

## II. HYDROMETEOROLOGY

*OBSERVATIONS: Weather Snowpack SWSI Streamflow Flood Events*

*FORECASTS: Runoff Volume Long Range Peaks Daily Streamflows*

### A. OBSERVATIONS

With the Pacific Northwest's highly diverse hydrologic conditions, both areally and seasonally, information on weather, snow packs, and streamflows played a pivotal role in the effective operation of the dams and reservoirs to meet the needs of the region's people, industry, and natural resources. This chapter summarizes these conditions, first generally in describing the overall conditions throughout the year and then some unique conditions that had a pronounced effect on the region. The chapter concludes with summaries of forecasts and peak streamflow conditions.

#### 1. Weather

The Pacific Northwest has the most diverse weather conditions of any region of the nation, varying from the arid conditions in the shadows of the Olympic and Cascade Mountains to very wet rainforest along the Pacific coast to dry areas that are subject to occasional cold outbreaks of winter continental weather in the Rocky Mountains along the Continental Divide. The normal seasonal variations are just as dramatic with the coastal areas and Cascade Mountains receiving their maximum precipitation in the winter months while the eastern basins, with more steppe and continental climates, have their maximum precipitation in early summer. To best consider all these seasonal and areal variations, the following weather discussion will reference departures of temperatures and precipitation from normals rather than observed values. Monthly sub-basin precipitation is shown in [Table 1](#) and [Table 2](#), basin temperature in [Table 3](#), and [Figure 6](#) is a map of the annual precipitation in the Columbia drainage. [Figure 6](#) shows accumulated precipitation across the Columbia Basin during the October 2000 through the September 2001 water year. [Figure 7](#) denotes the monthly accumulation of the Columbia Basin snowpack for Water Year 2001 expressed as a percent of normal peak snowpack. [Figure 8](#) denotes the accumulated precipitation in inches for Water Year 2001 at primary Columbia River basins. [Figure 9](#) is a map of the Pacific Northwest monthly temperature departures from normal for the month of December 2000.

The month of October was drier than normal across British Columbia. Precipitation was at or above normal across the rest of the Region. Temperatures were at or above normal across westside basins and below normal across eastside basins. Early in the month, a series of storm systems bringing mainly light precipitation to the Region gave way to high pressure and drier conditions. New record low temperatures were established across Western Montana as an unusually strong area of high pressure dropped south from Canada. During the middle of the month, a slow moving upper level low-pressure system caused locally heavy precipitation. Several cities broke daily precipitation records. Late in the month, the most significant precipitation fell across southern tier basins as an upper level low moved from northern California into the Great Basin.

For the month of October, Pacific Northwest mean temperatures departed -0.1 degrees from normal relative to 1961-1990 normals (31 stations). Mean temperature departures ranged from -2.8 to 8.7 degrees. No record high temperatures were reported during the month of October. Record low temperatures reported during the month of October occurred on the 5th, 6th, 7th, and 23rd. On the 5th, the following records were broken, 16 at Butte (tie) and 20 at Great Falls. On the 6th, record lows included 12 at Havre, 15 at Kalispell, and 16 at Great Falls. On the 7th, Havre dropped to 9, which tied a record, and Kalispell fell to 15. On the 23rd, Eugene tied a record low at 28.

Daily precipitation records which were broken during the month of October included .90 inches at Missoula on the 1st, .36 inches at Missoula and .75 inches at Great Falls on the 12th, .49 inches at Missoula, .43 inches at Portland, 1.09 inches at Astoria on the 13th, and .30 inches at Butte on the 30th.

The month of November was generally drier than normal while temperatures were typically below normal. Pacific Northwest mean temperatures departed - 4.3 degrees from normal relative to 1961-1990 normals (31 stations). Mean temperature departures ranged from -9.6 to 1.0 degrees.

Increasingly active Pacific disturbances did finally start pushing substantive precipitation into Westside basins around and after Thanksgiving, but overall little hydrologic priming occurred through much of early to mid November as a series of frequent but weak disturbances produced only light precipitation focused mostly into Westside basins. The dominant characteristic of interspersed drier periods was the positioning of offshore high pressure ridging, leaving the Region under the influence of cold Northwesterly flows.

No record high temperatures were reported during the month of November. Record low temperatures were reported during the month of November. No daily precipitation records were broken during the month of November.

The month of December was generally drier than normal, while temperatures were typically below normal. Early in the month, little precipitation was reported because of a ridge of high pressure that dominated through much of the period. Most of the precipitation that fell during December occurred during the middle of the month as high pressure broke down and a series of storm systems rolled in from the Pacific Ocean. The majority of the storm systems that impacted the Region late in the month were weak and brought only light precipitation.

Pacific Northwest mean temperatures departed -1.3 degrees from normal relative to 1961-1990 normals (31 stations). Mean temperature departures ranged from -5.2 to 1.1 degrees. No record high or low temperatures were reported during the month of December. No daily precipitation records were tied or broken during the month of December.

The month of January was generally drier than normal, while temperatures were typically above normal. Storm systems had a tendency to split as they approached the Pacific Northwest. A lot of the energy associated with these systems dove southeast into the southwest United States or lifted northeast into British Columbia. Because storm systems were weak and starved for moisture as they impacted the region, precipitation totals were below normal.

Pacific Northwest mean temperatures departed +1.9 degrees from normal relative to 1961-1990 normals (31 stations). Mean temperature departures ranged from -6.0 to 9.2 degrees. Several record high temperatures were broken or tied during the month of January. On the 2nd, the following records were broken: 70 at Brookings, 62 at Medford, 61 at North Bend, and 56 at Klamath Falls. On the 3rd, Great Falls tied a record high of 57. On the 4th, Eugene tied a record high of 63, and Astoria tied a record high of 59. On the 5th, Butte recorded a new record high of 50. On the 6th, Lewiston tied a record high of 57. On the 23rd, two record highs were broken in the Seattle area. SEA-TAC Airport reported 56, while the National Weather Service Office in north Seattle reported 59.

No record low temperatures were tied or broken during the month of January. No daily precipitation records were tied or broken during the month of January.

February was a cool and dry month. Like January, February storms systems split as they approached the Pacific Northwest. Most of the energy associated with these systems dove south to form fairly strong low-pressure systems off the coast of California, which then progressed into the southwest. Pacific Northwest precipitation totals were below normal.

Pacific Northwest mean temperatures departed -3.4 degrees from normal relative to 1961-1990 normals (31 stations). Mean temperature departures ranged from -10.0 to 2.3 degrees. No temperature or precipitation records

were broken in February.

Some items of note: Astoria experienced their third driest February since 1953, Portland their 5th driest February since 1931, Medford their 19th driest February on record, Salem their 6th driest February since 1892.

March was warm and dry. Like January and February, the Pacific Northwest came under the influence of a split flow. Storm systems traveling along in the Northern Stream brought enough valley rain and mountain snow to bump up precipitation totals to near normal levels across far northern tier basins. The remainder of the Region experience drier than normal conditions as storm systems tracked from the Eastern Pacific Ocean into the Southwest United States.

Pacific Northwest mean temperatures departed +1.8 degrees from normal relative to 1961-1990 normals (31 stations). Mean temperature departures ranged from -0.4 to 4.8 degrees. There were 7 record high temperatures tied or broken in March. They include: 72 at Salem and 70 at Astoria on the 6th, 71 at Salem (tie) and Eugene and 69 (tie) at Portland on the 7th, 70 at Havre on the 19th, and 72 at The Dalles (tie) on the 22nd.

There were 3 record low temperatures tied in March. They occurred on the 22nd and include: 22 at Astoria, 24 at Olympia, and 27 at Quillayute. No precipitation records were tied or broken in March.

April was cooler than normal. Drier than normal weather occurred across Southern Oregon...Northern Washington and Southeast Idaho with near or above normal precipitation elsewhere across the Region in April. The split flow that had been bringing much drier than normal conditions to the Pacific Northwest during the winter finally broke down during April. With the lack of a persistent ridge of high pressure along the Pacific Northwest coast, storm systems over the Gulf of Alaska and Eastern Pacific Ocean were able to track into the Pacific Northwest on a more frequent basis and with greater intensity. This pushed precipitation totals to above normal levels across the Owyhee...Salmon...Kootenai...Flathead... and Middle Columbia River Basins.

Pacific Northwest mean temperatures departed -1.1 degrees from normal relative to 1961-1990 normals (31 stations). Mean temperature departures ranged -3.2 to 2.3 degrees. There were 5 new high temperature records established in April. They included: 80 at Pendleton (downtown) on the 16th...69 at Astoria...77 at Klamath Falls... and 82 at Portland on the 25th...and 91 at Havre on the 28th.

May was warmer and drier than normal. Early in the month, a series of frontal systems moved across the Region and had their greatest impact across Washington, Northwest Oregon, Northern Idaho, and Southern British Columbia basins. Late in the month drier than normal conditions dominated as the main storm track lifted north into Canada.

Pacific Northwest mean temperatures departed +2.0 degrees from normal relative to 1961-1990 normals (31 stations). Mean temperature departures ranged from -1.3 to 6.4 degrees. There were many new high temperature records established in May.

June was cooler than normal. A zonal flow across the Pacific Northwest allowed a series of cold fronts to bring reinforcing shots of cool air to the Region. West of the Cascades and across northeast basins below normal temperatures were accompanied by above normal precipitation. Across southeast basins precipitation was generally below normal.

Pacific Northwest mean temperatures departed -2.2 degrees from normal relative to 1961-1990 normals (31 stations). Mean temperature departures ranged from -4.1 to 0.7 degrees. There were only 2 new high temperature records in June and both were established in Pocatello. Ninety-two was reported on the 1st and 91 was recorded on the 8th. There were several new low temperature records established in June, and there were 4 new daily precipitation records.

July was cooler and wetter than normal. A warm, dry southwesterly flow around a ridge of high pressure over the

Southwest United States and an upper low off the British Columbia Coast dominated early in the month. During the middle and latter part of the month the ridge of high pressure shifted east into the South-central United States, while a trough of low pressure moved east into British Columbia and the Pacific Northwest. This brought cooler weather into the region and pushed precipitation to above normal levels, especially east of the Cascades.

Pacific Northwest mean temperatures departed -0.61 degrees from normal relative to 1961-1990 normals (31 stations). Mean temperature departures ranged from -3.1 to 0.9 degrees. There were 5 high temperature records. Four low temperature records and 7 daily precipitation records established.

August was warmer and drier than normal. A stronger ridge of high pressure across the Great Basin and Rockies brought warmer and drier than normal conditions to most of the Pacific Northwest. In fact, August 2--1 was the warmest on record in Helena and the second warmest on record in Havre. The only areas that experienced above normal precipitation and near or slightly below normal temperatures were Northwest Oregon, Western Washington and areas of Southern British Columbia north of Revelstoke. An unusually strong storm system relative to summer standards brought significant rainfall to northwest basins on the 21st and 22nd.

Pacific Northwest mean temperatures departed +2.5 degrees from normal relative to 1961-1990 normals. Mean temperature departures ranged from -1.3 to 6.2 degrees. There were several record high temperatures reported in August and a vast majority of them occurred across Western Montana. Only two record low temperatures were reported in August. A few daily precipitation records were established.

September was warmer and drier than normal. A couple of weak cold fronts brought showers to northern tier basins early in the period and an area of low pressure brought light precipitation to southern tier basins during the middle of the month. Late in the month a ridge of high pressure dominated and brought warmer and drier than normal conditions to most of the Pacific Northwest. In fact, September 2001 was the warmest on record in Helena.

Pacific Northwest mean temperatures departed +3.3 degrees from normal relative to 1961-1990 normals. Mean temperature departures ranged from -1.5 to 6.3 degrees. There were several record high temperatures reported in September and a vast majority of them occurred across Western Montana. There were not any daily precipitation records reported in September. However, several locations reported their driest water year on record.

## 2. Snowpack

The 2001 Columbia Basin snowpack was low all year, starting with 59% of average on January 1st, dropping to 52% on the first of February and March, setting a new minimum of 54% on April 1st, and rising to a mere 58% by May 1st. While the low snowpack was predominant across all sub-basins, the record low conditions were primarily driven by the northern half of the Columbia. The basin above Grand Coulee set new record minimums in January (55%) and February (51%), tied 1977's record low of 52% in March, and set the min of record again in April at 55%.

In January, scattered sub-basins showed snowpack percentages that were low, but not extremely so-- the Snake headwaters and Deschutes, for example. But by February no sub-basin was above 70%. Holding the minimum most of the year was the Kootenai in Montana and Canada, with less than 50% of average from February through April. In April, the overall index for the snowpack above The Dalles broke the previous record by four percentage points-- 54%, as opposed to 1977's 58%. During April a wholesale meltout could have dropped percentages even further, but the weather conditions allowed the snowpack to deplete more slowly than average, raising the overall snowpack to 58%, well above minimum of record.

For information about snowpack measurements including that needed to develop the Oregon Surface Water Supply Index or SWSI for [Table 4](#), see the NRCS National Water & Climate Center web site at [http://www.wcc.nrcs.usda.gov/w\\_data.html](http://www.wcc.nrcs.usda.gov/water/w_data.html).

### 3. Surface Water Supply Index – SWSI

The Surface Water Supply Index (SWSI) was developed for the State of Oregon by the Oregon Snow Survey staff, Natural Resources Conservation Service, US Department of Agriculture, in Portland, Oregon. The index utilizes Snow, Precipitation, Reservoir and Streamflow data from key stations in each major Basin in the state. The index varies between -4.1 (very dry conditions) to 4.1 (very wet conditions) similar to the Palmer Drought Index. A value of 0 indicates normal water supplies. Not only does the index show the current conditions, but when plotted from month to month, will show trends as well. The index has been used for 15 years as a tool for state drought planners.

In most cases, Water Year 2000, was a near normal water year, but as the 2001 water year approached, conditions began to dry. By April of 2001, most basins of Oregon were experiencing some form of water shortages. Generally speaking, 2002 saw an improvement from the previous year. For more information concerning the Oregon SWSI, please contact USDA NRCS, 101 SW Main, Suite 1300, Portland, Oregon. The SWSI for the years 1997 to 2002 may also be found on the web at <http://www.or.nrcs.usda.gov/snow/snowsveys/swsi.html>

For pertinent information about the Idaho SWSI for water year 2000, see the web site at: <http://idsnow.id.nrcs.usda.gov/snow/bor/200101/idf1s07.htm>. (The Klamath, Lake County, and Harney areas do not contribute to the Columbia drainage or have flood control reservoirs and therefore are not germane to this report). The effects of the water supply on the regulation of the specific reservoir projects are discussed in Chapter III, the effects on power generation, irrigation, recreation, fisheries, and other activities are discussed, by activity, in Chapter IV.

### 4. Streamflow

Streamflows in the Pacific Northwest were measured at approximately 900 stream-gaging stations. To condense these data, data from 10 index gages, on both uncontrolled and controlled streams, were used to summarize the flows throughout the region. Data from all gages are reported with observed flows and are not adjusted for the amount of storage. Monthly mean discharges for each of these index stations, as expressed as a percentage of their 1971-2000 normal discharges, are shown in [Table 5](#). Flood peaks will be discussed in Section 5.

During the previous 6 years, the Columbia River Basin experienced annual flows that were "above or near normal." In contrast, the 2001 water year reversed that trend and set record or near record low annual mean flows throughout the region. The index station with the highest mean annual discharge, in percent of normal, was the Snake River near Heise, ID with 67%, and the lowest was the John Day River at Service Creek, OR, with 40%.

In late fall, a high pressure ridge developed off the Pacific Northwest coast and persisted throughout the winter months blocking many of the typical wet Pacific fronts that move through the Columbia River Basin. Most index stations began the water year with monthly mean flows in the "normal" range. By January the monthly mean flows had eroded to where all the index sites were reporting values that were below normal. Two index stations, the Willamette at Salem, OR and the John Day at Service Creek, OR reported January monthly means that were less than 25% of normal. Mountain snowpack in early January was approximately 70 - 80% of average throughout the Columbia River Basin. By late April the regional snowpack was less than 70% of average with many areas reporting snowpack at about 60% of average or less. Monthly streamflows averages continued to erode through February with the John Day, Spokane, and Willamette index stations reporting February monthly mean streamflows at 20%, 22% and 29% of normal, respectively.

Spring and summer precipitation amounts were near normal for most of Washington and Oregon while Idaho and western Montana had precipitation levels that were significantly below normal for that period. Monthly mean streamflows rebounded slightly with the increase in precipitation and spring snowmelt. By mid to late summer

most index stations were reporting monthly mean flows that were still in the 40 - 60% of normal range even though the regulated basins had flows supplemented by reservoir releases.

Tables 6, 7, 8, 9, and 10 show additional comparisons of WY 2001 observed streamflows and runoff with historical flows. The Snake River at Anatone, the Columbia River at Grand Coulee and the Columbia River at The Dalles had record low monthly mean observed streamflows for their respective period of record.

As noted earlier, many gaging stations in the Pacific Northwest had annual mean streamflows that were record low or near record low. However, it was the Columbia River at The Dalles that defined the 2001 water year by establishing a new record low of annual observed streamflow spanning a period of 123 years.

## 5. Flood Events

Water year 2001 was a very quiet year in terms of flooding.

a. WINTER FLOODS. Very little or no flooding took place in the Columbia River Basin during this major drought year. See Table 11 for a description of these winter flood peaks. Stages remained below zero damages throughout the basin.

b. SPRING FLOODS. During the spring snow melt period, only minor, below flood stage events were reported on the John Day and Imnaha Rivers in Oregon, and Henry's Fork in southern Idaho in May. See Table 12 for a description of these spring high water events.

## B. FORECASTS

River forecasts are prepared primarily by the Northwest River Forecast Center (NWRFC) under an agreement between the NWRFC, the Corps, and Bonneville and are fully coordinated with the Bureau of Reclamation. Under this Columbia River Forecasting Service (CRFS) agreement all major projects are assumed to be operated based on coordinated forecasts. This minimizes unanticipated project operations due to the use of different flow forecasts. This agreement sets three main goals: (1) pool certain resources of the three participating agencies within the region; (2) avoid duplication of forecasts; and (3) increase the overall efficiency of operation. These forecasts are released monthly about the tenth of each month between January and June and are based on the basin hydrologic conditions on the first of each month plus normal weather assumed throughout the remainder of the forecast period.

In addition to these CRFS forecasts, the NWRFC also prepared forecasts that are distributed through the state NWS offices for public warning, for rivers in areas that were not affected by project regulations.

For forecast points located below flood control projects, outflow schedules are provided by the operating agency before the downstream flood warning is issued. The forecast area includes all of Oregon, Washington, Idaho, western Montana, western Wyoming, and the Columbia Basin portion of British Columbia. Distribution of all these forecasts was through CROHMS, by the Columbia Basin Telecommunications system (CBT), and the National Weather Service (NWS) web page ([www.nwrfc.noaa.gov](http://www.nwrfc.noaa.gov)). The NWS AFOS system is used to transmit the forecasts to the state hydrologist offices in Seattle, Portland, Medford, Boise, Missoula, Pendleton, Pocatello, and Spokane for public release.

### 1. Runoff Volumes

Water supply volume forecasts issued on both January 1 and April 1, Table 13, indicated very low runoff conditions could be expected from almost all sub-basins. However, slightly below average runoff was forecast for the Deschutes River basin in central Oregon. Tables 14 displays the monthly forecasts at key sites and their verification.

Both the January 1<sup>st</sup> and April 1<sup>st</sup> forecasts projected very low runoff conditions for most Columbia/Snake River basins. Forecasts errors throughout the sub-basins were less than 5 percent for this major basin-wide drought

event.

[Table 15](#) shows the history of forecasts of the January-July runoff of the Columbia River at The Dalles for the period 1970-2001. These are the actual forecasts made each year and do not include the effects of improvements in forecast models or changes in the amount and quality of data used in models. WY-2000 adjusted runoff for the Dalles was 58.2 maf. A caveat for this table lists the actual historic forecasts that were made at the time and do not include corrections or adjustments for improvements in forecast models, changes in the quality of data, number of data stations used or their locations that have occurred in recent years.

For information about water supply streamflow products posted by NRCS, National Water & Climate Center, see the NRCS web site at [http://www.wcc.nrcs.usda.gov/water/w\\_qnty.html](http://www.wcc.nrcs.usda.gov/water/w_qnty.html). Products for this web site include streamflow color graphics maps and forecast probability charts.

## 2. Long-Range Peaks

Spring peak flow forecasts, expressed as a range of stages or flows, are a product of volume forecasts with model simulation of daily forecasts that provide adjustments to these long-range predictions. The forecast peak stage or flow are expressed so there was a probability that 16% of peak drainage may occur above the higher limit and a 16% probability of the peak occurring below the lower limit.

With below average runoff, no streams were forecast to exceed flood stage during the spring runoff period. All crests were far below normal throughout the basin. The regulated peak for the Portland-Vancouver harbor was below 7 ft. [Table 16](#) provides a comparison of this year's forecast and observed peaks for key sites.

## 3. Daily Streamflows

The forecasts of operational streamflow were prepared by the NWRFC. The three operating agencies, Bureau of Reclamation, Bonneville Power Administration, and the Corps, used these streamflow forecasts in their day-to-day reservoir project operation and energy production. Close and constant coordination was required between these agencies and the NWRFC because project operations were dependent upon forecasts and the forecasts must take into consideration the project operation. The results of water resource uses of these forecasts are described in the following two chapters of this report.

FIGURE 6

SEASONAL PRECIPITATION  
COLUMBIA RIVER BASIN  
OCTOBER 2000 - SEPTEMBER 2001  
PERCENT OF 1961 - 1990 AVERAGE

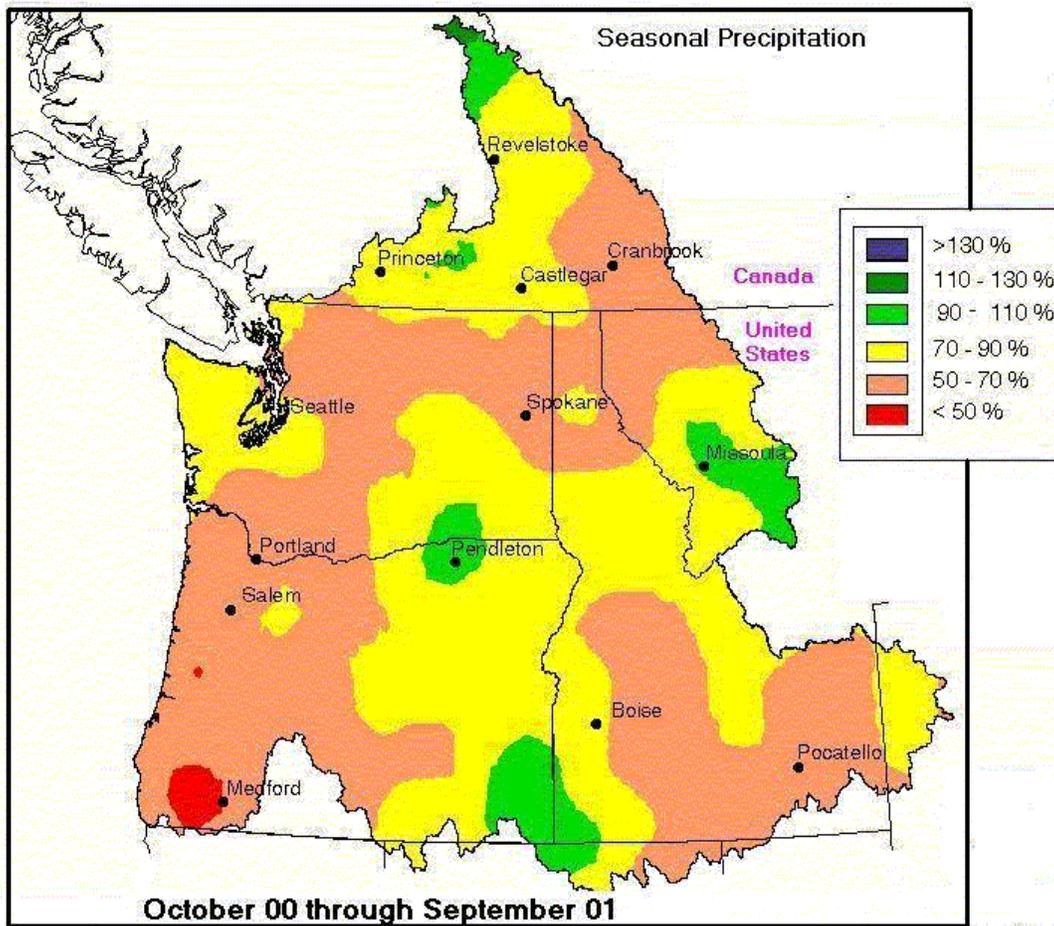


Figure 7  
Columbia Basin Snowpack

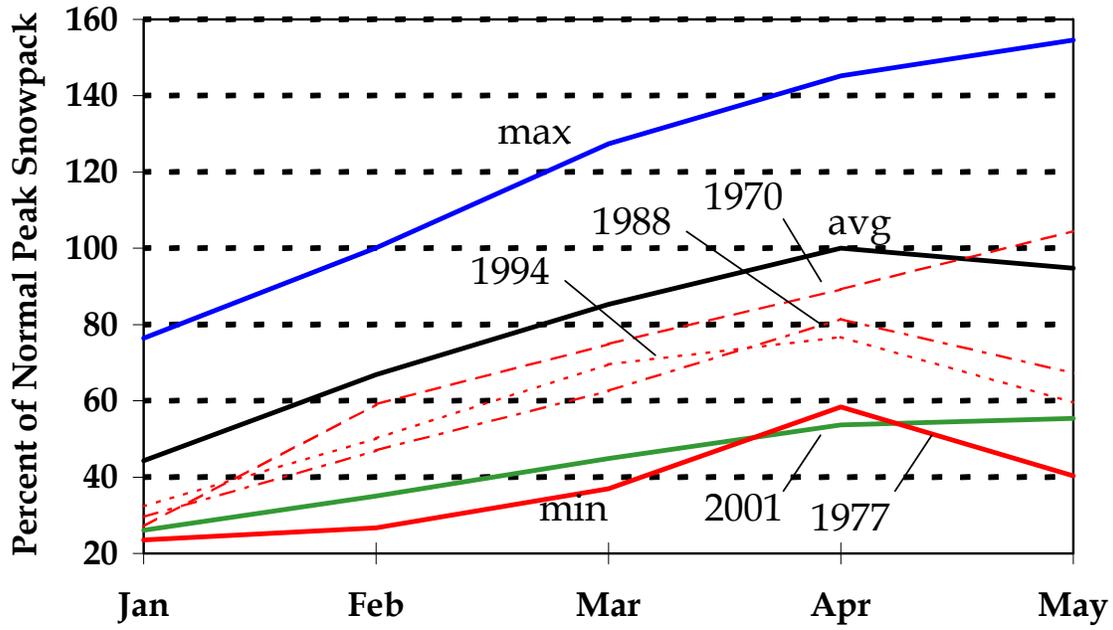


Figure 8

Accumulated Precipitation for Water Year 2001  
at Primary Columbia River Basins

**CUMULATIVE PRECIPITATION  
WATER YEAR 200**

**COLUMBIA BASIN ABOVE GRAND COULEE**

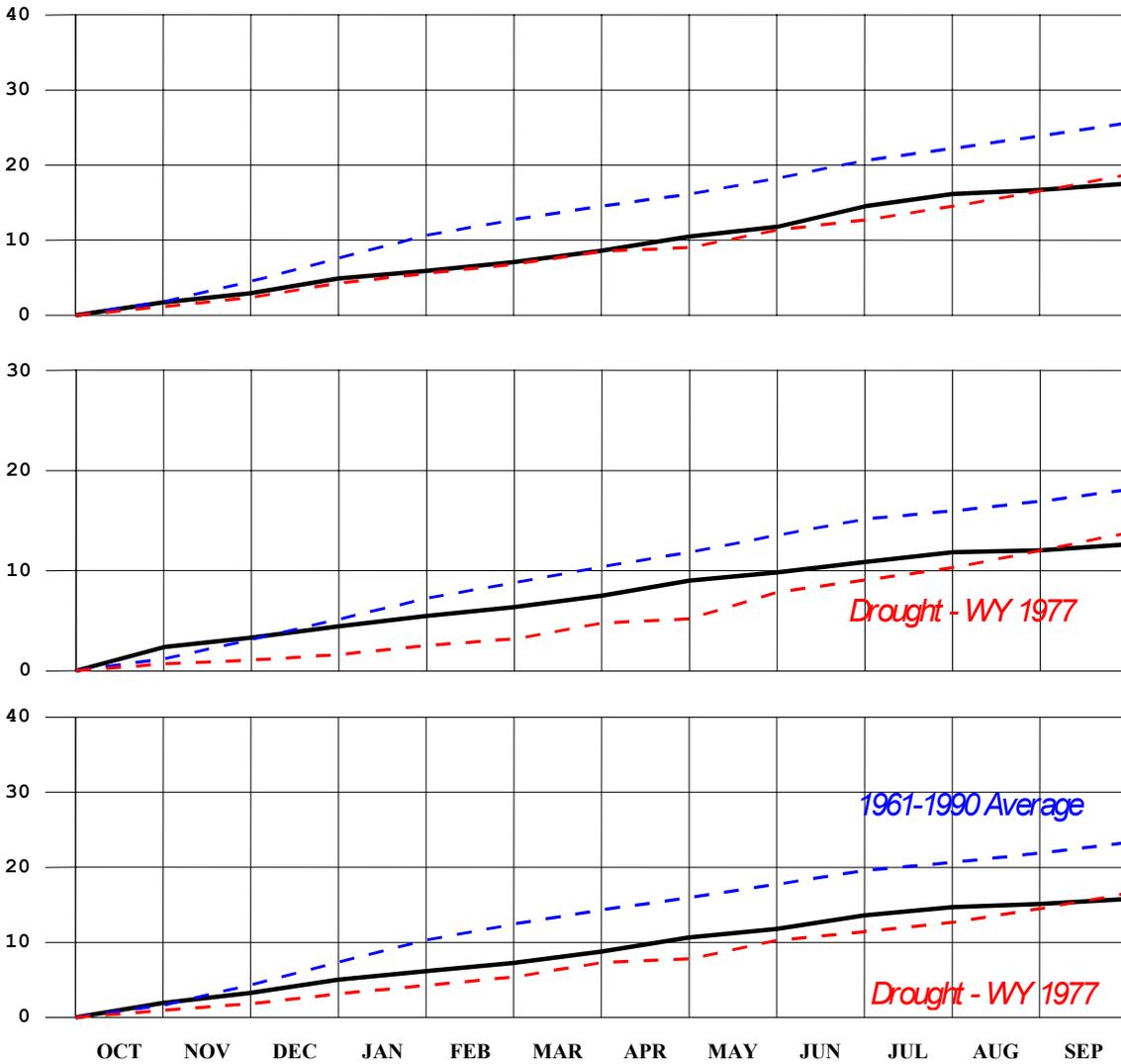


Figure 9

PACIFIC NORTHWEST MONTHLY  
TEMPERATURE DEPARTURES FROM NORMAL

DECEMBER 2000

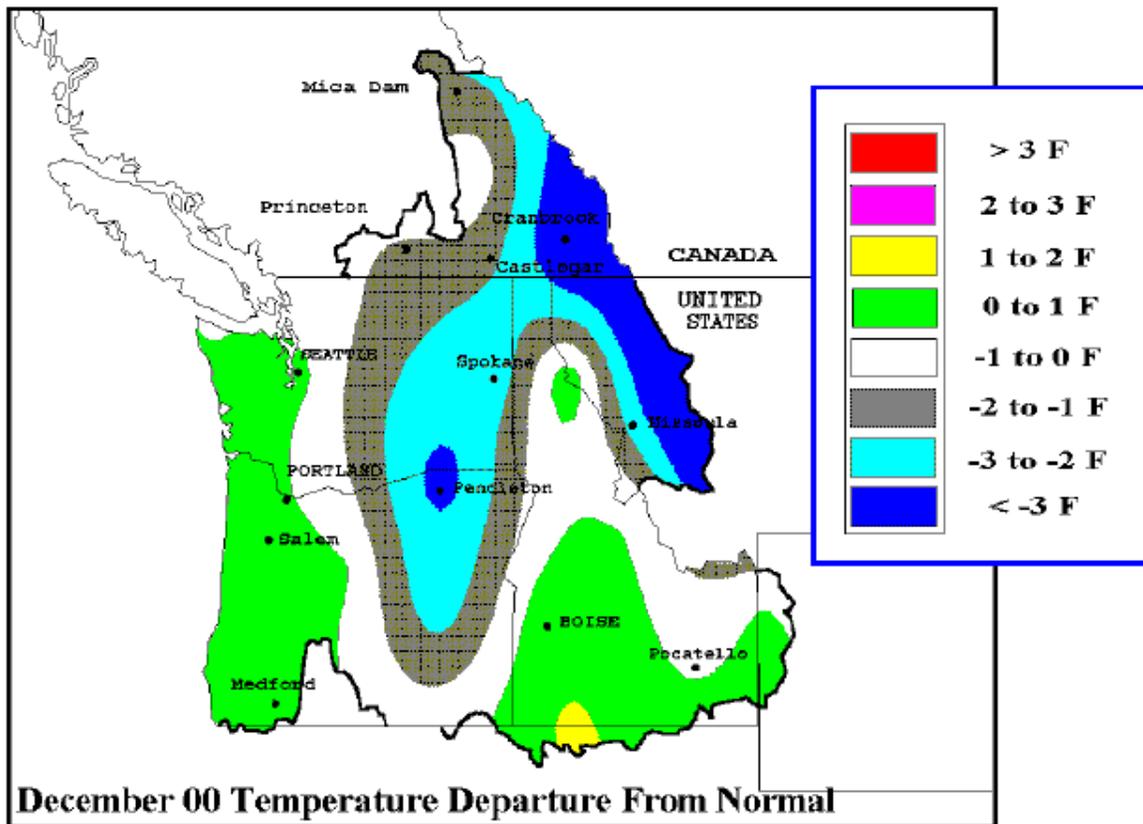


Table 1

**MONTHLY PRECIPITATION TOTALS BY SUB-BASIN – WY 2001  
(With Percentages of Normal)**

SUB-BASINS	UNITS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Columbia above Grand Coulee	in.	1.71	1.19	1.95	1.08	1.14	1.50	1.92	1.26	2.75	1.64	.54	.83
	%	96	43	63	36	55	84	120	59	117	102	32	48
Snake River above Ice Harbor	in.	2.36	.93	1.13	1.06	.85	1.15	1.52	.81	1.04	.95	.19	.62
	%	198	48	55	51	55	71	106	48	117	118	20	54
Columbia River above The Dalles	in.	1.93	1.32	1.73	1.19	1.07	1.55	1.87	1.13	1.80	1.12	.40	.68
	%	118	49	57	40	51	82	117	62	99	103	32	49
Columbia River above Castlegar	in.	2.01	1.77	3.25	1.94	1.41	2.52	2.12	2.37	3.00	2.99	1.53	1.53
	%	74	49	75	46	48	108	110	109	109	122	64	64
Kootenai	in.	1.22	1.29	2.08	.80	.65	1.30	2.24	1.21	2.59	1.23	.47	.88
	%	70	45	64	26	32	76	138	59	109	73	29	50
Clark Fork	in.	1.87	.78	1.06	.60	1.14	.99	1.21	.68	2.42	1.52	.11	.52
	%	170	48	58	29	86	77	98	35	124	146	8	40
Flathead	in.	1.40	.92	1.65	.90	1.69	1.39	2.24	.80	3.24	.85	.21	.59
	%	87	40	66	36	92	83	143	33	123	59	13	33
Pend Oreille-Spokane	in.	2.14	1.42	1.98	1.28	1.35	1.73	2.55	1.84	2.51	.96	.16	.43
	%	103	36	49	32	46	64	119	82	123	94	12	28
Northeast Washington	in.	1.17	1.16	1.22	.70	.63	1.76	1.06	.89	1.78	.76	.34	.45
	%	101	51	49	37	42	116	78	48	105	71	28	49
Okanogan	in.	.97	.85	1.28	.62	.52	1.24	.91	.77	1.65	1.17	.71	.52
	%	109	54	61	35	42	119	92	59	120	116	62	52
East Slope Washington Cascades	in.	1.69	2.71	3.26	2.34	2.14	2.85	2.23	1.53	1.41	.37	.69	.25
	%	63	46	46	33	46	84	106	105	115	57	72	17
Central Washington	in.	.58	1.02	.69	.52	.42	1.00	.71	.29	.83	.05	.22	.12
	%	105	82	50	51	53	132	113	41	148	17	53	27
Upper Snake	in.	2.21	1.14	1.90	1.01	1.32	.98	1.38	.87	1.16	1.13	.50	.86
	%	150	56	91	44	76	60	86	40	58	89	36	53
Snake River Plain	in.	1.53	.40	.52	.61	.44	.66	.86	.35	.30	.47	.11	.45
	%	188	34	49	57	51	64	84	27	27	80	15	53
Owyhee-Malheur	in.	2.18	.59	.69	1.05	.46	1.18	1.26	.50	.45	.81	.05	.35
	%	283	43	52	86	50	110	138	42	40	172	7	55
Salmon-Boise-Payette	in.	2.75	1.02	1.49	.87	.70	1.20	1.49	.83	.83	.94	.07	.89
	%	209	41	56	32	36	63	98	53	54	136	8	78
Burnt-Grande Ronde	in.	1.96	.94	.95	1.21	.56	.98	1.88	1.11	1.07	.89	.17	.33
	%	178	49	47	62	41	70	153	74	76	135	19	36
Clearwater	in.	4.34	1.92	2.35	1.63	1.79	2.06	2.67	2.18	2.83	1.21	.06	.55
	%	200	59	65	42	62	70	102	78	115	108	4	29
Southeast Washington	in.	1.51	1.44	1.32	1.29	.94	1.33	1.95	1.25	1.35	.48	.09	.37
	%	117	61	55	56	52	72	131	80	112	76	10	38
Upper John Day	in.	1.73	.78	1.04	.87	.36	1.24	1.65	.73	1.12	1.08	.21	.64
	%	165	41	55	52	30	93	141	51	88	174	24	79
Umatilla - Lower John Day	in.	2.04	1.40	1.08	1.11	.64	1.54	2.11	.66	1.18	.49	.18	.45
	%	179	65	52	57	43	100	150	50	110	106	24	56
Upper Deschutes – Crooked River	in.	1.30	.64	1.21	.50	1.06	1.04	1.24	.47	.71	.91	.22	.59
	%	134	29	53	24	74	78	144	50	77	178	32	92
Hood River – Lower Deschutes River	in.	2.91	1.89	2.46	1.29	1.36	2.24	1.99	.90	1.87	.54	.32	.53
	%	150	43	51	28	42	81	101	62	170	132	42	43
NW Slope Washington Cascades	in.	5.75	5.67	6.02	6.21	3.85	7.62	5.76	4.96	4.37	1.37	2.68	1.32
	%	78	46	46	46	39	89	93	110	128	70	111	30
SW Slope Washington Cascades	in.	4.62	4.31	4.10	3.62	3.28	5.98	5.09	3.49	4.19	1.00	2.09	1.12
	%	85	42	37	33	40	85	102	100	147	79	112	35
Willamette	in.	4.54	4.21	5.60	2.53	2.34	4.55	3.92	2.74	2.78	.63	.70	.76
	%	108	46	58	28	34	71	91	88	136	85	59	33
Rogue - Umpqua	in.	2.92	2.71	2.70	1.57	1.34	2.26	1.91	1.00	1.11	.38	.10	.75
	%	109	44	45	29	33	56	79	59	125	104	13	61
Klamath	in.	1.36	.68	1.14	.57	.91	1.17	1.04	.64	1.16	.73	.03	.57
	%	100	25	37	22	49	61	103	65	135	184	5	82
Lake County – Good Lake	in.	2.33	.67	.60	.39	.60	.69	.84	.17	.24	.84	.14	.94
	%	243	42	37	27	58	59	85	14	20	194	23	151
Harney Basin	in.	1.84	.68	.46	.64	.31	.75	.71	.62	.68	.70	.21	.74
	%	212	44	29	51	32	64	84	55	71	155	29	111

Table 2

**ACCUMULATED MONTHLY PRECIPITATION TOTALS BY SUB-BASIN – WY 2001  
(With Percentages of Normal)**

<u>SUB-BASINS</u>	<u>UNITS</u>	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>	<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>	<u>JUN</u>	<u>JUL</u>	<u>AUG</u>	<u>SEP</u>
Columbia above Grand Coulee	in.	1.71	2.90	4.90	5.93	7.07	8.58	10.50	11.76	14.51	16.14	16.69	17.52
	%	96	64	64	56	56	59	65	64	70	73	70	68
Snake River above Ice Harbor	in.	2.36	3.30	4.42	5.48	6.34	7.48	9.00	9.82	10.86	11.82	12.01	12.63
	%	198	105	86	76	72	72	76	72	72	74	71	70
Columbia River above The Dalles	in.	1.93	3.26	5.02	6.17	7.24	8.79	10.66	11.80	13.60	14.71	15.11	15.79
	%	118	74	68	60	58	61	67	66	70	71	69	68
Columbia River above Castlegar	in.	2.01	3.78	7.16	8.97	10.39	12.91	15.03	17.40	20.40	23.39	24.92	26.45
	%	74	59	67	60	58	64	68	72	75	79	78	77
Kootenai	in.	1.22	2.51	4.60	5.39	6.05	7.34	9.58	10.80	13.39	14.62	15.09	15.97
	%	70	54	58	49	47	50	59	59	65	65	63	62
Clark Fork	in.	1.87	2.65	3.71	4.31	5.45	6.45	7.66	8.34	10.76	12.29	12.39	12.91
	%	170	98	82	65	69	70	73	67	75	80	74	72
Flathead	in.	1.40	2.32	3.97	4.87	6.56	7.95	10.19	10.99	14.24	15.08	15.29	15.88
	%	87	59	62	54	61	64	73	67	75	74	69	67
Pend Oreille-Spokane	in.	2.14	3.56	5.54	6.82	8.17	9.90	12.45	14.29	16.79	17.75	17.91	18.34
	%	103	59	55	49	48	50	57	59	64	65	63	61
Northeast Washington	in.	1.17	2.33	3.54	4.24	4.87	6.63	7.68	8.57	10.35	11.12	11.46	11.91
	%	101	68	60	55	52	61	63	61	66	66	64	63
Okanogan	in.	.97	1.82	3.10	3.72	4.24	5.48	6.39	7.16	8.81	9.98	10.70	11.22
	%	109	74	68	59	56	64	67	66	72	75	74	73
East Slope Washington Cascades	in.	1.69	4.40	7.73	10.00	12.14	14.99	17.22	18.75	20.16	20.53	21.23	21.48
	%	63	51	49	44	44	49	52	55	57	57	57	56
Central Washington	in.	.58	1.59	2.28	2.80	3.22	4.22	4.94	5.22	6.05	6.10	6.33	6.45
	%	105	89	72	67	65	73	77	74	79	77	76	73
Upper Snake	in.	2.21	3.35	5.26	6.26	7.59	8.57	9.95	10.82	11.98	13.11	13.61	14.47
	%	150	96	94	79	79	76	77	72	70	72	69	68
Snake River Plain	in.	1.53	1.93	2.45	3.07	3.51	4.16	5.02	5.37	5.67	6.14	6.25	6.70
	%	188	96	80	74	70	69	71	64	60	61	58	58
Owyhee-Malheur	in.	2.18	2.77	3.46	4.51	4.97	6.16	7.42	7.92	8.36	9.17	9.22	9.57
	%	283	130	100	96	89	92	98	90	85	89	84	82
Salmon-Boise-Payette	in.	2.75	3.78	5.26	6.13	6.83	8.03	9.52	10.35	11.18	12.12	12.19	13.08
	%	209	98	81	67	61	61	65	64	63	66	63	64
Burnt-Grande Ronde	in.	1.96	2.90	3.85	5.06	5.62	6.60	8.48	9.59	10.66	11.55	11.72	12.05
	%	178	96	76	72	67	68	77	77	77	79	76	74
Clearwater	in.	4.34	6.27	8.62	10.25	12.04	14.11	16.78	18.96	21.78	22.99	23.05	23.60
	%	200	115	95	79	76	75	78	78	82	83	79	76
Southeast Washington	in.	1.51	2.96	4.28	5.57	6.51	7.84	9.79	11.04	12.39	12.87	12.96	13.33
	%	117	81	71	67	64	65	73	73	76	76	73	71
Upper John Day	in.	1.73	2.51	3.55	4.43	4.79	6.03	7.67	8.40	9.53	10.61	10.81	11.45
	%	165	85	74	68	62	67	75	72	74	78	75	75
Umatilla - Lower John Day	in.	2.04	3.44	4.52	5.62	6.26	7.80	9.91	10.57	11.76	12.24	12.42	12.87
	%	179	104	84	77	71	75	84	81	83	84	81	80
Upper Deschutes – Crooked River	in.	1.30	1.94	3.15	3.64	4.70	5.75	6.99	7.45	8.17	9.08	9.30	9.88
	%	134	61	58	48	52	56	62	61	63	67	65	66
Hood River – Lower Deschutes River	in.	2.91	4.81	7.27	8.56	9.92	12.16	14.15	15.05	16.92	17.46	17.78	18.31
	%	150	76	65	54	52	56	60	60	64	65	65	64
NW Slope Washington Cascades	in.	5.75	11.42	17.44	23.65	27.50	35.12	40.88	45.84	50.21	51.58	54.27	55.59
	%	78	58	53	51	49	54	58	61	64	64	65	64
SW Slope Washington Cascades	in.	4.62	8.93	13.03	16.65	19.93	25.90	31.00	34.49	38.68	39.68	41.77	42.89
	%	85	57	49	44	43	49	54	56	60	61	62	61
Willamette	in.	4.54	8.75	14.41	16.88	19.22	23.77	27.69	30.43	33.21	33.84	34.54	35.30
	%	108	65	63	53	50	53	56	58	61	61	61	60
Rogue - Umpqua	in.	2.92	5.64	8.34	9.91	11.25	13.51	15.43	16.42	17.54	17.91	18.01	18.76
	%	109	64	56	49	46	48	50	51	53	53	52	52
Klamath	in.	1.36	2.04	3.18	3.75	4.66	5.83	6.87	7.51	8.68	9.41	9.44	10.02
	%	100	49	44	38	40	43	47	48	53	56	54	55
Lake County – Good Lake	in.	2.33	3.00	3.60	3.99	4.59	5.28	6.11	6.28	6.52	7.35	7.50	8.43
	%	243	118	86	71	69	67	69	63	58	63	61	66
Harney Basin	in.	1.84	2.52	2.98	3.63	3.94	4.69	5.40	6.02	6.70	7.40	7.61	8.35
	%	212	105	75	69	64	64	66	65	65	69	66	69

**Table 3**

**BASIN AVERAGE  
MONTHLY TEMPERATURES  
Departure from Normal**

**for WY 2001**

<b>Month</b>	<b>Northwest Average</b>	<b>Warmest Station</b>	<b>Coollest Station</b>
<b>October</b>	<b>-0.1</b>	<b>8.7</b>	<b>-2.8</b>
<b>November</b>	<b>-4.3</b>	<b>1.0</b>	<b>-9.6</b>
<b>December</b>	<b>-1.3</b>	<b>1.1</b>	<b>-5.2</b>
<b>January</b>	<b>+1.9</b>	<b>9.2</b>	<b>-6.0</b>
<b>February</b>	<b>-3.4</b>	<b>2.3</b>	<b>-10.0</b>
<b>March</b>	<b>+1.8</b>	<b>4.3</b>	<b>-0.4</b>
<b>April</b>	<b>-1.1</b>	<b>2.3</b>	<b>-3.2</b>
<b>May</b>	<b>+2.0</b>	<b>6.4</b>	<b>-1.3</b>
<b>June</b>	<b>-2.2</b>	<b>0.7</b>	<b>-4.1</b>
<b>July</b>	<b>-0.6</b>	<b>0.9</b>	<b>-3.1</b>
<b>August</b>	<b>+2.5</b>	<b>6.2</b>	<b>-1.3</b>
<b>September</b>	<b>+3.3</b>	<b>6.3</b>	<b>-1.5</b>
<b>Annual</b>	<b>-0.13</b>	<b>4.12</b>	<b>-4.04</b>

Table 5

**MONTHLY MEAN STREAMFLOWS  
In Percent of Monthly Normal (1971-2000)  
WY 2001**

RIVER	STATION	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
JOHN DAY	Service Creek	105	<b>59</b>	<b>31</b>	<b>23</b>	<b>20</b>	<b>39</b>	<b>55</b>	<b>48</b>	<b>26</b>	<b>27</b>	<b>34</b>	<b>34</b>	<b>40</b>
COLUMBIA	The Dalles	92	95	89	<b>73</b>	<b>66</b>	<b>58</b>	<b>53</b>	<b>48</b>	<b>45</b>	<b>46</b>	<b>70</b>	<b>72</b>	<b>63</b>
WILLAMETTE	Salem	89	<b>44</b>	<b>34</b>	<b>24</b>	<b>29</b>	<b>37</b>	<b>71</b>	<b>83</b>	<b>67</b>	<b>74</b>	<b>77</b>	<b>61</b>	<b>47</b>
SPOKANE	Spokane	<b>124</b>	85	<b>41</b>	<b>27</b>	<b>22</b>	<b>25</b>	<b>37</b>	<b>70</b>	<b>38</b>	<b>48</b>	<b>51</b>	<b>55</b>	<b>46</b>
SNAKE	Heise	109	<b>57</b>	<b>53</b>	<b>49</b>	<b>46</b>	<b>29</b>	<b>28</b>	<b>80</b>	<b>70</b>	<b>76</b>	<b>74</b>	<b>86</b>	<b>67</b>
SNAKE	Weiser	86	<b>75</b>	<b>65</b>	<b>55</b>	<b>50</b>	<b>46</b>	<b>36</b>	<b>36</b>	<b>31</b>	<b>60</b>	<b>69</b>	<b>69</b>	<b>52</b>
SALMON	White Bird	100	82	<b>76</b>	<b>73</b>	<b>71</b>	<b>72</b>	<b>57</b>	<b>65</b>	<b>30</b>	<b>33</b>	<b>51</b>	<b>60</b>	<b>53</b>
CLEARWATER	Spalding	<b>139</b>	<b>58</b>	<b>39</b>	<b>47</b>	<b>44</b>	<b>53</b>	<b>58</b>	<b>73</b>	<b>46</b>	<b>94</b>	<b>156</b>	<b>37</b>	<b>64</b>
CLARK FORK	St Regis	103	<b>76</b>	<b>64</b>	<b>64</b>	<b>54</b>	<b>59</b>	<b>47</b>	<b>66</b>	<b>47</b>	<b>48</b>	<b>70</b>	<b>56</b>	<b>58</b>
MF FLATHEAD	W Glacier	<b>77</b>	<b>33</b>	<b>35</b>	<b>37</b>	<b>32</b>	<b>30</b>	<b>31</b>	<b>80</b>	<b>56</b>	<b>43</b>	<b>51</b>	<b>47</b>	<b>56</b>

**Bold** numbers are outside the “normal” range of 80% to 120%. Shaded stations are at or above The Dalles.

Table 6

## MEAN DISCHARGES AND PERCENTAGES OF NORMAL FOR WY 2001

RIVER STATION	ANNUAL		JANUARY-JULY (McNary Project)		APRIL-JULY (Lwr Granite @Snake River)		APRIL-AUGUST (Libby Project)	
	Q <sup>1</sup>	%	Q <sup>1</sup>	%	Q <sup>1</sup>	%	Q <sup>1</sup>	%
<b>Columbia River below Mica*</b>	16.14	79	17.63	88	27.86	76	29.10	78
<b>Columbia River below Arrow*</b>	32.25	76	37.66	77	59.33	76	55.13	77
<b>Kootenay River at Fort Steele</b>	3.65	59	4.67	63	7.40	57	6.69	57
<b>Kootenai River below Libby*</b>	6.15	54	7.92	61	11.87	50	10.51	50
<b>Duncan River below Duncan*</b>	2.81	78	3.20	76	5.17	79	5.15	79
<b>Kootenay River at Queens Bay*</b>	15.99	57	20.72	54	32.21	53	28.71	55
<b>Columbia River at Birchbank*</b>	47.29	65	55.90	63	87.06	60	84.04	63
<b>Clark Fork above Missoula</b>	1.83	58	2.35	59	3.26	53	2.84	56
<b>Clark Fork at St Regis</b>	4.24	56	5.47	54	7.81	51	6.75	54
<b>MF Flathead R near W Glacier</b>	1.61	55	2.36	45	3.89	52	3.27	52
<b>NF Flathead R nr Columbia Falls*</b>	1.58	53	2.21	56	3.44	46	2.93	47
<b>Flathead R below Kerr nr Polson*</b>	6.14	53	9.16	50	14.45	50	11.97	48
<b>Clark Fork near Plains*</b>	10.72	53	8.71	51	22.59	50	19.03	50
<b>Pend Oreille River at Newport</b>	12.75	49	18.35	45	27.66	48	23.22	77
<b>Spokane R at Spokane*</b>	2.99	45	4.29	41	5.70	50	4.71	51
<b>Columbia R below Grand Coulee*</b>	69.43	61	88.61	56	135.59	59	123.94	61
<b>Okanogan River near Tonasket</b>	1.33	47	1.71	45	2.52	41	2.14	41
<b>Wenatchee River at Peshastin</b>	1.56	51	2.16	46	3.28	53	2.78	51
<b>Columbia R below Priest Rapids*</b>	78.98	64	95.25	62	149.23	60	136.16	62
<b>Yakima River at Cle Elum*</b>	1.23	59	1.62	54	2.28	64	1.97	69
<b>Yakima River near Parker*</b>	2.18	47	2.81	41	3.77	47	3.23	51
<b>Snake River near Heise*</b>	4.17	57	5.01	65	6.79	51	6.01	50
<b>Boise River near Boise*</b>	1.19	42	1.58	42	1.99	33	1.71	38
<b>Payette River near Emmett*</b>	1.05	36	1.22	35	1.26	27	1.14	28
<b>Snake River at Hells Canyon*</b>	11.10	54	11.11	47	10.28	43	9.82	48
<b>Salmon River at White Bird</b>	6.14	53	7.87	58	10.89	46	9.34	47
<b>Grande Ronde River at Troy</b>	1.61	55	2.21	48	2.84	53	2.38	55
<b>Clearwater River at Orofino*</b>	6.23	69	9.02	62	13.06	64	10.82	66
<b>NF Clearwater R below Dworshak*</b>	3.02	53	4.32	45	6.08	50	5.11	54
<b>Clearwater River at Spalding*</b>	9.58	62	13.82	54	19.50	59	16.22	62
<b>Snake River below Lower Granite*</b>	27.45	53	34.08	48	42.53	47	36.65	48
<b>Columbia River at The Dalles*</b>	109.45	58	137.91	54	195.01	56	174.84	58
<b>McKenzie River near Vida*</b>	2.53	62	2.95	65	3.04	76	2.76	77
<b>N Santiam River near Mehama*</b>	1.89	55	2.25	59	2.18	69	1.85	67
<b>S Santiam River at Waterloo*</b>	1.48	49	1.91	61	1.85	78	1.52	75
<b>Willamette River at Salem*</b>	10.41	44	13.17	56	12.51	73	10.77	78
<b>Rogue River near Raygold*</b>	1.38	45	1.51	44	1.44	50	1.31	50
<b>Cowlitz River at Castle Rock*</b>	5.19	55	6.57	61	7.40	75	6.41	75
<b>Skagit R near Concrete*</b>	9.25	61	10.89	59	14.21	64	13.08	59

<sup>1</sup>Average discharge in kcfs.\*Adjusted for upstream storage.  
From NWRFC Runoff Processor.

Table 7

**OBSERVED DISCHARGE AND RUNOFF  
COLUMBIA RIVER AT GRAND COULEE, WASHINGTON  
(Period of Record: 1929–2001)**

MONTH	MONTHLY MEAN OBSERVED STREAMFLOWS (cfs)						
	MAXIMUM		MINIMUM		WY 2001		1971-2000 AVERAGE
	Discharge	WY	Discharge	WY	Discharge	% of Avg	
Oct	106,700	1998	41,130	1930	<b>71,740</b>	<b>92</b>	78,200
Nov	107,700	1986	28,480	1937	<b>92,500</b>	<b>106</b>	87,260
Dec	141,800	2000	23,200	1937	<b>104,600</b>	<b>102</b>	102,200
Jan	154,900	1996	18,220	1937	<b>96,090</b>	<b>85</b>	112,400
Feb	168,600	1996	18,200	1937	<b>88,050</b>	<b>77</b>	114,000
Mar	185,300	1982	23,840	1937	<b>72,800</b>	<b>66</b>	110,900
Apr	180,800	1969	32,020	1944	<b>60,460</b>	<b>56</b>	108,900
May	315,200	1934	<b>47,900</b>	<b>2001</b>	<b>47,900</b>	<b>36</b>	133,900
Jun	528,700	1948	70,600	1977	<b>78,400</b>	<b>56</b>	140,800
Jul	355,600	1950	<b>50,590</b>	<b>2001</b>	<b>50,590</b>	<b>42</b>	121,200
Aug	183,600	1976	60,490	1989	<b>68,700</b>	<b>66</b>	104,700
Sep	121,700	1976	55,880	1994	<b>62,280</b>	<b>79</b>	79,290
Annual	144,900	1997	70,200	1944	<b>74,410</b>	<b>69</b>	107,800
MONTH	OBSERVED RUNOFF ACCUMULATION (kaf)						
	MAXIMUM		MINIMUM		WY 2001		1971-2000 AVERAGE
	Runoff	WY	Runoff	WY	Runoff	% of Avg	
Oct-Mar	47,990	1996	9,300	1937	<b>31,620</b>	<b>87</b>	36,410
Jan-Jul	75,540	1948	<b>25,590</b>	<b>2001</b>	<b>29,590</b>	<b>58</b>	50,670
Apr-Jul	65,910	1948	<b>14,320</b>	<b>2001</b>	<b>14,320</b>	<b>47</b>	30,550
Apr-Aug	73,980	1948	<b>18,540</b>	<b>2001</b>	<b>18,540</b>	<b>50</b>	36,980
Apr-Sep	78,700	1948	<b>22,250</b>	<b>2001</b>	<b>22,250</b>	<b>53</b>	41,700
Annual	104,900	1997	50,960	1944	<b>53,870</b>	<b>69</b>	78,110

Table 8

**OBSERVED DISCHARGE AND RUNOFF  
SNAKE RIVER NEAR ANATONE, WASHINGTON  
(Period of Record: 1959-2001)**

MONTH	MONTHLY MEAN OBSERVED STREAMFLOWS (cfs)							1971-2000 AVERAGE
	MAXIMUM		MINIMUM		WY 2001			
	Discharge	WY	Discharge	WY	Discharge	% of Avg		
Oct	31,540	1985	13,760	1989	<b>17,550</b>	<b>81</b>	21,550	
Nov	36,960	1985	13,620	1993	<b>15,080</b>	<b>67</b>	22,530	
Dec	41,630	1965	13,570	1993	<b>15,590</b>	<b>61</b>	25,650	
Jan	71,930	1997	<b>16,140</b>	<b>2001</b>	<b>16,140</b>	<b>53</b>	30,550	
Feb	72,520	1965	<b>15,780</b>	<b>2001</b>	<b>15,780</b>	<b>46</b>	34,500	
Mar	90,400	1972	18,680	1977	<b>20,360</b>	<b>46</b>	44,640	
Apr	88,700	1974	18,880	1977	<b>23,730</b>	<b>44</b>	53,610	
May	118,700	1984	20,610	1977	<b>39,370</b>	<b>55</b>	71,120	
Jun	134,200	1984	16,850	1992	<b>22,410</b>	<b>30</b>	73,630	
Jul	63,860	1982	12,830	1977	<b>15,010</b>	<b>46</b>	32,830	
Aug	29,140	1997	9,765	1992	<b>13,400</b>	<b>73</b>	18,350	
Sep	31,730	1997	10,180	1992	<b>12,660</b>	<b>64</b>	19,630	
Annual	59,030	1997	18,050	1992	<b>18,950</b>	<b>51</b>	37,350	

MONTH	OBSERVED RUNOFF ACCUMULATION (kaf)						1971-2000 AVERAGE
	MAXIMUM		MINIMUM		WY 2001		
	Runoff	WY	Runoff	WY	Runoff	% of Avg	
Oct-Mar	17,570	1997	<b>6,060</b>	<b>2001</b>	<b>6,060</b>	<b>56</b>	10,800
Jan-Jul	34,700	1997	8,100	1977	<b>9,210</b>	<b>45</b>	20,520
Apr-Jul	23,810	1984	4,630	1977	<b>6,090</b>	<b>44</b>	13,960
Apr-Aug	25,420	1984	5,260	1977	<b>6,910</b>	<b>46</b>	15,090
Apr-Sep	27,030	1984	5,930	1977	<b>7,670</b>	<b>47</b>	16,260
Annual	42,740	1997	13,100	1992	<b>13,720</b>	<b>51</b>	27,060

Table 9

**OBSERVED DISCHARGE AND RUNOFF  
COLUMBIA RIVER AT THE DALLES, OREGON  
(Period of Record: 1879-2001)**

MONTH	MONTHLY MEAN OBSERVED STREAMFLOWS (cfs)						
	MAXIMUM		MINIMUM		WY 2001		1971-2000 AVERAGE
	Discharge	WY	Discharge	WY	Discharge	% of Avg	
Oct	174,800	1960	69,430	1930	<b>110,000</b>	<b>92</b>	119,300
Nov	200,800	1928	57,830	1937	<b>127,500</b>	<b>95</b>	134,300
Dec	258,300	1996	52,380	1937	<b>143,400</b>	<b>89</b>	160,900
Jan	275,000	1997	42,340	1937	<b>129,900</b>	<b>73</b>	178,700
Feb	340,400	1996	51,420	1937	<b>125,900</b>	<b>66</b>	190,600
Mar	345,000	1983	69,820	1937	<b>119,400</b>	<b>58</b>	206,100
Apr	386,400	1881	98,350	1944	<b>115,700</b>	<b>53</b>	218,900
May	624,400	1897	136,100	1977	<b>138,000</b>	<b>48</b>	287,000
Jun	1,002,000	1894	123,700	1977	<b>131,600</b>	<b>45</b>	290,800
Jul	793,300	1880	<b>86,780</b>	<b>2001</b>	<b>86,780</b>	<b>46</b>	189,400
Aug	385,700	1880	91,970	1994	<b>99,450</b>	<b>70</b>	141,200
Sep	198,200	1880	75,760	1994	<b>83,650</b>	<b>72</b>	116,100
Annual	263,700	1997	<b>117,600</b>	<b>2001</b>	<b>117,600</b>	<b>63</b>	186,000
MONTH	OBSERVED RUNOFF ACCUMULATION (kaf)						
	MAXIMUM		MINIMUM		WY 2001		1971-2000 AVERAGE
	Runoff	WY	Runoff	WY	Runoff	% of Avg	
Oct-Mar	87,160	1996	20,730	1937	<b>45,480</b>	<b>76</b>	59,560
Jan-Jul	173,800	1894	50,760	1977	<b>50,860</b>	<b>54</b>	93,970
Apr-Jul	148,500	1894	27,360	1977	<b>28,540</b>	<b>48</b>	59,620
Apr-Aug	165,200	1894	33,120	1977	<b>34,660</b>	<b>51</b>	68,300
Apr-Sep	175,600	1894	39,010	1977	<b>39,630</b>	<b>53</b>	75,210
Annual	227,000	1894	<b>85,140</b>	<b>2001</b>	<b>85,140</b>	<b>63</b>	134,800

Table 10

**OBSERVED DISCHARGE AND RUNOFF  
WILLAMETTE RIVER AT SALEM, OREGON  
(Period of Record: 1910-1916; 1924-2001)**

MONTH	MONTHLY MEAN OBSERVED STREAMFLOWS (cfs)						
	MAXIMUM		MINIMUM		WY 2001		1971-2000 AVERAGE
	Discharge	WY	Discharge	WY	Discharge	% of Avg	
Oct	33,440	1948	3,214	1937	<b>12,080</b>	<b>89</b>	13,630
Nov	72,040	1951	3,140	1937	<b>13,230</b>	<b>44</b>	30,410
Dec	116,700	1965	6,780	1977	<b>16,810</b>	<b>34</b>	49,160
Jan	95,930	1965	6,377	1977	<b>11,200</b>	<b>24</b>	46,770
Feb	91,350	1961	5,313	1977	<b>10,380</b>	<b>29</b>	35,710
Mar	73,670	1972	11,110	1941	<b>11,180</b>	<b>37</b>	30,120
Apr	63,410	1937	10,260	1977	<b>16,780</b>	<b>71</b>	23,730
May	38,610	1963	7,701	1973	<b>16,090</b>	<b>83</b>	19,300
Jun	37,360	1933	5,065	1940	<b>9,196</b>	<b>67</b>	13,800
Jul	19,870	1916	3,286	1940	<b>5,588</b>	<b>74</b>	7,592
Aug	9,540	1971	2,653	1940	<b>5,591</b>	<b>77</b>	7,292
Sep	13,340	1978	2,682	1931	<b>6,106</b>	<b>61</b>	10,070
Annual	37,960	1974	9,792	1977	<b>11,190</b>	<b>47</b>	23,930
MONTH	OBSERVED RUNOFF ACCUMULATION (kaf)						
	MAXIMUM		MINIMUM		WY 2001		1971-2000 AVERAGE
	Runoff	WY	Runoff	WY	Runoff	% of Avg	
Oct-Mar	21,250	1956	3,593	1977	<b>4,520</b>	<b>36</b>	12,400
Jan-Jul	18,100	1916	4,207	1977	<b>4,830</b>	<b>45</b>	10,620
Apr-Jul	8,101	1937	1,768	1926	<b>2,880</b>	<b>74</b>	3,890
Apr-Aug	8,395	1937	1,987	1926	<b>3,220</b>	<b>74</b>	4,340
Apr-Sep	8,641	1937	2,252	1926	<b>3,590</b>	<b>73</b>	4,930
Annual	27,480	1974	7,090	1977	<b>8,100</b>	<b>47</b>	17,330

Table 11

WINTER FLOOD PEAKS – WATER YEAR 2001

RIVER	GAGE	DAMAGE STAGE		ESTIMATED OBSERVED *			MAXIMUM OF RECORD		
		ZERO	MAJOR	DATE	STAGE	Q	DATE	STAGE	Q
<b>Johnson</b>	Milwaukie	27.4		28MAR01	26.04	0.28	08FEB96	30.27	2.17
<b>Tualatin</b>	Dilley	17.5		23DEC00	14.05	0.50	22DEC64	19.34	17.1
<b>Snake</b>	Weiser	12.0	12.4	13OCT00		16.0	24APR52	14.67	84.5
<b>Weiser</b>	Weiser	9.5		10MAR01	7.63	4.24	02JAN97	17.2	34.5

**Bold new record**

\*From WY-2001 USGS WSP

Zero Damage = Flood Stage

All stages in feet and discharges in kcfs

Table 12

SPRING FLOOD PEAKS – WATER YEAR 2001

RIVER	GAGE	DAMAGE STAGE		ESTIMATED OBSERVED*			MAXIMUM OF RECORD		
		ZERO	MAJOR	DATE	STAGE	Q	DATE	STAGE	Q
<b>John Day</b>	Service Creek	7.8		28APR01	7.34	6.54	23DEC64	17.85	40.2
<b>Snake</b>	Anatone	20.0		17MAY01	11.23	65.5	18JUN74	24.45	195.0
<b>Imnaha</b>	Imnaha	4.2		15MAY01	3.7	1.3	17JAN74	7.86	10.1
<b>Henrys Fork</b>	Rexburg	9.5		17MAY01	6.59	3.47	17MAY84	12.05	16.4

**Bold new record**

\*From WY-2001 USGS WSP

Zero Damage = Flood Stage

All stages in feet and discharges in kcfs

Table 13

**FORECAST AND OBSERVED RUNOFF VOLUME (kaf)  
for WY 2001**

STREAM	STATION	FORECAST PERIOD	30-YEAR NORMAL	NWS FORECAST		OBSV'D RUNOFF	FORECAST ERROR (%)	
				JAN 1	APR 1		JAN 1	APR 1
COLUMBIA	Mica Inflow	Feb-Sep	13,170	11,200	10,200	10,213	+7	0
	Duncan Inflow	Feb-Sep	2,319	2,000	1,810	1,788	+9	+1
KOOTENAI	Libby Inflow	Jan-Jul	6,396	4,830	3,470	3,341	+23	+2
		Apr-Sep	6,772	5,110	3,580	3,369	+26	+2
COLUMBIA	Birchbank	Apr-Sep	43,800	36,300	29,300	27,654	+20	+4
SF FLATHEAD	Hungry Horse Inflow	Jan-Jul	2,269	1,610	1,280	1,300	+13	-1
		Apr-Sep	2,184	1,550	1,300	1,290	+12	0
FLATHEAD	Flathead Inflow - Kerr	Apr-Sep	6,926	4,810	3,770	3,669	+16	+1
PEND OREILLE	Pend Oreille Iflw - Newport	Apr-Sep	14,370	10,100	6,980	7,188	+20	-1
SPOKANE	Spokane	Apr-Sep	2,864	2,300	1,570	1,445	+30	+4
COLUMBIA	Grand Coulee Inflow	Jan-Jul	63,230	48,800	37,500	37,388	+18	0
		Apr-Aug	60,940	47,100	36,800	37,422	+16	-1
COLUMBIA	Rock Island Dam	Apr-Sep	70,410	54,800	42,300	43,814	+16	-2
YAKIMA	Parker	Apr-Sep	1,994	1,560	1,100	1,020	+27	+4
SNAKE	Jackson Lk Infl	Apr-Jul	781	680	485	439	+31	+6
	Heise	Apr-Jul	3,451	3,010	2,030	1,643	+40	+11
BOISE	Boise	Apr-Jul	1,421	1,140	535	481	+46	+4
PAYETTE	Emmett	Apr-Jul	1,186	740	240	304	+37	-5
SNAKE	Weiser	Apr-Jul	5,465	3,230	1,730	2,192	+19	-8
SALMON	White Bird	Apr-Jul	5,956	5,180	3,100	2,637	+43	+8
GRANDE RONDE	Troy	Apr-Jul	1,214	1,110	655	687	+35	-3
NORTH FORK CLEARWATER	Dworshak	Jan-Jul	3,548	3,020	1,750	1,822	+34	-2
		Apr-Jul	2,700	2,300	1,400	1,472	+31	-3
CLEARWATER	Spalding	Apr-Jul	7,618	6,750	3,880	4,721	+27	-11
SNAKE	Lower Granite	Jan-Jul	29,740	23,600	14,100	14,381	+31	-1
		Apr-Aug	23,000	18,300	10,700	11,064	+31	-2
JOHN DAY	Service Creek	Apr-Sep	821	700	515	388	+38	+18
DESCHUTES	Moody	Apr-Sep	1,902	1,710	1,400	1,662	+3	+14
COLUMBIA	The Dalles	Jan-Jul	105,900	80,400	56,100	58,187	+21	-2
		Apr-Aug	93,250	70,800	49,600	52,790	+19	-3

Table 14

**UNREGULATED RUNOFF VOLUME FORECASTS  
(Thousand Acre-Feet)**

**for WY 2001**

FORECAST DATE	MICA	ARROW	LIBBY		DUNCAN	GRAND COULEE
	Feb-Sep <sup>1</sup>	Feb-Sep <sup>1</sup>	Jan-Jul <sup>1</sup>	Jan-Jul <sup>2</sup>	Feb-Sep <sup>1</sup>	Jan-Jul <sup>1</sup>
Jan 1	11,200	22,800	4,830	4,936	2,000	48,800
Feb 1	10,300	19,500	3,970	4,138	1,880	41,200
Mar 1	10,000	19,000	3,460	3,576	1,820	37,600
Apr 1	10,200	19,600	3,470	3,484	1,810	37,500
May 1	9,740	18,700	3,640	3,657	1,770	37,800
Jun 1	9,840	18,700	3,650	3,338	1,790	36,500
Observed	10,213	20,291	3,341	3,341	1,788	37,388
FORECAST DATE	HUNGRY HORSE	YAKIMA PARKER	DWORSHAK		LOWER GRANITE	THE DALLES
	Jan-Jul <sup>1</sup>	Apr-Sep <sup>1</sup>	Apr-Jul <sup>1</sup>	Apr-Jul <sup>2</sup>	Jan-Jul <sup>1</sup>	Jan-Jul <sup>1</sup>
Jan 1	1,610	1,560	2,300	2,727	23,600	80,400
Feb 1	1,350	1,270	1,800	1,781	18,800	66,400
Mar 1	1,320	1,130	1,550	1,727	16,300	58,600
Apr 1	1,280	1,100	1,400	1,473	14,100	56,100
May 1	1,310	1,090	1,440	1,433	14,100	56,500
Jun 1	1,330	1,140	1,550	1,398	14,800	55,500
Observed	1,300	1,012	1,472	1,472	14,381	58,187

<sup>1/</sup> NWS-RFC forecasts and forecast periods are posted on NWS web site for Long-Range Hydrologic Forecasts.

<sup>2/</sup> Shaded values are Official Corps of Engineers Project Forecasts.

**Table 15**

**MONTHLY FORECASTS VERSUS ACTUAL RUNOFF  
COLUMBIA RIVER ABOVE THE DALLES, OREGON**

YEAR	JANUARY – JULY RUNOFF VOLUME (KAF)						
	NWS FORECAST ISSUE DATE						OBSERVED <sup>1</sup>
	JAN 1	FEB 1	MAR 1	APR 1	MAY 1	JUN 1	
1970	82,500	99,500	93,400	94,300	95,100	---	<b>95,700</b>
1971	110,900	129,500	126,000	134,000	133,000	135,000	<b>137,500</b>
1972	110,100	128,000	138,700	146,100	146,000	146,000	<b>151,700</b>
1973	93,100	90,500	84,700	83,000	80,400	78,700	<b>71,200</b>
1974	123,000	140,000	146,000	149,000	147,000	147,000	<b>156,300</b>
1975	96,100	106,200	114,700	116,700	115,200	113,000	<b>112,400</b>
1976	113,000	116,000	121,000	124,000	124,000	124,000	<b>122,800</b>
1977	75,700	62,200	55,900	58,100	53,800	57,400	<b>53,800</b>
1978	120,000	114,000	108,000	101,000	104,000	105,000	<b>105,600</b>
1979	88,000	78,600	93,000	87,300	89,900	89,700	<b>83,100</b>
1980	88,900	88,900	88,900	89,700	90,600	97,700	<b>95,800</b>
1981	106,000	84,700	84,500	81,900	83,200	95,900	<b>103,500</b>
1982	110,000	120,000	126,000	130,000	131,000	128,000	<b>129,900</b>
1983	110,000	108,000	113,000	121,000	121,000	119,000	<b>118,700</b>
1984	113,000	103,000	97,600	102,000	107,000	114,000	<b>119,000</b>
1985	131,000	109,000	105,000	98,600	98,600	100,000	<b>87,700</b>
1986	96,800	93,300	103,300	106,000	108,000	108,000	<b>108,300</b>
1987	88,900	81,900	78,000	80,000	76,700	75,800	<b>76,500</b>
1988	79,200	74,800	72,700	74,000	76,100	75,000	<b>72,700</b>
1989	101,100	102,000	94,200	99,500	98,600	96,900	<b>90,600</b>
1990	86,500	101,000	104,000	96,000	96,000	99,500	<b>99,700</b>
1991	116,000	110,000	107,000	106,000	106,000	104,000	<b>107,000</b>
1992	92,600	89,100	83,300	71,200	71,200	67,800	<b>70,400</b>
1993	92,600	86,500	77,300	76,600	81,900	86,100	<b>88,000</b>
1994	79,700	76,300	78,100	73,200	75,500	74,600	<b>75,000</b>
1995	101,000	99,600	94,300	99,600	99,600	97,900	<b>117,100</b>
1996	116,000	122,000	130,000	126,000	134,000	141,000	<b>139,300</b>
1997	138,000	145,000	142,000	149,000	153,000	159,000	<b>159,000</b>
1998	86,400	95,200	91,700	90,800	89,100	101,000	<b>104,050</b>
1999	116,000	119,000	130,000	128,000	124,000	123,000	<b>124,080</b>
2000	105,000	106,000	105,000	105,000	105,000	102,000	<b>98,000</b>
2001	80,400	66,400	58,600	56,100	56,500	55,500	<b>58,200</b>

<sup>1</sup> Average 1971-2000 observed Jan-Jul runoff volume is 106.0 maf.

Table 16

**FORECAST AND OBSERVED PEAK FLOWS AND STAGES  
FOR WATER YEAR 2001**

**BASED ON NWS FORECAST ISSUED APRIL 1**

RIVER	STATION	FLOOD STAGE (ft)	PEAK REGULATED STAGE			PEAK REGULATED FLOW			
			Forecast (ft)		Obs <sup>1</sup> Stage (ft)	Forecast (kcfs)		Obs Flow (kcfs)	Date
			Low	High		Low	High		
Flathead	Columbia Falls	14.0	8.2	10.3	9.6	18.0	28.0	24.3	5/26
Clark Fork	above Missoula St Regis	10.0	4.2	7.9	6.0	3.5	11.5	6.8	5/16
		19.0	9.0	12.2	11.5	11.0	23.0	20.0	5/16
Pend Oreille Spokane Okanogan Wenatchee	Newport	63.5	62.0	62.8	-	22.0	29.0	28.5	5/17
	Spokane	27.0	22.4	24.1	23.3	11.5	18.5	15.0	5/4
	Tonasket	15.0	8.5	12.1	10.5	5.0	12.0	8.5	5/25
	Peshastin	13.0	7.2	8.9	8.7	8.0	12.0	11.6	5/25
Columbia	Priest Rapids	32.0	18.2	20.9	-	150.0	190.0	130.0	6/8
Yakima	Parker	10.0	4.4	7.2	4.0	3.1	9.7	2.5	4/28
Henrys Fork Payette Salmon Clearwater Snake	Rexburg	9.5	7.8	9.1	6.5	4.6	6.8	3.4	4/30
	Emmett	16KCFS	3.3	5.5	4.7	2.2	5.2	3.9	5/15
	Whitebird	32.0	20.1	24.3	21.5	25.4	46.1	30.8	5/17
	Spalding	18.0	8.4	12.4	11.1	24.0	54.0	43.5	5/15
Columbia	Lower Granite					80.0	130.0	90.0	5/17
	The Dalles	-	-	-	-	200.0	320.0	169.0	5/17
	Vancouver	16.0	5.9	10.5	6.0	-	-	-	5/24
Willamette	Portland	18.0	5.4	10.0	6.6	-	-	-	5/24

Peak forecasts predict the range of the 67% chance (1-sigma about the median) of occurrence. Abnormal weather during the critical melt period may cause the peak to be outside the indicated range.

Source: NW RFC Water Supply Outlook.