

**FLOODS OF JANUARY 9-11, 1990 IN NORTHWESTERN  
OREGON AND SOUTHWESTERN WASHINGTON**

**By Larry L. Hubbard**

---

---

**U.S. GEOLOGICAL SURVEY  
Open-File Report 91-172**



**Portland, Oregon  
1991**

U.S. DEPARTMENT OF THE INTERIOR  
MANUEL LUJAN, JR., Secretary  
U.S. GEOLOGICAL SURVEY  
Dallas L. Peck, Director

---

For additional information  
write to:

U.S. Geological Survey  
10615 S.E. Cherry Blossom Drive  
Portland, Oregon 97216

Copies of this report can  
be purchased from:

U.S. Geological Survey  
Books and Open-File Reports Section  
Box 25425, Federal Center  
Denver, CO 80225

## CONTENTS

|  | Page |
|--|------|
| Abstract .....                                     | 1    |
| Introduction .....                                 | 1    |
| Determination of flood stages and discharges ..... | 1    |
| Explanation of data .....                          | 3    |
| The storm system .....                             | 3    |
| The floods .....                                   | 7    |
| The damages .....                                  | 8    |
| Selected references .....                          | 10   |

## ILLUSTRATIONS

|  |   |
|--|---|
| Figure 1. Map showing flood area and location of flood determination points and climatological stations in northwestern Oregon and southwestern Washington ..... | 2 |
| 2. Graph showing daily precipitation record at Grays River Hatchery, Washington, January 3-10, 1990 .....  | 6 |
| 3. Hydrograph showing instantaneous discharge, of Naselle River near Naselle, Washington, January 3-11, 1990 .....   | 7 |

## TABLES

|  |   |
|--|---|
| Table 1. Flood stages and discharges January 9-11, 1990 in northwestern Oregon and southwestern Washington .....   | 4 |
| 2. Precipitation totals for period January 3-10, 1990 at selected climatological stations in northwestern Oregon and southwestern Washington .....                           | 6 |
| 3. Storm damages in excess of \$50,000 (rounded to nearest thousand dollars) reported by towns, cities, counties, and utilities in the states of Oregon and Washington ..... | 9 |

CONVERSION FACTORS AND VERTICAL DATUM

| Multiply                                   | By      | To obtain              |
|--|---------|------------------------|
| inch (in.)                                 | 25.4    | millimeter             |
| foot (ft)                                  | 0.3048  | meter                  |
| mile (mi)                                  | 1.609   | kilometer              |
| square mile (mi <sup>2</sup> )             | 2.590   | square kilometer       |
| cubic foot (ft <sup>3</sup> )              | 0.02832 | cubic meter            |
| cubic foot per second (ft <sup>3</sup> /s) | 0.02832 | cubic meter per second |

SEA LEVEL: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

FLOODS OF JANUARY 9-11, 1990 IN NORTHWESTERN OREGON  
AND SOUTHWESTERN WASHINGTON

--  
By Larry L. Hubbard

--  
ABSTRACT

The cumulative effect of a series of precipitation-laden Pacific storms over the period January 3-8, 1990, climaxing with extreme rainfall on January 9, resulted in heavy flooding on the northern Oregon coast and in western Washington from the southern border to the Seattle area. Interstate Highway 5 (I-5) was inundated with 3-5 feet of water and in the Chehalis area and was closed for several days. Four persons in the State of Washington lost their lives in the flooding. A Presidential Disaster Declaration was issued for two counties in Oregon and six counties in Washington. Total flood damage in the two states is estimated to exceed 19 million dollars.

Record peak flows were recorded at 10 gaging stations. At eight of these stations, the peak flows are estimated to have recurrence intervals of about 100 years. The most extreme flooding was on the Nehalem River in Oregon and the Chehalis River in Washington.

INTRODUCTION

The flooding described in this report was primarily the result of a series of back-to-back storms accompanied by heavy rainfall over an 8-day period. The heaviest rainfall, which occurred on the seventh day of the storm, January 9, caused extreme flooding because it fell on soils that were saturated from the preceding rainstorms.

This report describes the storm, the flood, and the flood damages, and includes a map showing the location of flood determination points and locations of selected precipitation stations (fig. 1). Flood-peak stream stages and discharges of the streams affected and those of previous floods of record are tabulated. Daily rainfall is shown for one site, and total rainfall for January 3-10 is shown for 10 sites.

DETERMINATION OF FLOOD STAGES AND DISCHARGES

Peak stages and discharges were obtained and compiled by the regular procedures of surface-water investigations by the U.S. Geological Survey.

The usual method of determining stream discharge is the application of a stage-discharge relation to a known stage. That relation at a station is usually defined by current meter measurements through as much of the range in stage as possible. If the peak discharge is above the range of the computed stage-discharge relation, that relation may be extended by logarithmic extrapolation, by velocity-area studies, or by use of other hydraulic techniques. Peak discharges that are far beyond the range of the stage-discharge relation at the gaging stations may be determined by various types of indirect measurements. During major floods, such as the January 1990 floods in northwestern Oregon and Southwestern Washington,



adverse conditions often make it impossible to obtain current-meter measurements near flood peaks at some sites. Peak discharges at a few of the sites in this report were determined by indirect methods based on detailed surveys of selected channel reaches after the flood had subsided. Descriptions of the indirect methods used by the Geological Survey are given in a series of publications titled "Techniques of Water-Resources Investigations of the United States Geological Survey, Book 3."

#### EXPLANATION OF DATA

A summary table (table 1) of peak stages and discharges is given for the flood. In the summary table, the first major breakdown of columns under "Maximum floods" provides information on known floods prior to the 1990 flood. This information includes period of record, gage heights, and discharges for maximum floods during that period prior to 1990. More than one period of record are shown for some stations. The information under the second major breakdown of columns under "maximum floods" shows information on the January 1990 floods. It includes information by columns on date, maximum stage, maximum discharge, and recurrence interval for the January 1990 flood.

The recurrence interval is the average interval, in years, in which a flood of a given magnitude (the 1990 peak) will be equalled or exceeded once as an annual maximum. A flood having a recurrence interval of 50 years can be expected to occur, on the average, once in 50 years, or it is one that has a 2-percent chance of being exceeded in any one year. All recurrence intervals in the tables were determined using guidelines for determining flood frequency as shown in a report by the U.S. Water Resources Council (1981).

#### THE STORM SYSTEM

A major and complex storm system moved through northwestern Oregon and southwestern Washington during the period, January 3-10. This storm system included high winds and strong surges of precipitation, and was accompanied by high tides along the Oregon Coast. The main storm passed over the extreme northwestern corner of Oregon and traveled in a northeasterly direction, passing over the south end of Puget Sound before decreasing in intensity near the summit of the Cascade Range. Precipitation in Oregon was heaviest in the Nehalem and Wilson River basins in Clatsop and Tillamook Counties. The National Weather Service climatological station at Nehalem recorded a total of 16.6 inches of rain over the January 3-10 period (table 2). This 8-day total precipitation is more than 15 percent of the total yearly precipitation that is recorded at the Nehalem station on the average. The most rainfall that was recorded anywhere in the two states during the 8-day period was 18.4 inches at Lees Camp, Oregon (U.S. National Oceanographic and Atmospheric Administration, 1990c). The station at Lees Camp, Oregon recorded more than 5 inches of precipitation on January 9. The daily precipitation record for Grays River Hatchery, Washington (fig. 2) illustrates the surging precipitation pattern of the storm system over the 8-day period, January 3-10, 1990. The most intense precipitation in the State of Washington during the storms occurred near the headwaters of the Skookumchuck, Deschutes, and Nisqually River basins in Lewis County (U.S. Federal Emergency Management Agency Region X, 1990a). Eight-day precipitation totals for selected climatological stations are shown in table 2.

Table 1.--Flood stages and discharges, January 9-11, 1990 in northwestern Oregon and southwestern Washington

[mi<sup>2</sup> = square miles, ft<sup>3</sup>/s = cubic feet per second]

| Map number           | Station number | Stream and place determination              | Drainage area (mi <sup>2</sup> ) | Maximum floods                |                      |                         |                            |                    |                                |                             |     |
|----------------------|----------------|---|----------------------------------|-------------------------------|----------------------|-------------------------|----------------------------|--------------------|--------------------------------|-----------------------------|-----|
|                      |                |   |                                  | Known before January 1990     |                      |                         | January 1990               |                    |                                |                             |     |
|                      |                |   |                                  | Period of record              | Year                 | Gage height (feet)      | Date                       | Gage height (feet) | Discharge (ft <sup>3</sup> /s) | Recurrence interval (years) |     |
| Wilson River basin   |                |   |                                  |                               |                      |                         |                            |                    |                                |                             |     |
| 1                    | 14301500       | Wilson River near Tillamook, Oregon         | 161                              | 1932-90                       | 1972                 | 16.91                   | 36,000                     | Jan. 9             | 16.03                          | 27,000                      | 25  |
| Nehalem River basin  |                |   |                                  |                               |                      |                         |                            |                    |                                |                             |     |
| 2                    | 14301000       | Nehalem River near Foss, Oregon             | 667                              | 1939-90                       | 1972                 | 23.11                   | 46,900                     | Jan. 9             | 25.07                          | 54,000                      | 100 |
| Naselle River basin  |                |   |                                  |                               |                      |                         |                            |                    |                                |                             |     |
| 3                    | 12010000       | Naselle River near Naselle, Washington      | 54.8                             | 1929-90                       | 1935                 | --                      | 11,100                     | Jan. 9             | 16.67                          | 9,350                       | 25  |
| Willapa River basin  |                |   |                                  |                               |                      |                         |                            |                    |                                |                             |     |
| 4                    | 12013500       | Willapa River near Willapa, Washington      | 130                              | 1949-55<br>1957-58<br>1961-90 | 1949<br>1958<br>1966 | --<br>--<br>--          | 11,400<br>7,360<br>11,400  | Jan. 9             | 24.06                          | 11,700                      | 25  |
| Chehalis River basin |                |   |                                  |                               |                      |                         |                            |                    |                                |                             |     |
| 5                    | 12020000       | Chehalis River near Doty, Washington        | 113                              | 1939-90                       | 1972                 | 18.36                   | 22,800                     | Jan. 9             | 19.96                          | 27,500                      | 100 |
| 6                    | 12025000       | Newaukum River near Chehalis, Washington    | 155                              | 1942-90                       | 1986                 | 12.76                   | 10,700                     | Jan. 9             | 12.75                          | 10,400                      | 30  |
| 7                    | 12025700       | Skookumchuck River near Vail, Washington    | 40.0                             | 1967-90                       | 1972                 | 10.93                   | 6,900                      | Jan. 9             | 10.01                          | 5,330                       | 20  |
| 8                    | 12027500       | Chehalis River near Grand Mound, Washington | 895                              | 1928-90                       | 1986                 | 18.41                   | 51,600                     | Jan. 10            | 19.34                          | 68,700                      | 100 |
| 9                    | 12031000       | Chehalis River at Porter, Washington        | 1,294                            | 1952-72<br>1974-84<br>1986-90 | 1972<br>1975<br>1986 | 23.88<br>23.36<br>23.36 | 55,600<br>48,100<br>45,900 | Jan. 11            | 24.52                          | 60,400                      | 100 |
| Cowlitz River basin  |                |   |                                  |                               |                      |                         |                            |                    |                                |                             |     |
| 10                   | 14232500       | Cispus River near Randle, Washington        | 321                              | 1929-90                       | 1974                 | 12.58                   | 21,700                     | Jan. 9             | 12.26                          | 20,100                      | 50  |
| 11                   | 14226500       | Cowlitz River near Packwood, Washington     | 287                              | 1929-90                       | 1933                 | 13.00                   | 36,600                     | Jan. 9             | 11.34                          | 22,800                      | <10 |

Table 1.--Flood stages and discharges, January 9-11, 1990 in northwestern Oregon and southwestern Washington--Continued

| Map number            | Station number | Stream and place determination                        | Drainage area (mi <sup>2</sup> ) | Maximum floods                |                      |                    |                                |        |                    |                                |                             |
|-----------------------|----------------|---|----------------------------------|-------------------------------|----------------------|--------------------|--------------------------------|--------|--------------------|--------------------------------|-----------------------------|
|                       |                |   |                                  | Known before January 1990     |                      |                    | January 1990                   |        |                    |                                |                             |
|                       |                |   |                                  | Period of record              | Year                 | Gage height (feet) | Discharge (ft <sup>3</sup> /s) | Date   | Gage height (feet) | Discharge (ft <sup>3</sup> /s) | Recurrence interval (years) |
| Deschutes River basin |                |   |                                  |                               |                      |                    |                                |        |                    |                                |                             |
| 12                    | 12079000       | Deschutes River near Rainier, Washington              | 89.8                             | 1949-77                       | 1974                 | 15.68              | 7,780                          | Jan. 9 | 17.01              | 9,600                          | 100                         |
| Nisqually River basin |                |   |                                  |                               |                      |                    |                                |        |                    |                                |                             |
| 13                    | 12082500       | Nisqually River near National, Washington             | 133                              | 1942-90                       | 1977                 | 11.96              | 17,100                         | Jan. 9 | 11.40              | 14,500                         | 25                          |
| 14                    | 12083000       | Mineral Creek near Mineral, Washington                | 75.2                             | 1942-90                       | 1972                 | --                 | 9,740                          | Jan. 9 | 13.56              | 13,800                         | 100                         |
| Puyallup River basin  |                |   |                                  |                               |                      |                    |                                |        |                    |                                |                             |
| 15                    | 12092000       | Puyallup River near Electron, Washington              | 92.8                             | 1908-25<br>1945-48<br>1957-90 | 1917<br>1946<br>1959 | --<br>--<br>--     | 7,700<br>9,100<br>10,800       | Jan. 9 | --                 | 9,900                          | 25                          |
| 16                    | 12093500       | Puyallup River near Orting, Washington                | 172                              | 1931-90                       | 1962                 | 11.82              | 15,300                         | Jan. 9 | 10.39              | 11,600                         | 10                          |
| 17                    | 12095000       | South Prairie Creek at South Prairie, Washington      | 79.5                             | 1950-71<br>1988-90            | 1955<br>1988         | --<br>30.67        | 6,850<br>2,440                 | Jan. 9 | 33.55              | 8,330                          | 100                         |
| 18                    | 12099600       | Boise Creek at Buckley, Washington                    | 15.4                             | 1977-81<br>1981-90            | 1979<br>1984         | 3.25<br>5.18       | 545<br>972                     | Jan. 9 | 3.76               | 673                            | <10                         |
| 19                    | 12101500       | Puyallup River at Puyallup, Washington                | 948                              | 1914-90                       | 1933                 | --                 | 57,000                         | Jan. 9 | 28.04              | 44,800                         | 50                          |
| Duwamish River basin  |                |   |                                  |                               |                      |                    |                                |        |                    |                                |                             |
| 20                    | 12104500       | Green River near Lester, Washington                   | 96.2                             | 1945-90                       | 1959                 | --                 | 22,000                         | Jan. 9 | 8.28               | 14,000                         | 20                          |
| 21                    | 12112600       | Big Soos Creek above Hatchery near Auburn, Washington | 66.7                             | 1960-90                       | 1972                 | 6.17               | 1,090                          | Jan. 9 | 7.55               | 1,750                          | 100                         |
| Snohomish River basin |                |   |                                  |                               |                      |                    |                                |        |                    |                                |                             |
| 22                    | 12145500       | Raging River near Falls City, Washington              | 30.6                             | 1974-90                       | 1986                 | 6.27               | 5,330                          | Jan. 9 | 6.02               | 4,640                          | 50                          |
| 23                    | 12149000       | Snoqualmie River near Carnation, Washington           | 603                              | 1928-90                       | 1932                 | 59.88              | 59,500                         | Jan. 9 | 59.06              | 48,900                         | 10                          |

Table 2.--Precipitation totals for period January 3-10, 1990  
at selected climatological stations in northwestern  
Oregon and southwestern Washington

| Site number | Station              | Precipitation (inches) |
|-------------|----------------------|------------------------|
| 1           | Tillamook 1 W        | 10.3                   |
| 2           | Lees Camp            | 18.4                   |
| 3           | Nehalem 9 NE         | 16.6                   |
| 4           | Grays River Hatchery | 14.3                   |
| 5           | Toledo               | 7.1                    |
| 6           | Rainier Ohanapecosh  | 12.4                   |
| 7           | Centralia            | 8.0                    |
| 8           | Olympia WSO AP       | 8.6                    |
| 9           | Buckley 1 NE         | 6.9                    |
| 10          | Snoqualmie Falls     | 9.7                    |

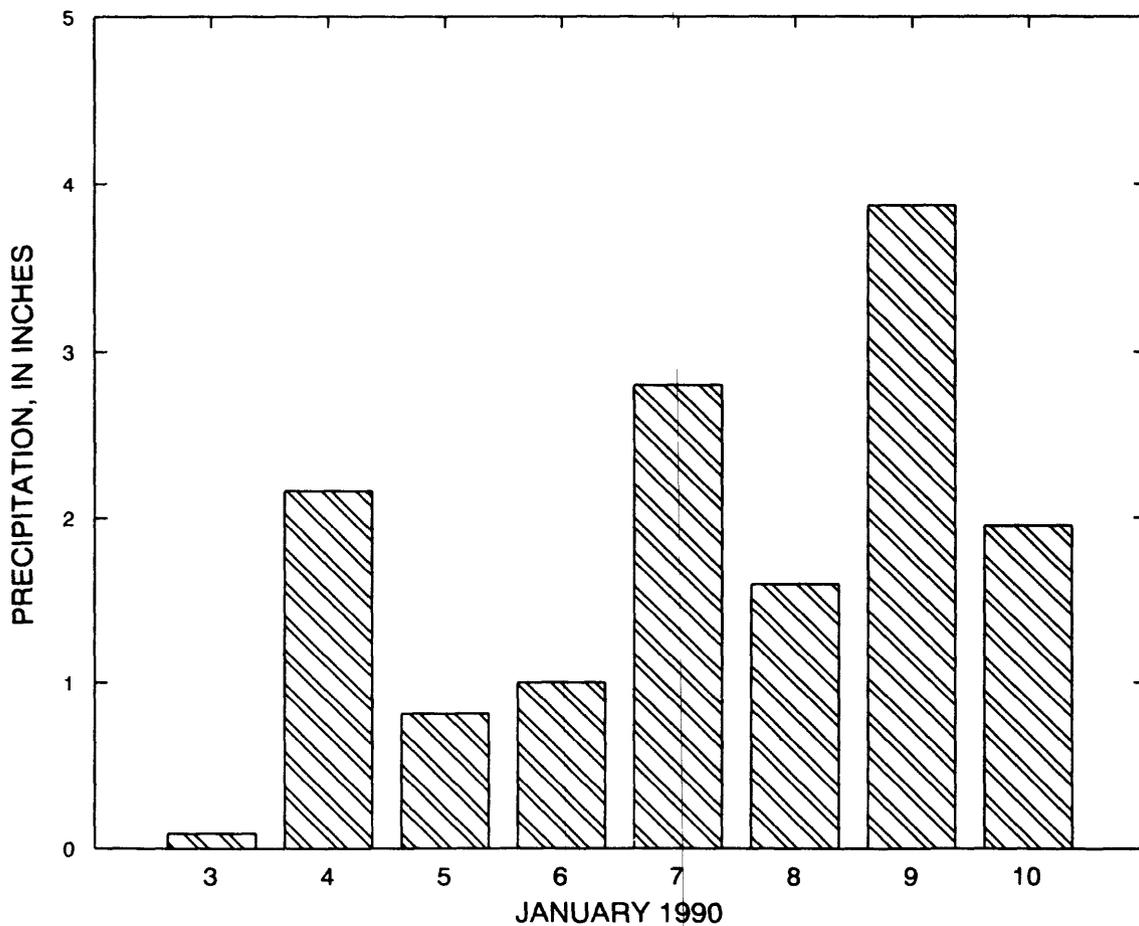


Figure 2.--Daily precipitation record at Grays River Hatchery, Washington, January 3-10, 1990.

## THE FLOODS

Heavy flooding occurred from Tillamook on the northern Oregon coast to eastern drainages of Puget Sound in western Washington. The heavy precipitation surges that occurred during the continuing rains of January 3-11 resulted in more than one flood peak on many of the rivers in the storms path (fig. 3). The rivers did not return to base flow between storms. The early precipitation saturated the soils in the river basins and added greatly to the runoff potential when the heaviest rains arrived on January 9. The severity of flooding on the north Oregon Coast was increased because the floodwaters of coastal rivers were backed up by high Pacific Ocean tides.

The major flooding in Oregon occurred in the Wilson River and Nehalem River basins. The Wilson River flood peak had only a 25-year recurrence interval, but the flooding of the Wilson River at the town of Tillamook was unusual because high tides created backwater and caused even higher flood stages than would have been experienced by the discharge alone. The Nehalem River peak was a 100-year flood that exceeded the discharges of any previous known floods on the river (table 1).

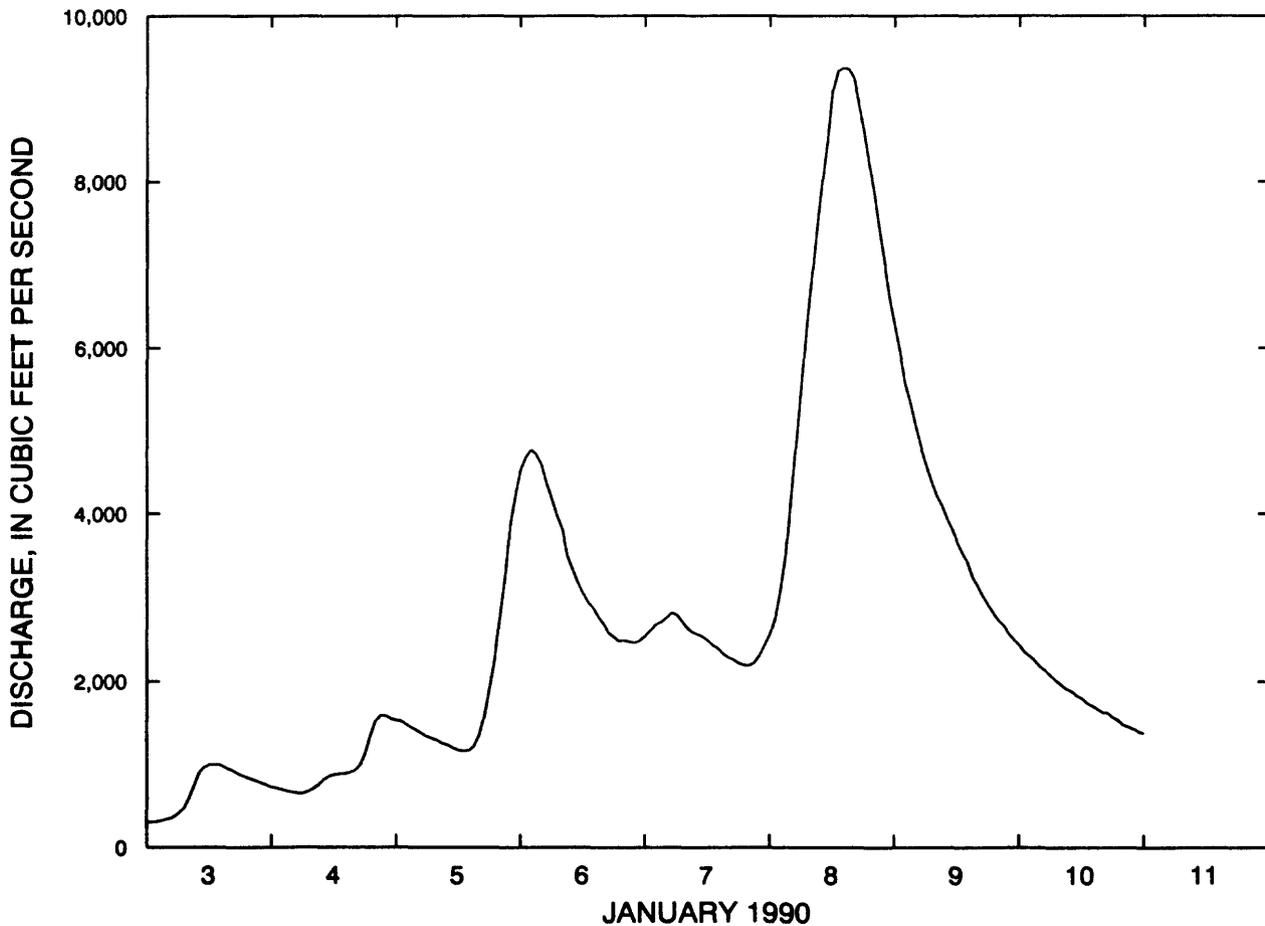


Figure 3.--Instantaneous discharge, of Naselle River near Naselle, Washington, January 3-11, 1990.

The heaviest flooding in Washington occurred in the Chehalis, Deschutes, Nisqually, and Puyallup River basins. Flood peaks at three gaging stations on the Chehalis River were estimated as the 100-year flood. The gaging station on the Deschutes River near Rainier, Washington also recorded a 100-year flood. Peaks of record were recorded at the following gaging stations in Washington State: Willapa River near Willapa, Chehalis River near Doty, Chehalis River near Grand Mound, Chehalis River at Porter, Deschutes River near Rainier, Mineral Creek near Mineral, and Big Soos Creek above Hatchery near Auburn and South Prairie Creeks.

#### THE DAMAGES

The floodwaters affected hundreds of homes, businesses and farms in both States. Many public facilities, such as sewage and electrical facilities sustained damage. "A hospital in Centralia was completely isolated as all the roads leading to it were inundated with water" (U.S. Federal Emergency Management Agency Region X, 1990a). Damage to roads and railroads was extensive in both states. Interstate Highway 5 (I-5), the principal north-south highway in western Oregon/Washington, was closed for several days between Chehalis and Centralia, Washington due to flooding. The highway was inundated with about 5 feet of water in that area. Four persons in the state of Washington lost their lives in the floods.

As a result of the flood damage, a Presidential Disaster Declaration was issued for two counties in Oregon and six counties in Washington. The two counties in Oregon were Tillamook and Clatsop; the six counties in Washington were Lewis, Grays Harbor, King, Pierce, Thurston, and Wahkiakum. Damage figures recorded for those counties are shown in table 3. The values shown in table 3 were obtained from U.S. Federal Emergency Management Agency Region X (1990a and 1990b), and written communication, Lora Murphy, Washington State Department of Emergency Management, 1990. Only those damages over \$50,000 are shown in the tables although there were many other damages of lesser amounts reported from other towns and utilities. Total flood damage for both states exceeded 19 million dollars.

Table 3.--Storm damages in excess of \$50,000 (rounded to the nearest thousand dollars) reported by towns, cities, counties, and utilities in the states of Oregon and Washington

[Damages resulting from wind and landslides as well as flood damage are listed below, but the majority of the damages are the result of flooding]

| Location                         | Damages     |
|----------------------------------|-------------|
| Oregon                           |             |
| Tillamook County                 | \$8,000,000 |
| Clatsop County                   | 367,000     |
| Washington                       |             |
| Lewis County                     | 966,000     |
| City of Chehalis                 | 149,000     |
| City of Centralia                | 410,000     |
| Lewis County PUD # 1             | 70,000      |
| Thurston County                  | 166,000     |
| City of Montesano                | 91,000      |
| Grays Harbor County              | 346,000     |
| City of Puyallup                 | 82,000      |
| Pierce County                    | 976,000     |
| City of Tacoma                   | 336,000     |
| City of Sumner                   | 74,000      |
| City of Auburn                   | 67,000      |
| City of Tukwilla                 | 92,000      |
| City of Renton                   | 108,000     |
| City of Issaquah                 | 98,000      |
| City of Kent                     | 109,000     |
| City of Bellevue                 | 62,000      |
| King County                      | 4,609,000   |
| Wahkiakum County                 | 53,000      |
| City of Pacific                  | 76,000      |
| Sammamish Plateau W & S District | 85,000      |
| Cedar River W & S District       | 71,000      |
| Port of Seattle                  | 53,000      |
| Seattle Metro                    | 115,000     |

## SELECTED REFERENCES

- Cummins, J.E., Collings, M.R., and Nassar, E.G., 1975, Magnitude and frequency of floods in Washington: U.S. Geological Survey Open-File Report 74-336, 46 p., 3 plates.
- Harris, D.D., Hubbard, L.L., Hubbard, L.E., 1979, Magnitude and frequency of floods in western Oregon: U.S. Geological Survey Open-File Report 79-553, 35 p., 2 plates.
- U.S. Federal Emergency Management Agency Region X, 1990a, Hazard mitigation opportunities in the State of Washington: Report of the Interagency Hazard Mitigation Team, FEMA-852-DR-WA, 47 p.
- \_\_\_\_\_ 1990b, Interagency flood hazard mitigation report, 1990, In response to the January 18, 1990 disaster declaration, State of Oregon, Tillamook and Clatsop Counties, FEMA-853-DR-OR, 30 p.
- U.S. National Oceanographic and Atmospheric Administration, 1990a, Climatological data, Oregon, January 1990: U.S. Department of Commerce, v. 40, no. 1, 35 p.
- \_\_\_\_\_ 1990b, Climatological data, Washington, January 1990: U.S. Department of Commerce, v. 94, no. 1, 25 p.
- \_\_\_\_\_ 1990c, Hourly precipitation data, Oregon, January 1990, U.S. Department of Commerce, v. 1, no. 1, 36 p.
- U.S. Water Resources Council, 1981, Guidelines for determining flood flow frequency: U.S. Water Resources Council Bulletin 17b, 183 p.