

The Great Flood of 1996

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A series of intense surges of subtropical moisture inundated western Oregon during the period February 5-9. The combination of record-breaking rain, warm temperatures, and a deep snowpack led to severe flooding throughout northern sections of the state. River flood stages were comparable in magnitude to the December, 1964 flood, the largest in Oregon since flood control reservoirs were built in the 1940's and 1950's.

The first precursor to the flooding was an unusually wet winter, causing soils to be saturated and streams and reservoirs to be at high levels. Most of northwest Oregon received at least 125% of normal precipitation for the first four months of the Water Year (October - January). Table 1 lists a few northwest Oregon stations' observed and normal seasonal precipitation for October 1995 - January 1996:

Location	Observed	Normal	Percent of normal
Laurel Mountain	108.66	59.10	184
Portland	27.46	19.50	141
Eugene	41.55	28.13	148
Govt. Camp	71.42	46.16	155

Table 1. Observed and normal seasonal precipitation, October 1995-January 1996

Fall and winter had had very little snowfall. By mid-January, the snow water average for high-elevation sites (NRCS SNOTEL stations) in the Willamette drainage was only 29% of average. Beginning in mid-January, however, unusually high amounts of snow fell in the middle and high elevations of the Cascades and Coast Range (in many locations, several feet per day were reported for many days). By January 31, the average snowpack for the Willamette drainage had risen to 112% of average.

An intense cold spell during the week of the 29th resulted in very low temperatures in the northern half of the state. Many Willamette Valley stations had lows in the teens for 4 or 5 consecutive days. A number of eastern Oregon locations had lows well below zero. A moderate storm on February 3rd dropped rain on top of frozen soil and roads, causing a major freezing rain episode throughout the Willamette Valley. Traffic was slowed or completely halted in many locations. The hardest hit was the Portland area, where icy conditions lasted for three days, and which also experienced wind chill factors of -20F or lower.

Then on February 6th, a strong subtropical jet stream reached Oregon. This warm, very humid air mass, which originated near the Equator in the western Pacific (near the Date Line), brought record rainfall amounts to northern sections of the state. Although such subtropical storms are by no means rare, it is unusual for them to persist with such intensity for such a long period of time (3-4 days). Table 2 shows 4-day total precipitation for northwestern Oregon locations, as well as the all-time 4-day records (some of them now surpassed -- new records are in bold). The most spectacular total was at Laurel Mountain in the Coast Range. The four-day total was 27.88 inches (8.20, 7.90, 7.05, and 4.73 for February 6-9, respectively).

	4-day total	Record	
Site	(inches)	(inches)	Year
Astoria	8.88	8.24	1975
Corvallis	8.10	7.84	1974
Eugene	9.14	10.30	1964
Government Camp	11.30	13.84	1964
Hillsboro	6.70	5.91	1974
Hood River	7.50	8.67	1964
Newport	9.81	10.17	1965
Oregon City	7.51	7.29	1964
Portland Airport	7.00	5.10	1994
Salem	8.18	8.69	1937

Table 2. Maximum 4-day precipitation totals for western Oregon locations

In addition to the wet conditions, temperatures were unusually mild. In the Willamette Valley, daily minimum temperatures were higher than normal maximum values for early February. Nighttime lows in the mid-50's were quite common. The freezing level quickly moved upward, to 7,000 - 8,000 feet. Rain fell even at mountain pass level. The warm rain and air temperatures quickly began to erode the snowpack. In addition to large amounts of rain, high elevation sites saw significant reductions in snow water equivalent (SWE). Table 3 lists total precipitation and SWE for the period February 5-9 for NRCS SNOTEL stations in Oregon (courtesy NRCS, Portland).

	Precipitation	SWE Loss	Total		Elevation
Site Name	(in.)	(in.)	(in.)	River Basin	(feet)
Blazed Alder	18.3	1.8	20.1	Willamette	3650
Daly Lake	10.1	6.1	16.2	Santiam	3360
Greenpoint	9.2	2.2	11.4	Hood	3200
Hogg Pass	9.7	5.1	14.8	Santiam	3500
Holland Meadows	3.9	6.9	10.8	Willamette	4900
Jump-Off-Joe	9.8	2.4	12.2	Santiam	3500
King Mountain	3.0	8.9	11.9	Umpqua	4000
Little Meadows	17.6	9.9	27.5	Santiam	4000
Marion Forks	11.1	12.2	23.3	Santiam	2600
Mckenzie	10.8	3.1	13.9	McKenzie	4800
Mt. Hood	11.3	3.4	14.7	Sandy	5400
New Crescent	2.4	3.4	5.8	Deschutes	4800
Ochoco Meadows	1.3	2.9	4.2	Crooked	5200
North Fork	12.1	8.5	20.6	Bull Run	3120
Peavine Ridge	10.6	5.5	16.1	Clackamas	3500
Quartz Peak	1.4	4.5	5.9	Klamath	5700
Red Hill	14.5	5.4	19.9	Hood	4400
Saddle Mountain	20.4	14.0	34.4	Tualatin	3250
Salt Creek Falls	10.2	3.0	13.2	Willamette	4000
Seine Creek	14.0	8.0	22.0	Tualatin	2000
Three Creeks	6.5	2.4	8.9	Deschutes	5650

Table 3. Total precipitation and SWE loss, SNOTEL stations, February 5-9, 1996

Streams rose quickly on the 6th and 7th, reaching flood stage in many locations. At Vida on the McKenzie River, the flow jumped from 4,000 cfs on the 5th to over 20,000 cfs on the 6th. Major and minor tributaries throughout western Oregon jumped their banks. Gradually the levels in the major tributaries and the main stem rivers increased as well. Several set all-time flood stage records. Table 4 is a summary of 1996 crests, as well as all-time records, for rivers throughout northern Oregon; new record levels are in bold (courtesy Oregon chapter of American Meteorological Society).

WESTERN OREGON:

	Flood stage	1996 crest	All-time record	
River/site	(feet)	(feet)	(feet)	Year
Columbia at Vancouver	16.0	27.2	31.0	1948
Willamette at Portland	18.0	28.6	33.0	1894
Willamette at Salem	28.0	35.1	47.0	1891
Willamette at Corvallis	20.0	23.5	32.4	1891
Sandy near Sandy	-	22.6	22.3	1964

Clackamas at Estacada	10.0	17.4	18.4	1964
Johnson Cr. at Sycamore	11.0	13.8	14.7	1964
Tualatin at Farmington	32.0	37.2	37.0	1933
Molalla at Canby	13.0	14.6	16.8	1964
Pudding at Aurora	22.0	30.5	30.0	1923
S. Yamhill at Whiteson	38.0	47.5	47.2	1964
N. Santiam at Mehama	11.0	13.4	17.5	1923
Santiam at Jefferson	15.0	23.2	24.2	1964
Luckiamute at Suver	27.0	33.0	34.5	1964
Nehalem at Foss	14.0	27.4	24.9	1990
Wilson at Tillamook	13.0	18.1	n.a.	n.a.
Nestucca at Beaver	18.0	18.2	n.a.	n.a.
Siletz at Siletz	16.0	24.5	31.6	1921

EASTERN OREGON:

	Flood stage	1996 crest	All-time record	
River/site	(feet)	(feet)	(feet)	Year
John Day at Service Creek	11.5	14.0	n.a.	n.a.
Umatilla at Pendleton	7.8	11.0	n.a.	n.a.
Grande Ronde at Troy	10.0	13.6	11.3	1964
Deschutes at Moody	8.0	12.0	n.a.	n.a.

Table 4. Summary of flood crests for Oregon rivers and streams

Comparisons with 1964 are inevitable, since that flood event is considered the largest in this area since flood control dams were completed following World War II. In the Willamette Valley and north coast, some of the current flood levels exceeded those observed in 1964, while others were slightly lower. The 1964 event was larger in extent, stretching from Northern California northward through most of Washington, and from the coast eastward into Idaho. The 1964 flood also began with much more low-elevation snow; Portland Airport, for example, had 11 inches of snow on the ground when the warm rains began in 1964.

George Robison, hydrologist with the Oregon Department of Forestry, circulated an internal memo with some preliminary flood perspectives. Below is an excerpt from George's well-written and very informative memo.

"Some preliminary gage data indicates that the following streams had floods of record that are equivalent to a 75+ year event.

1. S. Yamhill River near Whiteson
2. Pudding River
3. Tualatin River (2 gages)
4. Sandy River
5. Nehalem River
6. Grande Ronde River at Troy (Stage 2 feet higher than previous record!)
7. Deschutes River at Moody (Note peak flow recordings since 1897!)

"As information comes in there will be many more gages that will have floods of record. There were also many gages within the area of the flood's influence that had flows indicative of a 10-year event (for instance the Little Luckiamute River west of Salem had three ten year peak flows in three days). The flows on the Willamette were also indicative of a 10-year flood flow due to the effective use of flood control reservoirs. It appears that most streams in the northwest corner of the state (especially Columbia County) experienced a flood of record even larger than the 1964 flood. From the air, there was widespread high water related damage with a lesser relative role of landslide activity. Along the western Cascades north of Eugene, some streams experienced

floods of record as well. It could be that some of the small streams around Mapleton also had floods of record although there is no streamflow gage data to show this yet. Along the Columbia Gorge around Hood River there are also pockets of damage and high flows indicative of floods of record."

The 1996 flood caps a most unusual weather year in Oregon. A very wet November, big windstorm in December, and the snow and ice of January merely set the stage for the flood event. Doubtless we will look back on this as one of the most interesting (and damaging) winters in the history of Oregon.
