 percent 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 65,498 cfs on 14 April 2002. Dworshak was releasing 15,100 cfs on this date. The unregulated peak flow during the flood season was 90,481 cfs on 14 April 2002, 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 88.

During the summer of 2001 the projects had been operating at Minimum Operating Pool (MOP) to improve conditions for juvenile fish migration. The actual operations were within the lower foot of normal operating range at Little Goose and Lower Monumental and a one and a half foot and two foot operating range, respectively, at Lower Granite and Ice Harbor. The theory of the MOP operation is to lower the pools to increase the water velocity and facilitate faster downstream juvenile fish passage. These operations were cancelled for Little Goose, Lower Monumental and Ice Harbor on September 06, and a similar operation at Lower Granite was cancelled on September 20.

Lower Granite September unregulated inflow was 12.9 kcfs, 57% of average. Lower Granite outflows ranged between 11.3 and 16.9 kcfs during the month. Due to low Snake inflows the Lower Granite pool required operation below 734 feet on several occasions for short periods of time and the Snake projects had to be operated outside of their 1% efficiency as required by the Fish Passage Plan. Low inflows also required authorizing projects to go to zero nighttime flows at Lower Granite, Little Goose and Lower Monumental. Increased inflows in late October allowed the projects to return to operations within 1% of peak efficiency at all times, as required by the Fish Passage Plan. However, unregulated inflows throughout the fall and through

December were below average, generally less than 70% of normal.

Dredging was not undertaken during the in-stream season on the Snake due to a problem of gaining approval from the Fish Agencies regarding dredge tailing disposal.

Unregulated inflow conditions were nearly normal during the springtime months of April – June, varying between 101% and 80% of average at Lower Granite. Spill for juvenile fish passage began at the Snake Projects, except Lower Monumental, between April 03 and April 10. Spill was terminated at Lower Granite and Little Goose on July 16 and at Ice Harbor on August 31. The extended spill at Ice Harbor was designed to compensate for no spill at Lower Monumental, due to spillway repair construction activities. Due to high flows in April, there were several occasions where Lower Monumental had to spill involuntarily, following a specified spill pattern designed to minimize impacts to ongoing construction activities. MOP operations began on April 01. Lower Granite and Lower monumental were operated at MOP + 1 foot and Ice Harbor and Little Goose were operated at MOP + 2 feet due to navigation concerns. Spill ended on August 31 per concurrence of the TMT at the August 21 meeting. In late August there were several occasions where some of the pools operated higher than the specified MOP, due to operational restrictions. These deviations were fully coordinated.

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-feet, which can be used for flood control and recreation. There were no flood control operations at Mill Creek this year. Its annual operation is graphically shown on Chart 47.

Bennington Lake was filled to a test pool elevation of 1225 feet (ft) in order to evaluate seepage under the Dam, since the installation of relief wells at the toe of the dam in 1998 and foundation grouting of the right abutment area in 1999 and 2001. Bennington Lake began refill for test pool and recreation on February 5, 2002, reached its conservation pool elevation of 1205 ft on March 1, 2002, and reached the test pool elevation of 1225 ft. on April 4, 2002. It remained near 1225 ft. until May 6, 2002, when inflows dropped to a level that was not sufficient to keep the reservoir full. Seepage and evaporation losses caused draw down of Bennington Lake to conservation pool elevation 1205 ft. by August 28, 2002 and 1201.4 ft. by September 30. 2002.

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 project, which straddles the Oregon-Washington border, is operated by the Corps -- primarily for power, flood control, and navigation. The lake has approximately 500 kaf of active storage in its full operating range, 257-268 ft. Historically, the Corps generally operated the lake in the elevation range 260-265 ft from November through the spring runoff. Following the spring runoff, and continuing until mid-October, the lake was normally operated in its top 3 feet, 265-268 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 approximately mid-April through the end of September there is a 1.5-foot operating range. The normal operating range during this period is 262.5' – 264'. The lower elevation limit is adjusted to meet irrigation needs. Between September 30 and mid April there is a 2.5 foot operating range of 262.5' – 265' ft. In addition, at any time during the year the lake can be operated 257' – 268' 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 02, there were special operations set up for several different parties. There were special operations for goose hunting (20 October – 20 January) and goose nesting (March 18 – May 31). The requested operation for hunting was to operate in the top foot of the operating range on 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 tailwater ranges for fish-related research. Contractors also requested special operations to hold the forebay low to facilitate work in the pool. A request to cut spill to zero when upbound loaded fuel barges approach the navigation lock was implemented due to safety concerns. A similar request to cut spill to 30% of the total spill level when upbound non-fuel barges approach the navigation lock was also implemented due to safety concerns.

Spill for juvenile fish passage occurred at John Day from 10 April through 31 August. Day and night time spill levels were specified for the duration of the spill period, with some levels used to test juvenile fish passage and survival. Overall, spill was not to exceed the 120% TDG gas cap level. See Section G., Fishery Operations for additional information.

33. Upper Deschutes River Project

This multiple reservoir system is composed of Prineville and Ochoco Reservoirs on the Crooked River, both Section 7 projects, and Crane Prairie, Wickiup, and Haystack Reservoirs on the Deschutes River. Including Haystack, which is an offstream reregulating reservoir, there is a combined total active storage capacity of 454 kaf. This year's operation is graphically shown on Chart 49 and Chart 50.

Crane Prairie storage at the beginning of the water year was 24.1 kaf. Storage peaked for the season on April 24 at 43.9 kaf, which was 80% full. Carryover storage at the end of the year was 27 kaf. Wickiup storage at the beginning of the water year was 50.8 kaf. Storage peaked for the season on April 5 at 179.5 kaf, which was 90% full. Carryover storage at the end of the year was 31 kaf.

Prineville Reservoir entered the water year with a low carryover of 53 kaf (60% of average.) Winter flows were set at approximately 65 cfs until late March, when they were increased in response to irrigation demand. Peak storage of 140.1 kaf, 94 percent of active capacity was reached on April 29. The maximum inflow was approximately 1560 cfs on April 2; maximum release was 225 cfs during most of May. The reservoir had a storage of 74.9 kaf (84% of average) at the end of September.

Ochoco Reservoir entered the water year with a carryover of 8.4 kaf. The outlets were turned off during the winter months and all inflow was stored (except for about 2 to 4 cfs) until late March. Irrigation draft began in mid May. The peak inflow for the year was 292 cfs on April 14, and outflow peaked at 129 cfs for irrigation in early July. The reservoir reached a maximum content of 29 kaf (66% of capacity) on May 4. Irrigation demand drafted the reservoir during the summer to 10.9 kaf by the end of September.

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

These run-of-river projects are operated by the Corps for hydropower, navigation, irrigation, recreation, and fisheries. Chief Joseph is located on the mid-Columbia River in central Washington. 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 requirements for power production, navigation, recreation, fishery, and construction activities. This year's operation is graphically shown on Chart 80 and Chart 89.

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. Voluntary spill for juvenile fish passage ended June 20, 2002. Fish barging started on June 26, 2002 and ended August 17 when the transportation mode was switched back to trucking. Trucking continued until November 29, 2001. The fish bypass remained in operation through November 30, 2001.

Also continuing at McNary this year was the offloading and burying of four decommissioned, de-fueled, submarine reactor compartments and four decommissioned, de-fueled, cruiser reactor compartments at the Hanford Reservation. The four reactor barge shipments were made during October 2001, and March, and April of 2002. The four cruiser reactor compartment shipments were made during October 2001 and September 2002. Cruiser reactor compartments differ from submarine reactor compartments because they have 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 192 hours for a submarine compartment and 104 hours for the cruiser compartments.

Other activities requiring a specific forebay operation included national level competitive hydroplane racing, wakeboard tour competition, bass fishing tournament, construction work at the project, levee repair, canal work in the McNary wildlife refuge, waterfowl nesting on Lake Wallula, waterfowl hunting enhancement, mosquito control, and irrigation of a habitat management area. At times, these requests conflicted with each other, requiring special coordination.

Chief Joseph's special operations included monthly relief tunnel inspections and a test to determine the structural integrity and seal of tailrace stop-logs.

Bonneville Dam has a number of special operations throughout the year. Many of the operations are in response to the needs of migrating adult and juvenile salmonids. In general these operations specify certain spill levels, tailwater or forebay elevations.

From 20 Nov 2001 to 12 March 2002 there is a tailwater restriction in place to protect ESA-listed chum redds in the vicinity of Hamilton Creek. This tailwater restriction ensures that the redds will not be dewatered during power peaking operations.

From 12 – 15 March the Spring Creek Hatchery released 7.8 million fall Chinook juvenile salmon into the Columbia River. Bonneville Dam facilitates this release by spilling 200 kaf of water during the release period to assist the downstream migration of these fish. The tailwater was maintained above 13.5 ft during the operation.

Voluntary spill for juvenile fish passage started 12 April and ended August 31. See Section G., Fishery Operations for additional information.

Special forebay operations at Bonneville included the following:

- High forebay level required for intermittent Treaty gill net fishing from 13 April – 18 May and from 28 Aug – 28 Sep, cross channel swim (people swim from Oregon to Washington across the Columbia River), and to aid removal of grounded barges.
- Low forebay level required for trashrack gate guide repairs, bank stabilization in the forebay, work at Bingen Marina, missing person search and retrieval operation, and to aid removal of a sunken boat at the Port of Cascade Locks.
- Steady forebay level required for fish ladder flow measurement testing.

The Dalles project operated blocked trashracks at units 1 – 5 to support a juvenile fish passage study conducted from 20 April – 13 July. ODOT did a downstream inspection of a bridge that required a low tailwater elevation on 14 Oct. High spill in May washed out a fish release pipe and its supports – the assembly was replaced on 26 June. A minimum forebay elevation was specified for one 24 hour period per week, from Tuesday to Wednesday, during July and August to assist juvenile salmon trapping. Voluntary spill for juvenile fish passage started 10 April and ended August 31. See Section G., Fishery Operations for additional information.

The observed peak flow at The Dalles was 374.4 kcfs on June 06, 2002. The Dalles unregulated freshet peak flow was 606.73 kcfs on June 07, 2002. The unregulated January-July runoff at The Dalles was 103.752 Maf, or 97 percent of normal. The April - August unregulated runoff was 93.804 Maf, or 101 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 2001- 2002. This year's operation is graphically shown on Chart 79.

The unregulated peak stage at Vancouver, Washington was 20.83 ft on 8 June 2002. The observed peak stage at Vancouver, Washington was 13 ft, 3 ft below flood stage, on 18 April 2002. 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 90.

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 for 2002 are:

Location	May	June	July	August	September
Albany	------	------	4,500	5,000	5,000
Salem	20,500/17,500	13,000/8,700	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.

At Cougar, work was initiated on a new water temperature control structure. This required drafting the pool below the conservation and power pools. Cougar quit generating on April 01 2002 and the pool was drawn down to elevation 1400 feet on 26 May. The project will be out of service until 2005.

b. USBR TUALATIN PROJECT

Henry Hagg Lake is 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 runoff occurs mostly from winter rain storms. 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 7.6 kaf, 14 percent of capacity and 29 percent of average. The reservoir was 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 5 kaf on November 12. This represents the lowest storage since completion of the reservoir in 1975. Storage began to accumulate when discharges were reduced to minimum flows the last week of October, reaching the flood control rule curve on December 17. Period flood control releases were made starting on December 21 until the reservoir filled on April 28. The peak stage at the Tualatin River near Dilley control point was 17.62' on January 8, while Scoggins was on minimum release. The maximum inflow was 1340 cfs on January 7, and the maximum release was 740 cfs on January 14. The reservoir remained full from April 28 until drafting began in early June. Storage at the end of the water year was 7.8 kaf. Annual runoff in the Tualatin basin was 95.4 kaf, 105 percent of average.