

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 a graphic display of daily temperatures and precipitation for selected basins are shown in Charts 1-4 in [Appendix D](#), 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 1999 through the September 2000 water year. For September 2000, precipitation was 47 percent of normal (1961-1990) for the Columbia River above Coulee; 23 percent of normal for the Snake River above Ice Harbor; and 34 percent of normal for the Columbia River above The Dalles.

In early August 1999, a trough of low pressure off the California coast produced a moist southwest flow at mid levels of the atmosphere. Within this flow were weather disturbances that tracked northeast and helped to initiate scattered showers and thunderstorms, which were primarily focused across the higher terrain. In the middle of August, the jet stream lifted to the north in response to a building area of high pressure across the region. Intervals of light precipitation were reported across southern British Columbia. Dry and warmer weather prevailed elsewhere across the Pacific Northwest. A trough of low pressure brought unseasonably cool temperatures and unsettled conditions in late August. For August, precipitation was 131 percent of normal (1961-1990) for the Columbia River above Coulee; 101 percent of normal at the Snake River above Ice Harbor; and 122 percent of normal for the Columbia River above The Dalles.

In September 1999, a series of upper level disturbances brought light precipitation primarily to northern tier basins during the very beginning and end of the month. A ridge of high pressure maintained mainly dry weather during the remainder of the month.

In general, below normal precipitation and above normal temperatures were experienced for the southern half of the basin, near normal precipitation and below normal temperatures for the north. A ridge of high pressure dominated the basin early in October 1999 with minor disturbances progressing north into Canada. This pattern produced light precipitation and cold air in Canada, Idaho and Montana. A period of short-lived southwesterly flow followed, bringing moderate rain to western Washington and light precipitation into northern Idaho and

northwestern Montana. A ridge building into the south with minor disturbances brushing northwest Washington and Canada dominated the mid and latter portions of the month.

A cold front moved through western Montana on 2 and 3 October 1999 resulting in daily minimum temperature records. For October, precipitation was 129 percent of normal (1961-1990) at Columbia above Coulee; 62 percent of normal at the Snake River above Ice Harbor; and 100 percent at Columbia above The Dalles. Early in November a slow moving flat ridge of high pressure dominated the basin weather picture. Generally dry weather exists during this period, with an exception to northwest basins, where a cold front brought light precipitation. By mid-month this flat ridge moved east of the Rockies and was replaced by a series of storm systems bringing bouts of precipitation mainly west of the Cascades.

During the latter portion of November 1999, a series of weather disturbances moving along a stalled frontal system tapped a rich supply of moisture originating from the subtropics. This combination of weather features produced moderate to locally heavy precipitation west of The Cascades and locally heavy precipitation across higher elevations east of The Cascades. A mild flow off the Pacific Ocean and lack of Arctic intrusions led to average temperatures ranging from 2 to 10 degrees above normal. For November, precipitation was 148 percent of normal (1961-1990) at Columbia above Coulee; 70 percent of normal at the Snake River above Ice Harbor; and 114 percent of normal at Columbia above The Dalles.

Frequent periods of light precipitation occurred in December 1999, which were focused mainly across west side basins as well as central and northern Idaho. Early in the month a series of frontal systems affected the region. During the end of the month, a strong ridge of high pressure maintained generally dry weather and near normal temperatures across the region. Temperature inversions and lack of significant mixing in lower levels of the atmosphere produced ideal conditions for persistent low clouds, fog, and patchy drizzle or snow flurries across some valley locations.

For December 1999, precipitation was 90 percent of normal (1961-1990) at Columbia above Coulee; 93 percent of normal at the Snake River above Ice harbor; and 93 percent at Columbia above The Dalles. Precipitation for the month of December was generally slightly below average except for pockets of above average precipitation in western Washington, in northeast Oregon and in the Clearwater basin in Idaho. The driest conditions were in southern Idaho and southern Oregon. Mountain snow as reported by the British Columbia Ministry of Environment and the Natural Resource Conservation Service was below average for most of the basin. The exceptions were British Columbia, Montana, northern Idaho and southwest Washington where above average 1 January snow conditions existed. The lowest 1 January snow conditions were in southern Oregon and southern Idaho where the snow pack was near 50 percent of average. Fall runoff had been above average in Washington, British Columbia and in the Clearwater River area in Idaho. The above average runoff in northern areas reflects more rainfall runoff due to above average temperatures and indicates that soil moisture storage in these areas will be above average.

The January 2000, 1st volume forecast for the January - July period at The Dalles is 105 million acre-ft or 99 percent of average. This compares to a runoff of 124.1 million in 1999. [Figure 7](#) depicts the Columbia Basin snowpack accumulation from January through May 2000. Water supplies in February improved for all Snake River tributaries, while in the northern portions of the basin water supply forecasts changed little from January. Precipitation during January was above average for most of Idaho and near average for the northern basins. Seasonal precipitation for the Columbia basin above The Dalles was at 104 percent of normal.

February 2000 began with a strong jet stream located along the southern periphery of a trough of low pressure across the Gulf of Alaska. This guided storm systems into the Pacific Northwest on a frequent basis. When systems were able to tap moisture from the subtropics, heavy precipitation was often the result, especially across the Olympic Peninsula, Cascades, and coastal range. Breaks in this overall weather pattern occurred for only a couple of days early in the month and again for a slightly longer period at the end of the month. During these hydrological benign weather periods, high pressure maintained dry weather and high freezing levels.

For January 2000, precipitation was 100 percent of normal (1961 - 1990) at the Columbia above Coulee; 119 percent of normal at the Snake River above Ice Harbor; and 103 percent of normal at the Columbia above The Dalles.

It was a warmer and wetter than normal in February 2000. A split jet stream ushered a series of generally week low-pressure systems into the northern and southern tiers of the basin early in February 2000. By mid

month, and through the end of the month, the weather pattern shifted to a more zonal flow bringing rain to the basin valleys and snow to the mountains. Low-pressure systems came onshore with frequency of every other day toward the later part of the month.

During February 2000, snow conditions for basins in most of Washington, northern Idaho, British Columbia and western Montana remained near to slightly below average. However, snow conditions in southern basins increased dramatically with increases of 20 - 50 percent from January 1st. Runoff for January was above average in the Upper Columbia and Kootenai and near to below average for the rest of the basin. The 1 February forecast for the January - July period at the Columbia River above The Dalles was 106 million acre-ft or 100 percent of average, an increase of 1 percent from January. February precipitation was: 94 percent of normal (1961-1990) at Columbia above Coulee, 142 percent of normal at the Snake River above Ice Harbor, and 111 percent at Columbia above The Dalles.

Below normal precipitation was evident across much of the Pacific Northwest during March 2000. Notable exceptions included much of central and eastern Washington and Oregon as well as southern British Columbia, where precipitation was over 130 percent of normal in a few locations. Temperatures were above normal across much of Idaho and western Montana and near normal elsewhere east of the Cascades. West of the Cascades, temperatures were below normal.

Early in March 2000, a series of frontal systems brought abundant precipitation to western Washington and northwest Oregon. Precipitation was much lighter elsewhere across the region. During the middle of the month, precipitation started out being rather light as a cut off low-pressure system developed across the desert southwest and the main storm track lifted north of the region. As this system lifted out of the southwest, a series of frontal systems once again began affecting the region. Moderate to locally heavy precipitation returned to western Washington, northwest Oregon, and higher elevations east of the Cascades. Late in the month, occasional showers occurred, especially across northern tier basins. Otherwise, a ridge of high pressure was fairly dominant through the latter part of the month. No temperature or precipitation records occurred in the month of March.

For March 2000, precipitation was: 111 percent of normal (1961-1990) at Columbia above Grand Coulee, 86 percent of normal at the Snake River above Ice Harbor, and 103 percent at Columbia above The Dalles. The 1 March snow conditions were somewhat below to near average for most of the basin. In the Upper Columbia-Kootenai, Pend Oreille and Spokane areas, snow accumulations during February were slightly below average while snow improved by 5 - 15 percent in other areas.

Above average temperatures and generally above average precipitation caused above average runoff for most of the Columbia River area above Grand Coulee, the Upper Snake and on western Oregon tributaries. Other areas had February runoff ranging from 70 to 85 percent of average. The March final runoff volumes in general decreased slightly on the Columbia River and increased by 5 - 15 percent on the Snake River. The January - July runoff for the Columbia River above The Dalles was at 105.0 million acre-ft or 99 percent of average. This was down 1 percent from February 1st.

During March 2000, snow water equivalent percentages increased slightly across northern portions of the basin and decreased 3-15 percent in the southern areas of the basin. The best improvements in snow pack occurred in the Upper Columbia, Kootenai and Flathead River basins, which are important contributors to the total flow on the Columbia River at The Dalles.

Volume forecasts improved slightly for the April 2000 final forecast for the Upper Columbia - Kootenai and the Flathead Rivers. The Snake River tributaries generally dropped 3 - 5 percent. This resulted in a January - July forecast for the Columbia River at The Dalles of 105 million acre-ft or 99 percent of average.

During the beginning of April 2000, a ridge of high pressure along the West Coast was the dominant weather feature across the region. Dry conditions and unseasonably warm temperatures were common. During the middle of April, a couple of cut-off low pressure systems brought intervals of light to moderate precipitation, especially to southern tier basins. During the end of the month, a trough of low pressure deepened across the Gulf of Alaska. This allowed a series of weak frontal systems to impact the region. The most significant precipitation was reported across northern tier basins.

The snow water equivalent percentages decreased in most areas during the month of April 2000. This was caused by above normal temperatures for the month that marked the beginning of the snow runoff season. Observed stream flow for April was above average for most of the Columbia Basin. Only areas in the Middle to

Upper Snake experienced below normal runoff, but total runoff at Lower Granite was above normal. Volume forecasts for the Columbia above Grand Coulee were unchanged in May. Snake River tributaries generally dropped 1 - 5 percent. This resulted in a January - July forecast for the Columbia River at The Dalles to remain unchanged at 105 Million acre-ft (Maf) or 99 percent of average.

During June 2000 temperatures were below normal across southern British Columbia and northern Washington, near normal across southern Washington, northern Oregon, northern Idaho and western Montana; and, above normal across southern Oregon, southern Idaho and northwest Wyoming. Precipitation was above normal west of the Cascades and across southern British Columbia, northwest Wyoming and extreme Southeast Idaho. Precipitation was near or below normal elsewhere across the Pacific Northwest. During the beginning and end of June, a trough of low pressure along the Pacific Northwest coast brought cool and showery conditions to the west side and northern tier basins. During the middle of June, far southeast basins received precipitation from an upper level low-pressure system that slowly tracked from the Gulf of Alaska into Northern California, then into the Great Basin.

Snow packs had depleted sharply basin wide by the beginning of June 2000. In northern areas the June 1st snow was about 70 percent of average, while southern portions of the basin had lost most of their snow. A reduced snow pack and slightly below average May precipitation caused a drop in the June final forecast volumes. Forecasts dropped 2-6 percent in most basins. The June 1st January - July forecast for the Columbia River at The Dalles is 102.0 Maf or 96 percent, down 3 percent from May.

Other than a few dry days early in the month, early and middle June 2000 was generally cool and unsettled. Moderate rain episodes were reported on a few days across the Olympic Peninsula. Otherwise, precipitation was mainly light and most prevalent across northern tier basins. During the end of June, a series of weak weather disturbances brought bouts of light rain to northern tier basins. The remainder of the region enjoyed mainly dry conditions with high pressure in control. The June accumulated precipitation across the basin was only 70 percent of normal in the Columbia River above Grand Coulee, 42 percent of normal at the Snake River above Ice Harbor, and 65 percent in the Columbia River above The Dalles.

Dry and near normal temperatures characterize most of the basin during the month of July 2000. Precipitation was generally light and primarily fell across the extreme north and south of the western portion of the basin in association with a series of weak weather disturbances. The East remained fairly dry under the influence of a high-pressure system. July precipitation remained well below average with 77 percent of normal at Columbia above Grand Coulee, 45 percent of normal at the Snake River above Ice Harbor, and 74 percent at Columbia above The Dalles.

2. Snowpack

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/water/w_data.html.

3. Surface Water Supply Index – SWSI

Category-score numerical methods have been developed to indicate the status of the overall surface water supply. The Surface Water Supply Index (SWSI) was developed by the NRCS and has been applied, with slight variations, in portions of the Pacific Northwest. Thus far, the SWSI has only been applied to basins in Oregon, Idaho, and Montana; but only the Oregon values are computed monthly. These indices include consideration of the status of the surface waters and reservoir contents of the basin, along with precipitation, snow, temperature, and other parameters. The index has a range of +4.1 (very ample supply of water) through 0.0 (normal supply), to -4.1 (very inadequate supply).

For monthly information about the Oregon SWSI for the years 1997 to 2002, see the web site 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/idfls07.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 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. Mean monthly discharges for each of these index stations, as expressed as a percentage of their 1961-90 normal discharges, are shown in [Table 5](#). Flood peaks will be discussed in Section 5 below.

This was the first year in over 5 years in which the average discharge of the index stations was "near normal." The previous 5 years indicated flows "above normal." The station with the highest annual discharge, in percent of normal, was the Spokane River at Spokane, with 107%, and the lowest was the Clark Fork near St. Regis, with 69%.

The high water events in late November and mid-December in northwest Oregon and Washington produced only enough flow increase to push the average discharges for these gages from the lower normal range to the upper normal range. Heavy rains in northwest Montana sent the monthly average for the MF Flathead River to over double the monthly normal. After the first 2 months of the water year, the MF Flathead River had the highest percent of normal discharge of the index sites, with an average of 178%. This is in sharp contrast to the first 2 months of the 1999 water year, when the MF Flathead River recorded the lowest percent of normal discharge of the index sites, with an average of 43% of normal discharge. By the end of January, all the index sites were close to or within the normal range, with the notable exception of the John Day River at Service Creek, which had its monthly mean drop from 104% of normal in October to only 43% of normal in January.

Many of the basins accumulated a near normal snowpack through the winter and early spring. Flows were in the normal range in February and March for most index sites. Snowmelt in April and May boosted streamflows somewhat during those months, but because of the dry soil conditions from the previous fall, much of the snowmelt infiltrated into the ground instead of providing additional streamflow.

Below average late spring and summer precipitation throughout most basins resulted in below normal streamflow in the latter half of the year. The John Day River at Service Creek and the Clark Fork at St. Regis showed the greatest streamflow deficit from June to August with flows near or below 50% of normal. Above average precipitation occurred across most of the Pacific Northwest in September, returning streamflows closer to their normal range.

The year ended with most of the index sites close to or within their normal range for annual discharges with the exception of the Clark Fork at St. Regis, which was unable to recover from a dryer than average April through August period.

[Tables 6, 7, 8, 9, and 10](#) show additional comparisons of WY 2000 observed streamflows and runoff with historical flows. The December mean monthly-observed streamflow for the Columbia River at Grand Coulee was the highest for the entire 1961 to 2000 period. The tables show that in the four key

basins, the mean monthly discharges varied from 57% to 161% of their 30-year (1961- 1990) average.

5. Flood Events

Water year 2000 was a quiet year in terms of flooding.

a. **WINTER FLOODS.** Minor flooding took place in western Washington and western Oregon in November, December, and February. The rivers above flood stage were the Skokomish, Snoqualmie, and Chehalis in Washington, and the Clackamas, Nehalem, Wilson, Tualatin, Lukiamute, South Yamhill, Pudding, Santiam, Mohawk and Coquille Rivers in Oregon.

The Siletz River in Oregon experienced a record flood over Thanksgiving weekend, cresting near 53,500 cubic ft per second and 12.6 ft above flood stage. Several houses were evacuated in the lower Siletz River during the flood.

East of the Cascades, minor flooding occurred on the Yakima and Klickitat Rivers in eastern Washington in December, and on the Weiser River in central Idaho in February. See [Table 11](#) for a description of these winter flood events.

b. **SPRING FLOODS.** During the spring snow melt period, only minor, below flood stage events were reported on the Yakima River in Washington and the St. Joe River in northern Idaho in April. See [Table 12](#) for a description of these spring flood 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). 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 near normal runoff conditions could be expected from most sub-basins. Slightly above average runoff was forecast for streams draining from the Rocky Mountains into the upper Columbia River Basin, and below average runoff was forecast for the lower Snake River basin. [Tables 14](#) displays the monthly forecasts at key sites and their verification.

Both the January 1st and April 1st forecasts projected near average runoff for most Columbia/Snake River basins. The exception was the Lower Snake River from Weiser to Lower Granite Dam that was below average runoff as anticipated. Uncharacteristically, forecasts for the Upper Columbia in Canada experienced the largest

errors in the basin, with some locations over forecast by nearly 20 percent on April 1st. on the Snake River Basin, the Salmon River at Whitebird had the greatest error, again near 20 percent on April 1st. Other forecast points had errors from -7 to +10 percent.

Table 15 shows the history of forecasts of the January-July runoff of the Columbia River at The Dalles for the period 1970-2000. 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 98.0 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. 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 near average runoff, no streams were forecast to exceed flood stage during the spring runoff period. Crests near bank full were observed on the Lower Spokane and the upper Yakima River for April. Crest near bank full was also observed for the Henry's Fork River for May. The regulated peak for the Portland-Vancouver harbor was below 12 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 1999 – September 2000
Percent of 1961 – 1990 Average

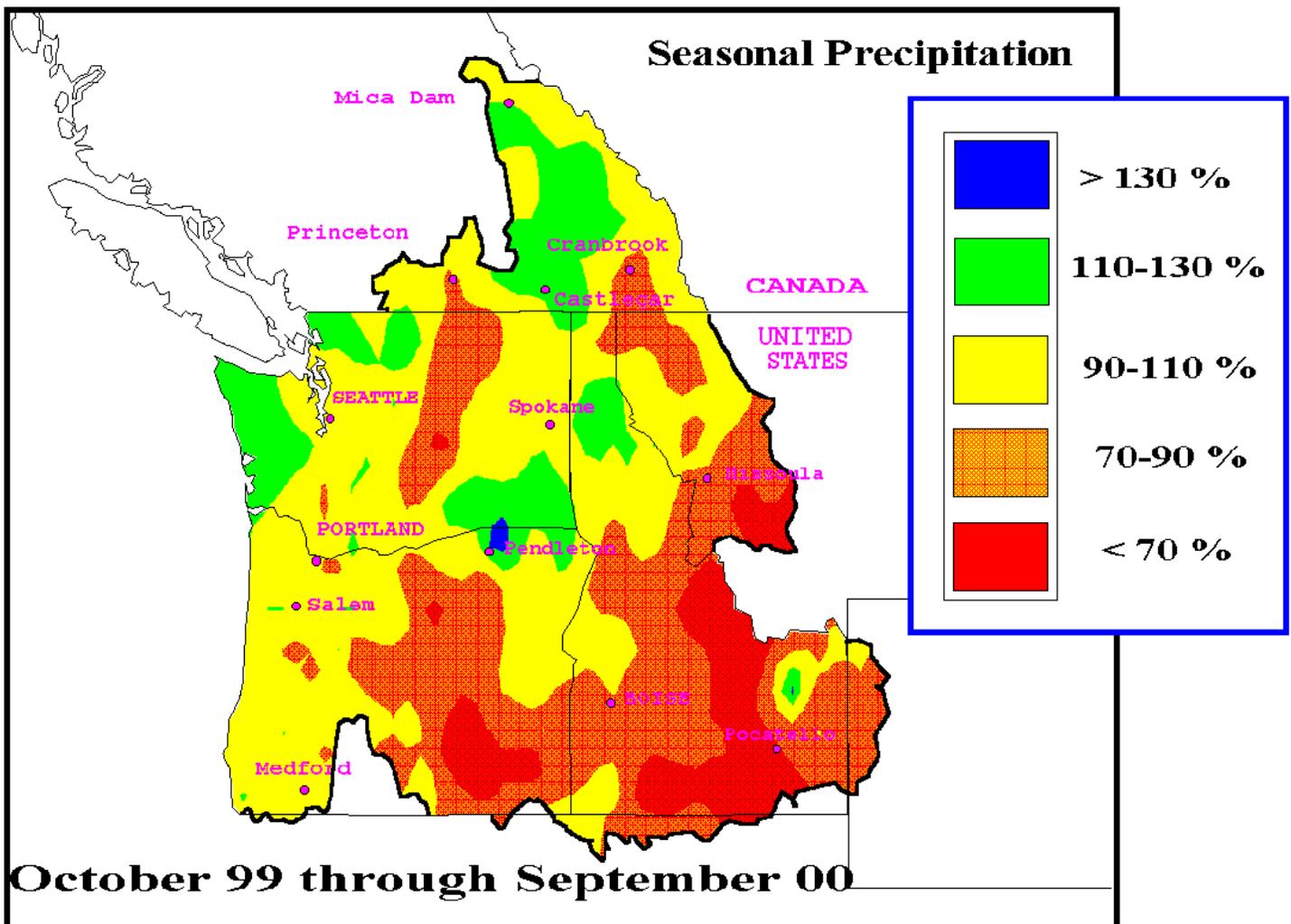


Figure 7
Columbia Basin Snowpack
for Water Year 2000

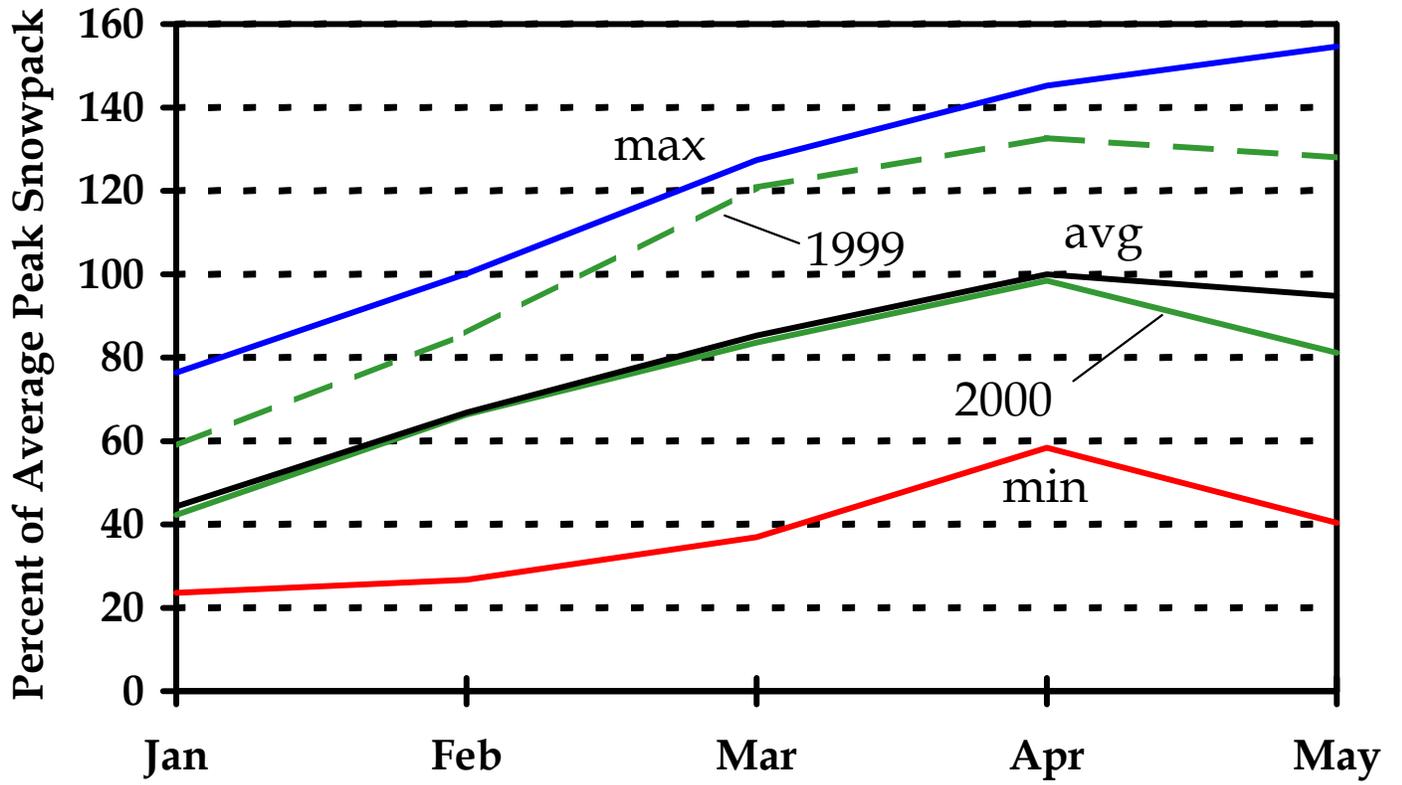


Table 1

MONTHLY PRECIPITATION TOTALS BY SUB-BASIN – WY 2000
(With Percentages of Normal)

SUB-BASINS	UNITS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Columbia above Grand Coulee	in.	2.29	4.07	2.78	3.01	2.03	1.98	1.86	1.99	1.78	1.23	0.61	1.99
	%	129	148	90	100	97	111	116	93	76	77	36	116
Snake River above Ice Harbor	in.	0.74	1.37	1.89	2.48	2.21	1.38	1.13	1.58	0.69	0.37	0.36	1.31
	%	62	70	93	119	143	86	79	93	43	45	38	113
Columbia River above The Dalles	in.	1.64	3.10	2.81	3.04	2.37	1.95	1.42	1.83	1.20	0.81	0.43	1.71
	%	100	114	93	103	113	103	89	101	66	74	35	122
Columbia River above Castlegar	in.	3.35	5.51	4.24	4.40	2.23	3.11	2.41	2.77	2.46	2.62	1.28	3.02
	%	123	151	98	105	76	133	125	128	89	107	54	126
Kootenai	in.	2.10	4.53	2.67	3.45	2.00	2.31	2.19	1.76	1.86	1.18	0.60	1.82
	%	120	157	83	113	100	135	135	86	78	70	36	104
Clark Fork	in.	1.33	2.06	1.53	1.71	1.70	0.71	1.10	1.60	1.00	0.43	0.21	1.43
	%	121	128	83	84	128	54	89	82	51	41	16	110
Flathead	in.	2.76	2.79	2.08	2.44	2.07	1.54	1.51	1.67	1.86	1.10	0.54	2.18
	%	173	120	83	97	113	92	96	70	71	70	34	122
Pend Oreille-Spokane	in.	2.81	4.60	5.22	3.95	3.52	2.64	2.63	3.04	1.90	0.53	0.15	2.06
	%	136	117	130	98	119	97	123	136	93	52	11	132
Northeast Washington	in.	1.18	2.59	2.14	2.08	1.61	2.01	1.39	1.65	1.40	0.66	0.15	0.84
	%	103	114	87	111	106	133	103	89	82	62	12	91
Okanogan	in.	0.83	2.15	1.39	1.52	1.46	0.90	0.74	1.18	1.00	1.24	0.41	1.00
	%	94	137	67	87	117	87	75	91	72	123	36	100
East Slope Washington Cascades	in.	2.55	8.36	7.13	6.53	4.03	2.58	1.15	1.71	1.35	0.46	0.07	1.68
	%	95	141	100	93	87	76	55	117	110	70	7	116
Central Washington	in.	0.54	0.76	0.83	1.33	1.32	0.99	0.44	0.80	0.52	0.19	0.00	0.39
	%	99	62	60	131	165	131	69	116	93	66	0	88
Upper Snake	in.	0.37	1.08	2.05	3.65	2.37	1.46	1.22	2.16	1.22	0.63	1.11	0.87
	%	25	54	98	159	136	90	76	100	61	49	81	53
Snake River Plain	in.	0.33	0.43	0.81	1.86	1.47	0.85	0.83	1.06	0.16	0.22	0.31	0.50
	%	41	36	75	173	171	83	81	80	14	37	44	59
Owyhee-Malheur	in.	0.37	0.47	0.79	1.77	1.89	1.10	0.84	0.80	0.31	0.24	0.30	0.81
	%	47	35	53	145	203	101	93	67	28	50	50	126
Salmon-Boise-Payette	in.	0.86	1.99	2.03	2.80	2.80	1.41	1.15	1.44	0.71	0.18	0.06	1.20
	%	65	79	76	103	143	74	76	91	46	27	7	104
Burnt-Grande Ronde	in.	1.01	2.43	2.10	2.42	2.09	1.50	0.93	1.57	0.95	0.22	0.04	1.60
	%	91	126	105	124	154	107	75	105	67	33	4	174
Clearwater	in.	2.24	4.10	4.60	3.75	3.50	2.27	1.82	2.80	1.39	0.35	0.24	2.45
	%	103	125	127	96	122	77	70	100	56	31	18	130
Southeast Washington	in.	1.33	2.26	2.71	2.25	2.83	1.99	1.09	2.43	1.31	0.24	0.03	1.64
	%	103	95	113	97	156	109	73	156	109	38	4	171
Upper John Day	in.	1.12	1.14	0.86	2.05	1.58	1.72	0.81	1.42	0.72	0.37	0.02	0.47
	%	107	60	46	123	130	128	69	99	57	60	2	58
Umatilla - Lower John Day	in.	0.99	2.25	1.45	2.49	2.52	2.17	0.86	1.63	0.81	0.16	0.00	1.54
	%	87	104	70	127	171	141	61	123	75	34	0	190
Upper Deschutes – Crooked River	in.	1.37	1.27	0.87	3.18	2.93	1.43	0.74	0.62	0.23	0.38	0.02	0.28
	%	141	58	38	151	204	107	85	66	25	75	3	44
Hood River – Lower Deschutes River	in.	1.90	4.99	4.21	6.10	4.25	2.13	0.99	1.67	0.90	0.31	0.03	0.87
	%	98	114	86	133	131	77	50	116	81	75	5	71
NW Slope Washington Cascades	in.	8.96	17.24	15.59	9.63	7.23	8.01	5.57	6.27	4.09	1.18	1.15	5.62
	%	122	139	120	72	74	93	90	140	120	60	47	129
SW Slope Washington Cascades	in.	4.99	15.38	11.96	9.55	7.86	5.55	3.08	4.54	3.12	0.57	0.50	3.37
	%	92	149	109	86	96	79	62	130	110	45	27	104
Willamette	in.	3.68	10.62	8.01	11.64	7.82	4.64	3.34	4.03	1.81	0.38	0.06	1.20
	%	87	115	83	130	115	72	78	129	89	51	5	52
Rogue - Umpqua	in.	3.17	4.72	3.28	8.89	5.37	2.23	3.94	1.80	0.76	0.57	0.04	0.58
	%	118	77	54	166	130	55	163	106	85	159	6	47
Klamath	in.	0.98	1.41	1.06	4.76	3.32	1.13	1.81	0.72	0.18	0.44	0.05	0.53
	%	72	51	35	183	177	59	179	73	21	110	8	76
Lake County – Good Lake	in.	0.73	0.37	0.32	2.70	1.76	0.93	1.55	0.64	0.25	0.31	0.00	1.57
	%	76	24	19	187	169	80	156	53	22	73	1	253
Harney Basin	in.	0.53	0.64	0.78	1.73	1.59	0.94	0.74	0.46	0.34	0.51	0.09	0.81
	%	60	42	50	137	164	80	87	41	35	122	12	121

Table 2

ACCUMULATED MONTHLY PRECIPITATION TOTALS BY SUB-BASIN – WY 2000
(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.	2.29	6.35	9.13	12.14	14.06	16.05	17.91	19.90	21.46	22.90	23.51	25.50
	%	129	141	120	114	110	111	111	109	105	103	98	100
Snake River above Ice Harbor	in.	0.74	2.10	3.99	6.47	8.54	9.91	11.05	12.63	13.32	13.68	14.04	15.36
	%	62	67	77	89	97	95	93	93	88	86	83	85
Columbia River above The Dalles	in.	1.64	4.74	7.55	10.59	12.94	14.88	16.30	18.13	19.33	20.14	20.57	22.28
	%	100	108	102	102	104	104	102	102	99	98	94	96
Columbia River above Castlegar	in.	3.35	8.86	13.10	17.50	19.42	22.52	24.94	27.70	30.17	32.79	34.07	37.09
	%	123	139	122	117	109	112	113	114	112	111	107	108
Kootenai	in.	2.10	6.63	9.30	12.75	14.50	16.81	19.00	20.76	22.63	23.81	24.40	26.22
	%	120	143	118	117	112	115	117	113	109	106	102	102
Clark Fork	in.	1.33	3.39	4.92	6.63	8.30	9.01	10.17	11.70	12.70	13.13	13.33	14.77
	%	121	125	108	101	105	98	97	94	88	85	80	82
Flathead	in.	2.76	5.55	7.63	10.07	12.13	13.67	15.18	16.85	18.71	19.71	20.25	22.43
	%	173	141	119	113	113	110	108	103	98	96	92	94
Pend Oreille-Spokane	in.	2.81	7.41	12.63	16.58	20.30	22.94	25.57	28.60	30.15	31.03	31.19	33.24
	%	136	123	126	118	119	116	117	119	117	114	109	111
Northeast Washington	in.	1.18	3.78	5.92	8.00	9.78	11.79	13.19	14.84	16.23	16.89	17.04	17.88
	%	103	110	100	103	105	109	109	106	103	101	95	95
Okanogan	in.	0.83	2.99	4.38	5.90	7.36	8.26	9.01	10.19	11.18	12.42	12.84	13.84
	%	94	121	96	94	97	96	94	94	91	94	89	90
East Slope Washington Cascades	in.	2.55	10.91	18.03	24.57	28.52	31.10	32.25	33.96	35.31	35.77	35.84	37.52
	%	95	127	115	108	104	101	98	99	99	99	96	97
Central Washington	in.	0.54	1.31	2.14	3.47	4.81	5.80	6.23	7.03	7.15	7.74	7.74	8.13
	%	99	73	67	83	96	101	98	99	99	98	93	93
Upper Snake	in.	0.37	1.45	3.51	7.16	8.99	10.45	11.67	13.83	15.05	15.68	16.78	17.65
	%	25	42	63	91	93	93	91	92	88	86	85	83
Snake River Plain	in.	0.33	0.76	1.57	3.43	4.73	5.58	6.42	7.47	7.63	7.85	8.16	8.66
	%	41	38	51	82	94	92	91	89	80	78	76	74
Owyhee-Malheur	in.	0.37	0.84	1.54	3.30	5.15	6.25	7.09	7.89	8.20	8.43	8.74	9.54
	%	47	39	44	71	92	93	93	90	83	88	80	82
Salmon-Boise-Payette	in.	0.86	2.86	4.89	7.69	10.20	11.61	12.76	14.20	14.91	15.09	15.16	16.35
	%	65	74	75	83	91	89	87	88	84	82	79	80
Burnt-Grande Ronde	in.	1.01	3.43	5.54	7.96	10.11	11.62	12.54	14.11	15.06	15.28	15.32	16.92
	%	91	113	110	114	121	119	114	113	109	105	99	103
Clearwater	in.	2.24	6.33	10.93	14.69	17.82	20.08	21.91	24.71	26.09	26.44	26.68	29.14
	%	103	116	121	113	112	107	102	102	98	95	92	94
Southeast Washington	in.	1.33	3.59	6.30	8.55	11.13	13.12	14.21	16.64	17.95	18.19	18.22	19.86
	%	103	116	121	113	112	107	102	102	98	95	92	94
Upper John Day	in.	1.12	2.26	3.13	5.18	6.70	8.41	9.22	10.64	11.37	11.74	11.76	12.22
	%	107	77	65	80	87	93	90	91	88	87	82	80
Umatilla - Lower John Day	in.	0.99	3.24	4.69	7.18	9.75	11.93	12.79	14.42	15.23	15.39	15.39	16.93
	%	87	98	87	98	111	115	109	110	107	105	100	105
Upper Deschutes – Crooked River	in.	1.37	2.64	3.50	6.68	9.61	11.04	11.77	12.40	12.63	13.01	13.03	13.31
	%	141	83	64	88	107	107	105	102	97	96	91	89
Hood River – Lower Deschutes River	in.	1.90	6.89	11.10	17.20	21.16	23.29	24.28	25.95	26.85	27.15	27.19	28.05
	%	98	109	99	109	111	107	102	103	102	102	99	98
NW Slope Washington Cascades	in.	8.96	26.20	41.78	51.42	58.65	66.66	72.23	78.49	82.58	83.75	84.90	90.52
	%	122	133	128	111	105	103	102	104	105	104	102	104
SW Slope Washington Cascades	in.	4.99	20.37	32.33	41.88	49.65	55.20	59.28	62.81	65.94	66.51	67.02	70.39
	%	92	129	121	111	108	104	101	102	103	102	99	100
Willamette	in.	3.68	14.30	22.31	33.95	41.10	45.74	49.08	53.11	54.92	55.30	55.35	56.55
	%	87	106	97	106	106	101	99	101	100	100	98	96
Rogue - Umpqua	in.	3.17	7.89	11.17	20.06	25.44	27.67	31.61	33.41	34.17	34.74	34.79	35.36
	%	118	89	75	99	104	97	103	103	102	103	101	99
Klamath	in.	0.98	2.39	3.44	8.20	10.49	11.62	13.43	14.15	14.33	14.77	14.82	15.36
	%	72	58	48	84	90	86	92	91	87	88	85	84
Lake County – Good Lake	in.	0.73	1.11	1.42	4.13	5.48	6.41	7.95	8.59	8.84	9.15	9.16	10.73
	%	76	44	34	73	82	82	90	86	79	79	75	83
Harney Basin	in.	0.53	1.16	1.95	3.68	4.97	5.90	6.64	7.10	7.43	7.94	8.03	8.84
	%	60	48	49	70	80	80	81	76	72	74	70	73

Table 3

**BASIN AVERAGE
MONTHLY TEMPERATURES
Departure from Normal (°F)**

for WY 2000

Month	Northwest Average	Warmest Station	Coollest Station
October	+0.7	+18.5	-3.5
November	+5.7	+10.2	+2.4
December	+4.4	+12.6	-3.9
January	+3.0	+11.7	-0.9
February	+2.4	+8.4	-3.3
March	+2.6	+13.1	-3.1
April	+3.0	+8.2	0.3
May	+0.3	+6.6	-1.7
June	+0.3	+4.3	-3.4
July	-0.5	+2.7	-6.1
August	+0.2	+3.7	-2.5
September	-0.8	+1.2	-3.2
Annual	<i>1.78</i>	<i>8.43</i>	<i>-2.18</i>

Table 5

**MEAN MONTHLY STREAMFLOWS
In Percent of Monthly Normal
WY 2000**

RIVER	STATION	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
JOHN DAY	Service Creek	104	80	48	43	89	115	131	56	43	47	37	70	82
COLUMBIA	The Dalles	111	120	138	126	110	101	132	91	61	79	103	102	101
WILLAMETTE	Salem	82	90	112	108	93	93	93	116	107	104	98	87	100
SPOKANE	Spokane	102	105	144	87	91	109	151	102	71	89	75	96	107
SNAKE	Heise	113	88	89	89	84	139	119	71	62	109	176	167	96
SNAKE	Weiser	91	97	91	97	84	82	92	61	54	87	103	102	84
SALMON	White Bird	87	96	94	95	93	94	136	95	52	46	61	77	78
CLEARWATER	Spalding	78	81	77	87	116	113	114	68	53	57	338	104	86
CLARK FORK	St Regis	77	88	91	79	78	81	118	68	49	45	52	62	69
MF FLATHEAD	West Glacier	137	218	134	100	90	85	136	92	75	71	75	79	94

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

Table 6

MEAN DISCHARGES AND PERCENTAGES OF NORMAL FOR WY 2000

RIVER STATION	ANNUAL		JANUARY-JULY (McNary Project)		APRIL-JULY (Lwr Granite @Snake River)		APRIL-AUGUST (Libby Project)	
	Q ¹	%	Q ¹	%	Q ¹	%	Q ¹	%
Columbia River below Mica*	19.93	98	22.14	108	34.98	93	35.56	93
Columbia River below Arrow*	42.45	100	49.63	103	77.83	100	74.62	98
Kootenay River at Fort Steele	6.26	101	7.58	111	11.94	100	10.79	99
Kootenai River below Libby*	11.17	98	13.79	113	20.61	97	18.21	94
Duncan River below Duncan*	3.86	107	4.34	110	6.91	105	6.82	105
Kootenay River at Queens Bay*	29.56	106	37.37	114	56.53	104	49.35	101
Columbia River at Birchbank*	76.26	105	92.28	110	126.87	105	131.88	102
Clark Fork above Missoula	2.00	64	2.60	71	3.47	61	2.94	58
Clark Fork at St Regis	5.29	70	7.18	76	10.14	72	8.50	68
MF Flathead R near W Glacier	2.75	94	3.72	94	5.93	94	4.98	90
NF Flathead R nr Columbia Falls*	2.92	98	3.81	105	5.92	94	5.01	91
Flathead R below Kerr nr Polson*	10.45	90	14.72	91	22.84	90	18.89	84
Clark Fork near Plains*	16.57	83	22.93	86	34.12	84	28.41	78
Pend Oreille River at Newport	21.23	81	30.01	80	44.43	84	36.78	77
Spokane R at Spokane*	6.91	105	9.86	98	11.65	100	9.59	99
Columbia R below Grand Coulee*	112.43	99	144.81	102	215.95	103	191.85	100
Okanogan River near Tonasket	2.85	100	3.67	106	5.38	102	4.53	96
Wenatchee River at Peshastin	3.21	105	4.01	89	6.08	105	5.17	101
Columbia R below Priest Rapids*	128.23	104	164.09	109	240.91	105	214.09	103
Yakima River at Cle Elum*	2.28	110	2.70	92	3.83	113	3.22	108
Yakima River near Parker*	4.83	104	5.74	87	7.86	105	6.49	97
Snake River near Heise*	6.08	84	7.78	96	10.95	84	9.48	80
Boise River near Boise*	2.28	80	3.30	82	4.44	73	3.68	70
Payette River near Emmett*	2.46	83	3.22	82	3.96	80	3.45	79
Snake River at Hells Canyon*	17.88	87	20.22	84	18.99	75	17.38	79
Salmon River at White Bird	9.11	78	12.56	88	18.25	82	15.36	78
Grande Ronde River at Troy	2.95	101	4.23	87	4.77	93	3.96	91
Clearwater River at Orofino*	7.82	86	11.78	87	16.54	85	13.55	80
NF Clearwater R below Dworshak*	5.74	100	8.26	93	11.05	95	9.07	88
Clearwater River at Spalding*	13.75	89	20.22	87	26.85	83	22.05	79
Snake River below Lower Granite*	43.97	84	63.50	84	70.88	79	6.01	78
Columbia River at The Dalles*	179.90	95	232.28	97	318.80	96	279.11	94
McKenzie River near Vida*	4.40	107	5.02	106	4.16	105	3.73	104
N Santiam River near Mehama*	4.37	128	4.84	130	4.01	130	3.45	141
S Santiam River at Waterloo*	3.89	129	4.32	112	2.84	130	2.34	126
Willamette River at Salem*	31.49	133	36.53	133	21.62	134	18.39	134
Rogue River near Raygold*	4.11	134	4.98	138	3.88	136	3.46	136
Cowlitz River at Castle Rock*	11.24	120	13.01	121	11.67	129	10.45	138
Skagit R near Concrete*	17.14	112	20.11	127	25.67	108	24.68	126

¹Average discharge in kcfs.

*Adjusted for upstream storage.
From NWRFC Runoff Processor.

Table 7

**OBSERVED DISCHARGE AND RUNOFF
COLUMBIA RIVER AT GRAND COULEE, WASHINGTON**

MONTH	MEAN MONTHLY OBSERVED STREAMFLOWS (cfs)						
	MAXIMUM		MINIMUM		WY 2000		1961-90 AVERAGE
	Discharge	WY	Discharge	WY	Discharge	% Average	
Oct	106,700	1998	55,890	1964	85,720	115	74,410
Nov	107,700	1986	52,930	1964	102,700	130	79,270
Dec	141,800	2000	51,420	1964	141,800	161	87,920
Jan	154,900	1996	50,750	1964	140,400	145	96,670
Feb	168,600	1996	64,750	1968	111,700	110	101,100
Mar	185,300	1982	53,920	1993	97,600	97	101,100
Apr	180,800	1969	48,430	1993	138,900	132	105,300
May	237,300	1971	65,760	1973	138,400	98	141,700
Jun	420,400	1961	70,600	1977	106,000	58	183,500
Jul	262,100	1964	63,890	1989	111,000	76	146,400
Aug	183,600	1976	60,490	1989	104,800	100	104,900
Sep	121,700	1976	55,880	1994	80,480	105	76,910
Annual	144,900	1997	83,200	1993	113,400	105	108,300

MONTH	OBSERVED RUNOFF ACCUMULATION (kaf)						
	MAXIMUM		MINIMUM		WY 2000		1961-90 AVERAGE
	Runoff	WY	Runoff	WY	Runoff	% Average	
Oct-Mar	47,990	1996	20,290	1964	41,160	127	32,520
Jan-Jul	72,830	1997	35,480	1977	50,970	97	52,720
Apr-Jul	55,230	1961	17,780	1977	29,910	86	34,900
Apr-Aug	61,150	1961	22,580	1977	36,350	88	41,350
Apr-Sep	65,630	1972	27,270	1977	41,140	90	45,930
Annual	104,900	1997	60,230	1993	82,300	105	78,450

Table 8

**OBSERVED DISCHARGE AND RUNOFF
SNAKE RIVER AT ANATONE, WASHINGTON**

MONTH	MEAN MONTHLY OBSERVED STREAMFLOWS (cfs)						
	MAXIMUM		MINIMUM		WY 2000		1961-90 AVERAGE
	Discharge	WY	Discharge	WY	Discharge	% Average	
Oct	31,540	1985	13,760	1989	21,000	94	22,260
Nov	36,960	1985	13,620	1993	19,350	80	24,240
Dec	41,630	1965	13,570	1993	20,260	75	26,920
Jan	71,930	1997	16,760	1993	27,770	91	30,540
Feb	72,520	1965	17,090	1977	31,660	92	34,570
Mar	90,400	1972	18,680	1977	38,290	95	40,440
Apr	88,700	1974	18,880	1977	56,210	112	49,980
May	118,700	1984	20,610	1977	53,600	79	67,640
Jun	134,200	1984	16,850	1992	42,620	57	74,200
Jul	63,860	1982	12,830	1977	24,200	77	31,280
Aug	29,140	1997	9,760	1992	13,870	77	18,090
Sep	31,730	1997	10,180	1992	19,230	98	19,630
Annual	59,030	1997	18,050	1992	30,630	84	36,600

MONTH	OBSERVED RUNOFF ACCUMULATION (kaf)						
	MAXIMUM		MINIMUM		WY 2000		1961-90 AVERAGE
	Runoff	WY	Runoff	WY	Runoff	% Average	
Oct-Mar	17,570	1997	6,360	1991	9,570	89	10,770
Jan-Jul	34,700	1997	8,100	1977	16,550	84	19,770
Apr-Jul	22,320	1971	4,630	1977	10,660	79	13,470
Apr-Aug	25,420	1984	5,260	1977	11,520	79	14,580
Apr-Sep	27,030	1984	5,930	1977	12,660	80	15,750
Annual	42,740	1997	13,100	1992	22,230	84	26,520

Table 9

**OBSERVED DISCHARGE AND RUNOFF
COLUMBIA RIVER AT THE DALLES, OREGON**

MONTH	MEAN MONTHLY OBSERVED STREAMFLOWS (cfs)						
	MAXIMUM		MINIMUM		WY 2000		1961-90 AVERAGE
	Discharge	WY	Discharge	WY	Discharge	% Average	
Oct	167,000	1998	91,720	1964	128,000	111	115,000
Nov	163,700	1991	90,720	1964	149,900	120	125,400
Dec	258,300	1996	89,230	1962	200,100	138	144,500
Jan	275,000	1997	93,160	1964	200,700	126	159,600
Feb	340,400	1996	107,800	1964	190,200	110	173,100
Mar	345,000	1983	105,300	1964	187,900	101	185,900
Apr	344,300	1969	103,900	1977	273,100	132	206,500
May	487,000	1971	136,100	1977	260,400	91	287,000
Jun	591,100	1961	123,700	1977	209,300	61	340,500
Jul	354,600	1964	88,600	1977	168,100	79	211,800
Aug	223,100	1976	91,970	1994	142,700	103	139,000
Sep	160,800	1976	75,760	1994	115,200	102	112,800
Annual	263,700	1997	120,400	1977	185,400	101	183,300
MONTH	OBSERVED RUNOFF ACCUMULATION (kaf)						
	MAXIMUM		MINIMUM		WY 2000		1961-90 AVERAGE
	Runoff	WY	Runoff	WY	Runoff	% Average	
Oct-Mar	87,160	1996	35,290	1964	63,930	118	54,350
Jan-Jul	142,700	1997	50,760	1977	89,890	95	94,150
Apr-Aug	105,200	1972	33,120	1977	63,830	89	71,760
Apr-Sep	113,800	1997	39,010	1977	70,680	90	78,470
Annual	190,900	1997	87,200	1977	134,600	101	132,800

Table 10

**OBSERVED DISCHARGE AND RUNOFF
WILLAMETTE RIVER AT SALEM, OREGON**

MONTH	MEAN MONTHLY OBSERVED STREAMFLOWS (cfs)						
	MAXIMUM		MINIMUM		WY 2000		1961-90 AVERAGE
	Discharge	WY	Discharge	WY	Discharge	% Average	
Oct	24,390	1969	7,940	1988	11,110	82	13,620
Nov	70,400	1974	8,440	1988	27,320	90	30,310
Dec	116,700	1965	6,780	1977	53,710	112	48,100
Jan	95,930	1965	6,380	1977	51,120	108	47,520
Feb	91,350	1961	5,310	1977	34,500	93	37,070
Mar	73,670	1972	11,270	1992	27,960	93	29,930
Apr	46,440	1993	10,260	1977	21,200	93	22,820
May	38,610	1963	7,700	1973	21,600	116	18,620
Jun	30,910	1984	5,660	1992	13,980	107	13,020
Jul	12,410	1983	5,420	1966	7,580	104	7,320
Aug	9,540	1971	5,340	1966	6,980	98	7,100
Sep	13,340	1978	6,160	1992	8,470	87	9,690
Annual	37,960	1974	9,790	1977	23,800	100	23,710

MONTH	OBSERVED RUNOFF ACCUMULATION (kaf)						
	MAXIMUM		MINIMUM		WY 2000		1961-90 AVERAGE
	Runoff	WY	Runoff	WY	Runoff	% Average	
Oct-Mar	21,080	1977	3,590	1977	12,460	100	12,430
Jan-Jul	16,620	1972	4,210	1977	10,730	102	10,560
Apr-Jul	6,930	1993	1,980	1987	3,890	104	3,730
Apr-Aug	7,460	1993	2,360	1987	4,320	104	4,160
Apr-Sep	8,040	1993	2,810	1987	4,820	102	4,740
Annual	27,480	1974	7,090	1977	17,280	101	17,170

Table 11

WINTER FLOOD PEAKS – WATER YEAR 2000

RIVER	GAGE	DAMAGE STAGE		ESTIMATED OBSERVED *			MAXIMUM OF RECORD		
		ZERO	MAJOR	DATE	STAGE	Q	DATE	STAGE	Q
Johnson	Milwaukie	27.4		26NOV99	28.06	0.84	08FEB96	30.27	2.17
Tualatin	Dilley	17.5		26NOV99	17.75	3.16	22DEC64	19.34	17.1
Snake	Weiser	12.0	12.4	28FEB00	7.30	33.9	24APR52	14.67	84.5
Weiser	Weiser	9.5		28FEB00	11.67	16.6	02JAN97	17.2	34.5

Bold new record

*From WY-2000 USGS WSP

Zero Damage = Flood Stage

All stages in feet and discharges in kcfs

Table 12

SPRING FLOOD PEAKS – WATER YEAR 2000

RIVER	GAGE	DAMAGE STAGE		ESTIMATED OBSERVED*			MAXIMUM OF RECORD		
		ZERO	MAJOR	DATE	STAGE	Q	DATE	STAGE	Q
John Day	Service Creek	7.8		05APR00	9.04	10.3	23DEC64	17.85	40.2
Snake	Anatone	20.0		23APR00	11.63	68.9	18JUN74	24.45	195.0
Imnaha	Imnaha	4.2		13APR00	4.27	1.99	17JAN74	7.86	10.1
Henry's Fork	Rexburg	9.5		28MAY00	8.76	6.03	17MAY84	12.05	16.4
Imnaha	Imnaha	4.2		22APR00	4.21	1.92	17JAN74	7.86	10.1
John Day	Service Creek	7.8		14APR00	9.14	10.6	23DEC64	17.85	40.2

Bold new record

*From WY-2000 USGS WSP

Zero Damage = Flood Stage

All stages in feet and discharges in kcfs

Table 13

**FORECAST AND OBSERVED RUNOFF VOLUME (kaf)
for Water Year 2000**

STREAM	STATION	FORECAST PERIODS ¹	30-YEAR NORMAL	NWS FORECAST RUNOFF ¹		OBSV'D RUNOFF ²	NWS FORECAST ERROR (%)	
				JAN 1	APR 1		JAN 1	APR 1
COLUMBIA	Mica Inflow	Feb-Sep	13,170	14,300	13,700	12,430	+15	+10
	Duncan Inflow	Feb-Sep	2,319	2,520	2,420	2,376	+6	+2
KOOTENAI	Libby Inflow	Jan-Jul	6,396	6,830	7,030	5,820	+17	+21
		Apr-Sep	6,772	7,230	7,290	5,837	+24	+25
COLUMBIA	Birchbank	Apr-Sep	43,800	48,100	46,600	42,852	+12	+9
SF FLATHEAD	Hungry Horse Inflow	Jan-Jul	2,269	2,100	2,140	2,045	+3	+5
		Apr-Sep	2,184	2,020	2,090	1,937	+4	+8
FLATHEAD	Flathead Inflow - Kerr	Apr-Sep	6,926	6,470	6,530	5,867	+10	+11
PEND OREILLE	Pend Oreille Iflw - Newport	Apr-Sep	14,370	13,100	13,200	11,462	+14	+15
SPOKANE	Spokane	Apr-Sep	2,864	3,060	2,770	2,957	+3	-6
COLUMBIA	Grand Coulee Inflow	Jan-Jul	63,280	66,600	65,800	61,101	+9	+8
		Apr-Sep	64,850	68,300	67,700	61,410	+11	+10
COLUMBIA	Rock Island Dam	Apr-Sep	70,480	74,900	73,800	66,779	+12	+11
YAKIMA	Parker	Apr-Sep	1,994	2,030	2,000	2,061	-2	-3
SNAKE	Jackson Lk Infl	Apr-Jul	781	630	670	675	-7	-1
	Heise	Apr-Jul	3,451	2,700	2,940	2,651	+2	+11
BOISE	Boise	Apr-Jul	1,421	970	1,150	1,075	-10	+7
PAYETTE	Horseshoe Bend	Apr-Jul	1,618	1,430	1,570	1,269	+13	+24
SNAKE	Weiser	Apr-Jul	5,465	3,590	3,930	3,942	-9	0
SALMON	White Bird	Apr-Jul	5,955	5,560	5,540	4,418	+26	+25
GRANDE RONDE	Troy	Apr-Sep	1,471	1,380	1,580	1,244	+11	+27
NORTH FORK CLEARWATER	Dworshak	Jan-Jul	3,548	3,680	3,480	3,485	+6	0
		Apr-Jul	2,700	2,800	2,670	2,675	+5	0
CLEARWATER	Spalding	Apr-Jul	7,618	7,790	7,380	6,500	+20	+14
SNAKE	Lower Granite	Feb-Sep	30,220	26,100	27,200	24,908	+5	+9
		Apr-July	21,650	18,700	19,200	17,163	+9	+12
JOHN DAY	Service Creek	Apr-Sep	821	780	930	643	+21	+45
DESCHUTES	Moody	Apr-Sep	1,902	1,790	2,020	2,090	-14	-3
COLUMBIA	The Dalles	Jan-Jul	105,900	105,000	105,000	98,009	+7	+7
		Apr-Sep	98,980	98,100	98,200	89,519	+10	+10

^{1/} Forecasts and forecast periods are those posted on NWRFC web site for Long-Range Hydrologic Forecasts.

^{2/} From NWRFC Runoff Processor.

Table 14

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

for WY 2000

FORECAST DATE	MICA	ARROW	LIBBY		DUNCAN	GRAND COULEE
	Feb-Sep ¹	Feb-Sep ¹	Jan-Jul ¹	Jan-Jul ²	Feb-Sep ¹	Jan-Jul ¹
Jan 1	14,300	30,200	6,830	6,787	2,520	66,600
Feb 1	14,000	28,600	6,950	6,920	2,380	66,100
Mar 1	13,300	28,100	6,860	6,872	2,390	65,000
Apr 1	13,700	29,000	7,030	7,065	2,420	65,800
May 1	13,800	28,700	6,850	7,208	2,400	65,800
Jun 1	13,500	27,900	6,930	7,152	2,330	64,800
Observed	12,430	25,943	5,820	5,820	2,376	61,101
FORECAST DATE	HUNGRY HORSE	YAKIMA PARKER	DWORSHAK		LOWER GRANITE	THE DALLES
	Jan-Jul ¹	Apr-Sep ¹	Apr-Jul ¹	Apr-Jul ²	Jan-Jul ¹	Jan-Jul ¹
Jan 1	2,100	2,030	2,800	2,970	25,700	105,000
Feb 1	2,110	2,000	2,800	2,719	26,900	106,000
Mar 1	2,160	1,980	2,800	2,696	27,600	105,000
Apr 1	2,140	2,000	2,670	2,798	26,700	105,000
May 1	2,130	2,150	2,560	2,665	26,400	105,000
Jun 1	2,180	1,940	2,560	2,657	25,700	102,000
Observed	2,045	2,061	2,675	2,675	24,595	98,000

^{1/} NWS-RFC forecasts and forecast periods are posted on NWS web site for Long-Range Hydrologic Forecasts.

^{2/} 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 ¹
	JAN 1	FEB 1	MAR 1	APR 1	MAY 1	JUN 1	
1970	82,500	99,500	93,400	94,300	95,100	---	95,700
1971	110,900	129,500	126,000	134,000	133,000	135,000	137,500
1972	110,100	128,000	138,700	146,100	146,000	146,000	151,700
1973	93,100	90,500	84,700	83,000	80,400	78,700	71,200
1974	123,000	140,000	146,000	149,000	147,000	147,000	156,300
1975	96,100	106,200	114,700	116,700	115,200	113,000	112,400
1976	113,000	116,000	121,000	124,000	124,000	124,000	122,800
1977	75,700	62,200	55,900	58,100	53,800	57,400	53,800
1978	120,000	114,000	108,000	101,000	104,000	105,000	105,600
1979	88,000	78,600	93,000	87,300	89,900	89,700	83,100
1980	88,900	88,900	88,900	89,700	90,600	97,700	95,800
1981	106,000	84,700	84,500	81,900	83,200	95,900	103,500
1982	110,000	120,000	126,000	130,000	131,000	128,000	129,900
1983	110,000	108,000	113,000	121,000	121,000	119,000	118,700
1984	113,000	103,000	97,600	102,000	107,000	114,000	119,000
1985	131,000	109,000	105,000	98,600	98,600	100,000	87,700
1986	96,800	93,300	103,300	106,000	108,000	108,000	108,300
1987	88,900	81,900	78,000	80,000	76,700	75,800	76,500
1988	79,200	74,800	72,700	74,000	76,100	75,000	72,700
1989	101,100	102,000	94,200	99,500	98,600	96,900	90,600
1990	86,500	101,000	104,000	96,000	96,000	99,500	99,700
1991	116,000	110,000	107,000	106,000	106,000	104,000	107,000
1992	92,600	89,100	83,300	71,200	71,200	67,800	70,400
1993	92,600	86,500	77,300	76,600	81,900	86,100	88,000
1994	79,700	76,300	78,100	73,200	75,500	74,600	75,000
1995	101,000	99,600	94,300	99,600	99,600	97,900	117,100
1996	116,000	122,000	130,000	126,000	134,000	141,000	139,300
1997	138,000	145,000	142,000	149,000	153,000	159,000	159,000
1998	86,400	95,200	91,700	90,800	89,100	101,000	104,050
1999	116,000	119,000	130,000	128,000	124,000	123,000	124,080
2000	105,000	106,000	105,000	105,000	105,000	102,000	98,000

¹ Average 1971-2000 observed Jan-Jul runoff volume is 106.0 maf.

Table 16

**FORECAST AND OBSERVED PEAK FLOWS AND STAGES
FOR WATER YEAR 2000**

BASED ON NWS FORECAST ISSUED APRIL 1

RIVER	STATION	FLOOD STAGE (ft)	PEAK REGULATED STAGE			PEAK REGULATED FLOW			
			Forecast (ft)		Obs ¹ Stage (ft)	Forecast (kcfs)		Obs Flow (kcfs)	Date
			Low	High		Low	High		
Flathead	Columbia Falls	14.0	11.3	14.3	11.4	33.1	53.0	34.2	5/23
Clark Fork	above Missoula St Regis	10.0	7.1	10.5	5.3	9.4	19.2	5.5	5/24
		19.0	12.5	15.0	11.3	24.2	36.8	18.8	5/24
Pend Oreille Spokane Okanogan Wenatchee	Newport	100KCFS	-	-	-	53.0	84.0	55.5	5/23
	Spokane	27.0	24.7	26.2	26.1	20.0	26.8	26.3	4/24
	Tonasket	15.0	12.4	14.9	11.6	12.8	19.2	10.8	5/23
	Peshastin	13.0	9.4	11.6	8.9	13.3	19.3	11.9	5/21
Columbia	Priest Rapids	32.0	21.8	27.4	-	204.0	304.0	220.0	4/23
Yakima	Parker	10.0	6.4	8.6	5.8	7.5	14.1	5.8	5/24
Henry's Fork Payette Salmon Clearwater Snake	Rexburg	9.5	8.7	10.0	8.8	5.9	9.3	6.1	5/26
	Emmett	16KCFS	7.2	10.4	7.0	8.2	15.5	7.8	5/25
	Whitebird	32.0	25.5	28.6	23.6	52.4	73.1	41.9	5/26
	Spalding	18.0	11.1	15.3	11.5	42.7	81.5	46.5	5/04
	Lower Granite	325. ¹				126.7	223.9	115.0	4/23
Columbia	The Dalles	-	-	-	-	300.0	380.0	375.0	4/23
	Vancouver	16.0	9.2	13.0	11.4	-	-	-	4/24
Willamette	Portland	18.0	8.7	12.5	11.5	-	-	-	4/24

^{1/} 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.