III. RESERVOIR REGULATION

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.

A. SYSTEM OPERATION

The 1 January 2003 water supply forecast (WSF) for the Columbia River at The Dalles for January through July was 80.5 Maf, or 75 percent of the 1971-2000 average. This was similar to the January final forecast in 2001, which was a drought year. Precipitation was much below normal through the fall and to the end of the calendar 2002 year. Only March and April of 2003 experienced more normal precipitation and increased streamflow. However this did not significantly influence the overall water supply. The unregulated runoff from January through July was 87.7 Maf at The Dalles, 82 percent of the 1971-2000 average. The unregulated runoff for 2003 peak unregulated flow at The Dalles was 592,300 cubic feet per second (cfs)) on 1 June 2003 and a regulated peak flow of 386,500 cfs occurred on 31 May 2003.

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.

Mica (Kinbasket) Reservoir reached its maximum elevation of 2465.1 ft on 3 September 2002, 9.9 ft below full pool. The reservoir drafted rapidly during October through December, reaching 2,405.6 ft by 31 December, 8.6 ft above the historical minimum elevation for that date. The reservoir continued to draft January through March, reaching a minimum elevation of 2,342.8 feet, on 8 April 2003. With a low initial level and below normal seasonal inflows, the reservoir refill level during the operating year was much below normal, reaching a maximum elevation of 2442.0 ft, 33.0 ft below full pool on 23 August 2003.

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 2002-2003 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 1,880 feet. During the spring freshet, March through July, the reservoir operated as low as elevation 1,875.3 ft, or 4.7 ft 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 was at elevation 1440.6 ft on 31 July 2002. The coordinated hydro system was on proportional draft from August 2002 through January 2003. This contributed to the Arrow Reservoir being drafted to its minimum elevation much earlier than normal, reaching 1393.3 ft by 3 February 2003. The reservoir reached its maximum level of the year at elevation 1440.6 ft on 4 July 2003, 3.4 ft below full pool.

Local inflow into Arrow Reservoir was 66 percent of normal over the period August 2002 to December 2002. Due to the proportional draft of the hydro system, Arrow outflows were approximately 20 percent higher than the historical average for this corresponding period. Arrow outflow varied from a monthly average low of 43,800 cfs in October to a monthly average high of 58,000 cfs in November. Local inflow into Arrow Reservoir was 84 percent of normal over the period January 2003 to August 2003. Outflow over this same period varied from a monthly average high of 58,700 cfs in August to a monthly average low of 15,000 cfs in April.

Arrow Reservoir operation was modified during the operating year under three Operating Committee Agreements to enhance whitefish and rainbow trout spawning and emergence downstream of the Arrow project in British Columbia and to provide additional power and non-power benefits in the U.S. From 21 December 2002 to 31 January 2003, Arrow outflow was held near 45,000 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 2003. Arrow outflow through the emergence period from 1 February to 21 March 2003 was held between 20,200 cfs and 30,000 cfs to help protect deposited eggs. During April and May 2003, Arrow outflows were held between 15,000 cfs and 20,000 cfs to ensure successful rainbow trout spawning immediately below Arrow, at water levels that could be maintained until hatch.

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.

Lake Koocanusa began October 2002 at elevation 2440.5 feet, 18.5 feet from full. Inflow to the reservoir averaged 3.75 kcfs across the month while outflow was 6 kcfs for the first 2 weeks of October and subsequently reduced to 4.8 kcfs for the following 16 days. The lake drafted 2.6 feet in October to elevation 2437.9 feet. The outflow was held at 4,800 cfs through November except for a short increase near the end of the month for power generation. Inflow averaged 3 kcfs and the pool drafted to elevation 2435 feet by the end of November.

The operating strategy in December 2002 was to release outflow for optimal power generation and draft Lake Koocanusa to elevation 2411 feet by the end of December. The power objectives were achieved by releasing as much as full powerhouse outflow through 21 December, and shape flow through the week. On 22 December, the outflow was reduced using the slow ramp down rates recommended in the USFWS bull trout BiOp. By 25 December, Libby was releasing 7,300 cfs and reached it objective of elevation 2411 feet on 31 December. The low outflow at the end of December and the continuing low flow through January may have enhanced burbot movement in the Kootenai River.

In January 2003 the USACE adopted use of the VARQ flood control operation for interim use. Based on the January water supply forecast at Libby of 4.861 Maf (78 percent of average) for the April through August period, the end of January VARQ flood control target elevation was 2426.7 feet, and the 15 March target flood control elevation was 2441.1 feet. January inflow to Libby was less than 4,000 cfs, and the dam reduced outflow to its normal minimum outflow of 4,000 cfs. The February and March water supply forecasts remained well below average and the flood control target elevations remained well above reservoir elevations that could physically be achieved. Libby Dam continued to release minimum outflow of 4,000 cfs through March and into April and was unable to refill to the flood control elevation. By March the water supply forecast had deteriorated to 4.181 Maf (67 percent of average) and the end of April flood control target was as high as elevation 2456.8 feet, only 2.2 feet from full. However low inflow since January kept the reservoir drafting, and the actual elevation of Libby Reservoir was as low as elevation 2404.2 feet at the end of March, 43.8 feet below the VARQ flood control elevation. There was some increase of inflow to the reservoir in April and although Libby continued to release only 4,000 cfs in April, the reservoir only refilled to elevation 2411.3 feet.

During May 2003 the inflow to Libby increased somewhat and the peak of the freshet was slightly greater than 54,000 cfs on 30 May. The dam continued to release only 4,000 cfs in May and refilled to elevation 2435.5 feet on 31 May, only 23.5 feet from full. In June and July the operating strategy shifted to meet operations for listed sturgeon in the Kootenai River to meet the objectives of the USFWS BiOp. To meet those objectives, the USACE was to release 800 kaf from Libby in excess of minimum flow of 4,000 cfs and try to refill the reservoir by 30 June and not spill. These objectives were achieved by increasing the outflow from Libby to near 25,000 cfs (maximum powerhouse outflow) by 7 June and maintaining that outflow for 12 days before reducing slightly to 19,000 cfs. This operation was timed to enhance the release of larval sturgeon in the Kootenai River. At the end of June inflow to the reservoir was at or slightly less than powerhouse outflow capacity and Lake Koocanusa was at elevation 2457.6 feet, 1.4 feet from full. Lake

Koocanusa filled to within one foot of full on 2 July and remained in the top foot through 15 July, when the reservoir began to draft to meet the 31 August draft limit for the BiOps of elevation 2439 feet. Outflow from Libby was held between 14,000 cfs and 18,000 cfs for the remainder of July and August to draft to this elevation. There was not agreement reached for a Libby - Arrow storage exchange in 2003 because of unfavorable hydrologic conditions in Canada.

In September 2003 the outflow was reduced to no lower than 6,000 cfs to maintain wetted habitat in the Kootenai River downstream of Libby, and the reservoir drafted to near elevation 2434 feet.

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.

Duncan The Kootenai River at Bonners Ferry, Idaho is a major control point for the flood control operation of Libby Dam. It is located 82 miles downstream of Libby Dam. Stages are affected by both river flow and backwater from Kootenay Lake. Libby Project provides flood control for Bonners Ferry.

The peak regulated stage was 57.1 feet on June 10, 2003. Libby was releasing 24.4 kcfs at the time of this peak. The unregulated peak stage gage reading would have been 68.3 feet on May 31, 2001. Bankfull is at 66.5 feet. The January-July unregulated runoff was 5187 kaf, 82% of normal, while the April-September unregulated runoff was 5340 kaf or 80% 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.

The Duncan Reservoir filled during 2002, reaching a maximum of 1892.3 ft, 0.3 ft above full pool on 16 July 2002. A high inflow event coinciding with the full reservoir caused discharges to reach 14,500 cfs from 17 July to 20 July 2002. The project passed inflows until 10 August 2002 when the reservoir started to draft. In the latter half of August, Duncan discharge was maintained around 8,000 cfs as part of a Libby/Canadian storage exchange agreement. During the period of September through December 2002, Duncan discharge was maintained at or below 8,000 cfs to supplement inflow into Kootenay Lake. By mid-January 2003, the reservoir was at minimum pool and was passing inflows.

Reservoir discharge was reduced to the minimum of 100 cfs on 11 May 2003 to initiate refill. The observed season water supply at Duncan for the February through September period was 94 percent of normal. Discharge from the project was increased from 100 cfs to 6000 cfs as the reservoir reached 1891 ft, 1 ft below full pool on 1 August 2003. The reservoir was maintained at 1 ft below full pool through August as a flood buffer and to support recreation on the reservoir.

In September, the project discharge was increased to between 8,000 cfs and 10,000 cfs to draft the

reservoir prior to kokanee and whitefish spawning. Discharges were reduced to 2600 cfs to facilitate spawning at lower flows to limit the risk of over-winter dewatering of redds.

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.

The level of Kootenay Lake at Queens Bay was elevation 1742.5 ft on 31 September 2002 and drafted to a low of 1740.5 ft on 2 December 2002. The lake levels remained well below the IJC levels throughout the fall in order to minimize spill at the Brilliant project later in the year and to meet system requirements. The lake refilled in December due to increased discharges from Libby.

Kootenay Lake was drafted during January to March to remain below the maximum IJC level and to meet generation requirements. On 11 March 2003, Kootenay Lake was at its minimum elevation of 1738.9 ft. Increasing inflows in March resulted in the Kootenay Lake reaching 1739.2 ft on 1 April.

During April, as inflow increased beyond the maximum outflow capacity, the lake elevation rose to 1740.55 ft by the end of the month. The Kootenay Lake Board of Control declared the commencement of the spring rise for the regulation of Kootenay Lake on 25 April 2003. Following the declaration of spring freshet, Kootenay Lake was operated in accordance to the IJC lowering formula.

Kootenay Lake discharges remained near inflows until the Kootenay Lake level rose sharply in response to the spring freshet inflow in late May. Kootenay Lake discharge was increased in accordance with the IJC order for Kootenay Lake. Regulated inflow peaked at 78,000 cfs on 9 June 2003. Discharge from the lake peaked at 61,000 cfs on 21 June 2003. Kootenay Lake peaked at elevation 1748.95 ft on 19 June 2003.

Kootenay Lake levels started to drop due to receding runoff and discharges were adjusted to control reservoir levels slightly below the IJC limits. The level at the Nelson gauge drafted below the trigger elevation of 1743.32 ft on 1 August 2003. Discharges were adjusted to control the Nelson gauge slightly below that level until the end of August, at which time the Queen's Bay level was 1743.60 ft. Inflow in September averaged 18.5 kcfs while outflow averaged 17.7 kcfs and the pool filled to elevation 1744 feet.

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 103.26 kcfs on 23 July 2003 and the unregulated peak flow was 216.42 kcfs on 15 June 2003. Bankfull and flood stage is 225 kcfs. The unregulated January-July

runoff was 34,246 or 88% of normal. The unregulated April-September runoff at Birchbank was 37,219 kaf, or 86% 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.

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 1449 kaf or 81% of normal, while the April-September unregulated runoff was 1404 kaf or 78% of normal. The observed daily peak flow at Columbia Falls was 37.3 kcfs on 29 May 2003 and the unregulated peak flow was 57.5 kcfs on 30 May 2003. The Hungry Horse outflow was about 4.5 kcfs during the peak flow period. 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.

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 is licensed for power generation, 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.

Flathead Lake maintained the summer recreation elevation of 2892.0-2893.0 ft through November 17, 2003. The lake was then gradually drafted throughout the late fall and winter months for power and flood control, reaching its minimum for the winter, elevation 2887.24 ft on 11 March 2003. Per the Memorandum of Understanding Agreement (MOA -- date 1962, revised 1965) between the Corps and Montana Power, Kerr will endeavor to reach 2883' on 15 April for flood control. It goes on to say that there is a natural channel restriction at

the outlet of the lake, which reduces the outflows at low lake levels and that this elevation might not be attained every year. On 15 April, the actual project elevation was 2887.37 feet. Observed inflows below Kerr were 102% of normal in March and 70% of normal in April. Operations were coordinated between the Corps and the Kerr project pursuant to the MOA.

The Corps coordinates with Montana Power to refill Kerr in a controlled manner during the spring freshet. The project refilled to 2890.0 feet by May 28 and reached a maximum water year pool elevation of 2893.0 feet on June 23. The project operated in the top half foot (2892.5 ft. – 2293 ft.) through September 30.

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.

Pend Oreille Lake is a natural lake, whose level is partially controlled by Albeni Falls Dam, a Corps project operated for flood control, power, and recreation. Albeni Falls Dam is located 29 miles downstream of Pend Oreille Lake 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.

Pend Oreille Lake was drafted to elevation 2061.0 feet by October 1, 2002. The pool continued to draft to the winter operating range of 2055.0 to 2055.5 feet by November 15, 2002. The pool was kept in this range until January 1, at which time the operating range increased by 0.5 feet to 2055 – 2056 feet. On May 1 the range increased to 2055.5 – 2056.5 feet. On May 26 the range increased to 2056 – 2057 feet. The pool was slowly filled starting on May 30, based on refill guidance from HEC, during the spring freshet, and was at 2062 feet by June 19. The subsequent summer operating range from June 20 – September 15 was from 2062.0 – 2062.5 feet. On September 16 the pool was drafted to reach the new range of 2060 - 2061 feet by September 30.

The unregulated inflow for the period of April thru July was 11,977 KAF or 76% of average. Unregulated inflow to the project was highest during the months of April, May, and June at 33.4 kcfs, 53.0 kcfs, and 51.4 kcfs respectively. Observed inflow for this period was 30.4 kcfs, 42.3 kcfs, and 48.0 kcfs respectively. Observed outflow for this period was 29.8 kcfs, 37.9 kcfs, and 42.2 kcfs respectively. Inflow for the water year was below average at 59%, with only the months of March and April having inflow above average, at 116% and 104% respectively. The project started to spill on April 14 and continued through June 28. During the rest of the water year the project was able to maintain the pool within its specified operating range by operating within powerhouse capacity.

Dry conditions were in effect for the basin. Precipitation in the water year Oct 02 – March 03 was 89% of normal. Pend Oreille Lake reached its summer operating range of 2062' on June 19. A peak observed inflow of 67.8 kcfs was reached on June 4. Unregulated peak inflow would have been 76.7 kcfs on June 6. Peak discharges were 67.8 kcfs on June 4. The unregulated January-July runoff was 11.977 Maf, 78% of normal, while the April-September runoff was 10.354 Maf, or 74% 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.

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 89). The observed regulated day-average peak flow was 192.7 kcfs on May 22, 2003. The observed highest hourly flow was 260.9 kcfs on June 16, 2003

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 03 was 70 kcfs during daylight hours. Special flow operations were also required of Priest Rapids Dam in the fall 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.

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.

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.

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.

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.

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.

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.

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.

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.

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. This year's operation is graphically shown on Chart 88.

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.

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 1534 feet by the end of August 2002 for salmon flow augmentation, and continued to draft to elevation 1520 feet by September 10, at which time flows were reduced from 10.1 kcfs to between 1.5 and 1.7 kcfs. The project ended September at elevation 1518.4 ft, 81.6 ft from full. Inflows for September averaged 1.1 kcfs and ranged from 1.6 to 0.5 kcfs. The project continued to draft in October. Outflows continued to hold steady from 1.4 to 1.6 kcfs. The project ended October at elevation 1516.3 ft, 83.7 ft from full. Inflow for October averaged 1.0 kcfs with a range from 0.5 to 1.6 kcfs. As required by the BiOp, project outflow remained above 1.3 kcfs during this period. Precipitation for September was 1.05 inch or 62% of average, which brought water year 2002 to 30.98 inch or 99% of average. October was 0.72 inch or 33% of average.

Dworshak released the minimum outflow allowed by TDG concerns, or about 1.5 kcfs, throughout the November - February period. Pool elevation at the beginning of December was 1516.1 feet, January was 1516.7 feet and at the beginning of February was 1532.7 feet. Rain caused the project to fill to elevation 1552.0 by the end of February. Inflow to Dworshak in November was 1.5 kcfs, or 56% of normal. Inflow to Dworshak in December was 1.5 kcfs, or 46% of normal. Inflow to Dworshak in January was 4.3 kcfs, or 130% of normal. In February, inflow was 7.1 kcfs, or 143% of normal. Even with the high inflows in January and February, the end of February flood control elevation of 1565.0 feet was not reached.

Dworshak began March near elevation 1552 feet, 48 feet from full. Outflow was at minimum of about 1,400 cfs until March 6, when flow was increased to 4,400 cfs for four and a half days while Columbia Generating Station was off line, when flow in the Snake River increased to help make up the generation loss of CGS. The March final water supply at Dworshak for the April through July period was 1,79 MAF, 68% of average, however inflow in March was 9,800 cfs, 143% of average. By the end of March, the reservoir had filled to elevation 1580 feet, 20 feet from full and outflow had to be increased to slow the fill to the local flood control elevation. By April 3 Dworshak outflow was increased to nearly 16,000 cfs, of which over 6,000 cfs was spill to maintain flood control space at Dworshak. The April final water supply forecast increased to 2,323 MAF, 88% of average. Dworshak continued to release nearly 16,000 cfs through the month of April and drafted to elevation 1567 feet. Inflow in April was 107% of average.

Dworshak began May near elevation 1568 feet, 32 feet from full and was operated during May on adaptive management for flood control, fish, and water quality purposes. Dworshak discharged the maximum flow to stay below 110% TDG (from 14 – 16 kcfs) from 3 Apr thru 21 May of which 4 – 6 kcfs was spill. Flows near 15 kcfs continued until 22 May to help augment Lower Granite flows. Flows were ramped down to minimum (1.5 kcfs) from 22 – 26 May to ensure reservoir refill. Outflow in June averaged 3.6 kcfs and refill was achieved on June 30 to elevation 1599.85 feet. Lower Granite exceeded its April 3 – June 20 flow objective of 89 kcfs by 0.98 kcfs for a total average observed flow of 89.98 kcfs.

Dworshak reached full on July 1, and remained within 1 foot of full through July 6. Discharge was ramped up on July 7 from 4 to 14 kcfs to assist with Lower Granite flow augmentation as well as to reduce Lower Granite water temperatures. Flows were ramped down to 12.2 kcfs on July 24 and held through August 4, ramped down to 10 kcfs and held through Aug 18, then ramped down to a day average outflow of 7 kcfs with day/night shaping. Dworshak reached elevation 1568 ft by July 31 and 1532.5 ft by Aug 31. Dworshak is expected to reach its interim draft limit of 1520 ft on Sept 15, at which time flows will be reduced to 1.5 kcfs (minimum flow) and will remain there through most of the winter. Inflow averaged 2.5 kcfs (66% of normal) in July and 0.84 kcfs (52% of normal) in August.

Dworshak began September at elevation 1531.6 ft, 68.4 ft from full. Inflows averaged 0.8 kcfs while outflow stayed near 7.2 kcfs for the first 11 days of the month. Outflow then ramped down to 4.7 kcfs for 3 days, and to 1.6 kcfs for the remainder of the month. This operation allowed the pool to reach an interim draft limit of 1520 ft on September 15, as requested by the Columbia River Inter-Tribal Fish Commission (CRITFC), on behalf of its member tribes the Nez Perce Tribe, the Confederated Tribes of the Warm Springs

Reservation, the Confederated Tribes of the Umatilla Reservation, and the Yakama Nation, as well as the State of Idaho. Normal 2000 FCRPS Biological Opinion operations require the pool to be drafted to elevation 1520 by August 31. However, Idaho, Nez Perce Tribe, and CRITFC desired to meet water quality standards in the Clearwater River that afforded balanced protection of sub-yearling salmonids and returning adults, optimized the rearing of listed Clearwater River fall Chinook, and minimize impacts at the Dworshak National Fish Hatchery. This was accomplished by shifting the release of 200 kaf of storage from August to the first two weeks of September.

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 regulated flow at Spalding this year was 61,200 cfs on May 29. Dworshak was releasing 1,600 cfs on this date. The unregulated peak flow during the freshet was 83,600 cfs on May 31, 2001, well below the flood control limit of 105,000 cfs (flood stage) or 85,000 cfs (bank full).

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 spring of 2003 the projects began operating near Minimum Operating Pool (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. MOP + 1 to MOP + 2 (734-735 feet) operations began April 3rd at Lower Granite. MOP to MOP + 1 (633-634 feet) operations began April 6th at Little Goose and April 7th at Lower Monumental (537-538 feet) and Ice Harbor (437-438 feet). Little Goose was changed to MOP + 1 to MOP +2 (634-635 feet) on April 9th because of navigation concerns raised by the Towboat operators. Ice Harbor was also changed to MOP + 1 to MOP +2 (438-439 feet) on April 9th because of navigation concerns raised by the Towboat operators.

Little Goose returned to a pool range of 634-638 feet on August 31, one foot higher than the normal low pool elevation due to navigation concerns. Lower Monumental returned to a pool range of 537-540 feet on September 1. Ice Harbor returned to a pool range of 438-440 feet on September 2, one foot higher than normal low pool elevation due to navigation concerns. Lower Granite returned to a normal pool range of 734-738 feet on October 8, 2003 after natural cooling of the water occurred. The forebay temperature was 65-66° F.

Spill for juvenile fish passage began April 3 at Lower Granite, April 5th at Little Goose, April 7th at Lower Monumental, and at April 9th at Ice Harbor. Spill for juvenile fish passage ended on June 20 at Lower Granite, Little Goose, and Lower Monumental. Spill ended at Ice Harbor on August 31 which coincides with the end of the summer spill season.

The April-July unregulated runoff to Lower Granite was 16734 kaf, or 78 percent of normal. The regulated peak flow into Lower Granite was 208,200 cfs on May 31, 2003 and the unregulated peak was 282,100 cfs on May 31, 2003.

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.

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'. In addition, at any time during the year the lake can be operated 257' – 268' 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 03, there were special operations set up for several different parties. There were special operations for goose hunting (9 October – 26 January) and goose nesting (11 April – 31 May). 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.

Spill for juvenile fish passage occurred at John Day only during the spring, from 14 April through 31 August. 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.

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 91.

Chief Joseph Dam

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

McNary Dam

McNary Dam had Biological Opinion flow requirements that varied throughout the spring and summer (see Section G., Fishery Operations). Voluntary spill for juvenile fish passage began April 14, 2003 and ended June 20, 2003. Fish barging started on June 28, 2003 and ended August 17 when the transportation mode was switched back to trucking. Trucking continued until October 1, 2003. The fish bypass remained in operation through October 1, 2003.

Also continuing at McNary this year was the offloading and burying of five decommissioned, de-fueled, submarine reactor compartments at the Hanford Reservation. One heavy and one small submarine reactor compartment package occurred in October 2002. Two small submarine reactor compartment packages occurred in November 2002. One small submarine reactor compartment package occurred in September 2003. 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 reactor compartment unloading at the Port of Benton slip.

Other activities requiring a specific forebay operation included national level competitive hydroplane racing, professional wakeboarding tournament, bass fishing tournament, waterfowl nesting on Lake Wallula, waterfowl hunting enhancement, installation of new concrete boat ramp at Hat Creek State Park, construction of a boat dock in Richland WA, construction of a mitigation pond, and WADOT bridge inspection. At times, these requests conflicted with each other, requiring special coordination.

The Dalles

Spill tests were conducted between October 21 and November 4 to support a juvenile fish survival test. Silt was flushed from the spill bays on March 25. A minimum forebay elevation was specified for one 24 hour period per week, from Tuesday to Wednesday, from March 27 to August 31 to assist juvenile salmon trapping. Voluntary spill for juvenile fish passage started April 14 and ended August 31. A special spill operation was conducted on May 20 thru June 11 for balloon tag testing. See Section G., Fishery Operations for additional information.

The observed peak flow at The Dalles was 354.2 kcfs on May 31, 2003. The Dalles unregulated freshet peak flow was 592.3 kcfs on June 01, 2003. The unregulated January-July runoff at The Dalles was 87.688 Maf, or 82 percent of normal. The April - August unregulated runoff was 73.767 Maf, or 79 percent of average.

Bonneville Dam

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 October 11 thru October 31, the Bonneville tailwater was restricted to a stage of 15.5 feet or less to protect equipment and foundation work on the Bonneville B2 corner collector construction. During the

month of November, the tailwater was restricted to a stage of 16.0 feet or less for the same construction work, except from November 9 – 11 where it was restricted to 12 feet or less. From Dec 20 thru Feb 28 the tailwater was held below 19 feet.

Starting on November 5 until the time of the Spring Creek Hatchery release there was 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.

On March 8 the Spring Creek Hatchery released 7.5 million fall Chinook juvenile salmon into the Columbia River. Bonneville Dam facilitates this release by operating units in a preferential manner, maintaining turbine units within their respective 1% efficiency ranges, operating spillbays and fish facilities in accordance to the fish passage plan, maintaining the tailwater above 13.0 feet, and spilling 50 kaf of water for 36 hours after the release period to assist the downstream migration of these fish.

Voluntary spill for juvenile fish passage started April 10 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 April 24-26, May 22-24 and 29-31, July 21-23, August 26-30, and September 2-5 , 9-12, 16-20, and 24-27.
- Cross channel swim (people swim across the Columbia River at Hood River).
- Steady forebay level required for fish ladder flow measurement testing.
- High forebay for a rock barge to be able to leave its slip in Bingen, WA.
- Low forebay to minimize turbidity while ODOT drives a large pipe through the left bank upstream of Hood River.

35. Columbia River at Vancouver

The Columbia River Basin reservoir system did not need to be operated for flood control during the winter of 2002- 2003. This year's operation is graphically shown on Chart 79.

The observed peak stage at Vancouver Washington was 13.95 feet, 2.05 feet below flood stage, on February 1, 2003. Flood stage at Vancouver is 16 feet and a major flood is considered to be at a stage of 26 feet. The unregulated peak stage at Vancouver was 20.8 feet, 4.8 feet above flood stage, on June 2, 2003. As a comparison, in 1964, the flood crest was 27.7 feet and in February 1996, 27.2 feet was reached. The all time record is 31 feet in 1948.

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 for 2003 are:

Location	May	June	July	August	September
Albany	------	------	4,500	5,000	5,000
Salem	20,500/17,800	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, the reservoir will be held near elevation 1450 feet through the spring and summer for execution of the construction contract. 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.