FLOOD PROFILES AND INUNDATED AREAS ALONG THE LOWER NISQUALLY RIVER WASHINGTON

U.S. GEOLOGICAL SURVEY
Water-Resources Investigations 42-73

Prepared by Water Resources Division,
Washington District, in Cooperation With
State of Washington Department of Ecology

BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	3. Recipient's Accession No.

4. Title and Subtitle
Flood Profiles and Inundated Areas Along the Lower Nisqually River, Washington

5. Report Date
October 1973

6.

7. Author(s)
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8. Performing Organization Rept. No. WRI-42-73

9. Performing Organization Name and Address
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Washington District
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10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address
U.S. Geological Survey, WRD
Washington District
1305 Tacoma Avenue So.
Tacoma, Washington 98402

13. Type of Report & Period Covered
Final

14.

15. Supplementary Notes
Prepared in cooperation with the Washington State Department of Ecology

16. Abstracts

Nisqually River flood profiles, covering the reach from near the river mouth to river mile 6.4, indicate that the main channel will convey without overflow discharges as large as about 21,000 cubic feet per second; this discharge has a 6-year recurrence interval. The banks in some areas will be overtopped at 25,500 cubic feet per second, which has a 13-year recurrence interval. Determined for six flood-profile stations were areas where overbank flooding first occurs and water-surface profiles of 3.4-year and 100-year floods. Alder and La Grande Reservoirs can reduce the magnitude of lower annual flood peaks downstream to some extent, but insufficient data are available to allow prediction of their effects on very large floods.

17. Key Words and Document Analysis. 17a. Descriptors

Flood plains/ Floodwater/ High water mark/ Historic flood/ maximum probable flood/ Stage-discharge relations

17b. Identifiers/Open-Ended Terms

Floodflows and inundation areas in western Washington/ Flood-profile information in Washington

17c. COSATI Field/Group Ø 2 A

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
No restriction on distribution	UNCLASSIFIED	9
	20. Security Class (This Page) UNCLASSIFIED	22. Price No charge

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1974

UNITED STATES DEPARTMENT OF THE INTERIOR

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GEOLOGICAL SURVEY

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ABSTRACT

Nisqually River flood profiles, covering the reach from near the river mouth to river mile 6.4, were developed in a 2-year field study (1970-72) as part of a continuing program with the State of Washington Department of Ecology. The main channel of the reach will convey without overflow discharges as large as about 21,000 cubic feet per second, which have a 6-year recurrence interval. The banks in some areas will be overtopped at 25,500 cubic feet per second, which has a 13-year recurrence interval. The areas where overbank flooding will first occur, and water-surface profiles of a 3.4-year and 100-year flood were determined for six flood-profile stations. The largest flood for which data are available was that of December 1933; the approximate area that would be presently inundated by such a flood is shown. Alder and La Grande Reservoirs can reduce the magnitude of lower annual flood peaks downstream to some extent, but insufficient data are available to predict their effects on very large floods.

INTRODUCTION

During the 1971 fiscal year a part of the U.S. Geological Survey's cooperative program with the State of Washington Department of Ecology involved the installation of flood-profile gages on the Nisqually River to provide data for flood studies by the department. A summary of the data collected for 1970-72, together with an analysis of flood characteristics, is given below for the reach of the river studied. The report was prepared under the general supervision of L. B. Laird, district chief. Critical review of the manuscript by D. O. Moore and Donald Richardson of the Geological Survey enhanced the final report.

Crest-stage gages, which record the maximum stage occurring between inspections, were installed in June 1970 at six locations along the Nisqually River from its mouth to river mile 6.4. The locations of the gages (profile stations) and river miles are shown in figure 1 and are described as follows:

Profile station number	River mile	Location
1	6.4	NW¼SE¼ sec.21, T.18 N., R.1 E., on left bank 2 miles southeast of Nisqually.
2	4.9	SW¼NE¼ sec.16, T.18 N., R.1 E., on left bank 1 mile southeast of Nisqually.
3	3.8	NW¼SW¼ sec.9, T.18 N., R.1 E., on left bank at downstream side of railroad trestle ½ mile east of Nisqually.
4	2.7	NW¼NE¼ sec.8, T.18 N., R.1 E., on left bank at Franks Landing ¾ mile north of Nisqually.
5	2.4	On left bank just downstream from westbound lanes of I-5, 1 mile north of Nisqually.
6	1.4	SE¼SW¼ sec.32, T.19 N., R.1 E., on left bank 2 miles north of Nisqually.

The Geological Survey has operated several gaging stations for many years in the Nisqually River basin. Tabulated below for those stations pertinent to this study, are data on location, period of record, and maximum discharges in cfs (cubic feet per second).

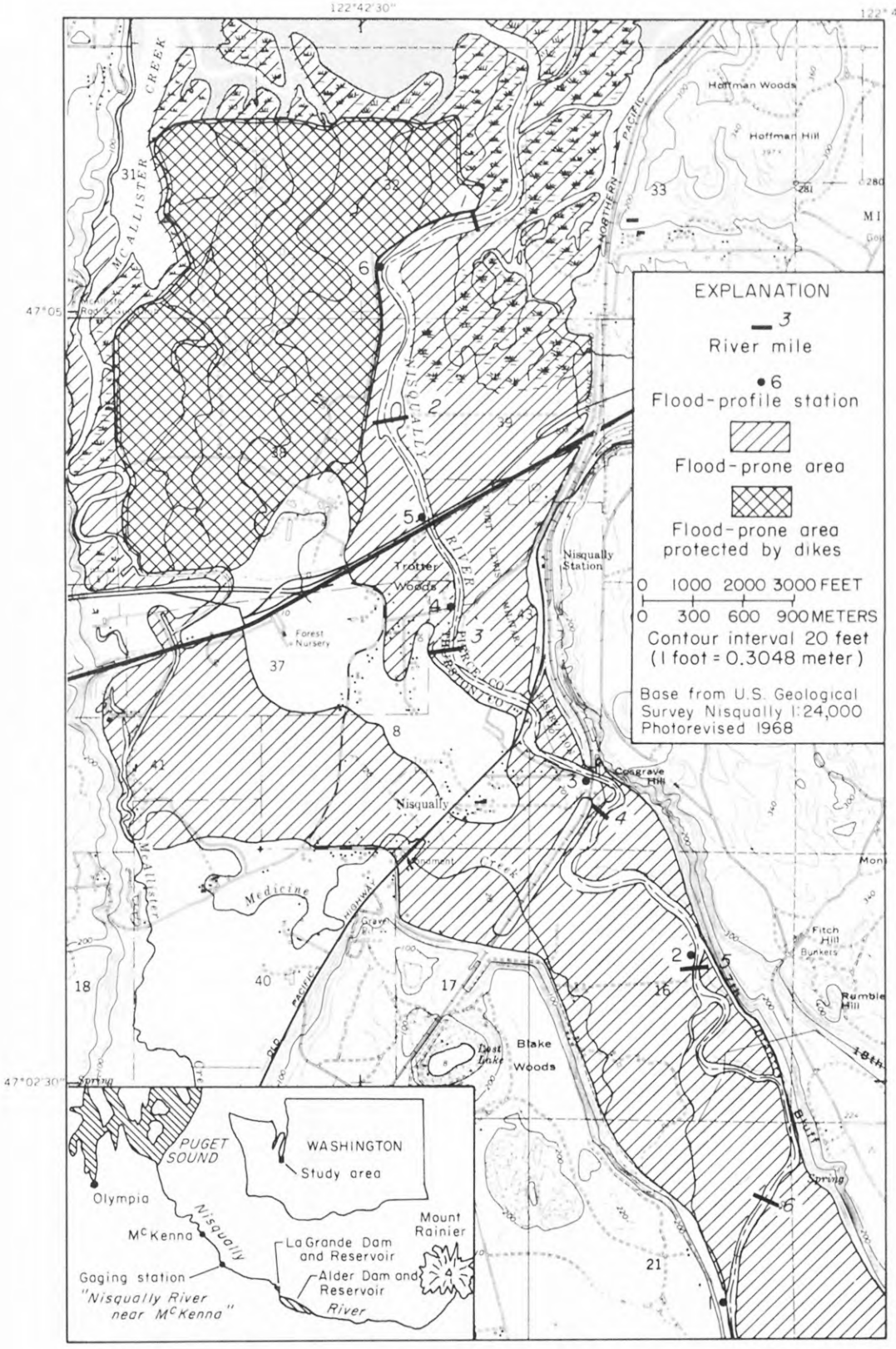

FIGURE 1.--Area estimated to be subject to inundation by recurrence of flood discharge similar to that of December 1933.

Station name or location	River mile location	Drainage area (sq mi)	Years of operation	Maximum discharge	
				cfs	Date
Nisqually River near Alder	47.7	252	1931-44	25,000	12/22/33
Nisqually River above Powell Creek	32.6	431	1970-present	17,400	2/29/72
Nisqually River near McKenna	31.6	445	1941-63	20,800	12/12/55
Nisqually River at McKenna	21.8	517	1947-68	25,700	1/29 65
Nisqually River at Interstate Highway 5	2.4	711	1933 1959-present	[a]/42,000 25,500	12/22/33 1/29 or 1/30/65

[a]/ Estimated.

FLOOD OF DECEMBER 1933

Historical information furnished by residents indicate that the most severe flooding in the downstream reach of the Nisqually River occurred on or about December 22, 1933, with a stage of 15.8 feet at station 4 (as described by a resident) and 14.0 feet at station 5 (from State Highway Department bridge plans). Discharge of the 1933 flood in the study area was estimated by the Geological Survey to have been 42,000 cfs.

The flood was observed by residents to flow through the county road tunnel in the center of the E½ sec.17. Water surface at a resident's garage, one-half mile southwest of Nisqually and upstream from Old Pacific Highway, was reported to have been between 2 and 3 feet above ground level. The newspapers reported that water was 18 inches deep over Old Pacific Highway south of the bridge in section 8, and a resident near the center of the east half of section 8 reported this overflow was within 100 feet of her home; the floodwater flowed west toward McAllister Creek. Logjams were reported at the railroad trestle near station 3, and have been mentioned by other residents as occurring during more recent floods, causing irregular flood profiles, overflow, and channel changes.

The approximate area subject to flooding under present conditions by a flood discharge similar to that of 1933 is shown in figure 1. The boundaries of inundated areas shown in figure 1 are believed to be reasonably accurate, but probably are least reliable for the area along the west side of the valley between the Old Pacific Highway and Interstate 5 (U.S. Hwy. I-5), in section 7 and the south half of section 8.

FLOOD OF JANUARY 1965

The flood of January 1965 (25,500 cfs) overtopped the banks of the river at various points, discussed here in downstream order. Water-surface elevations referred to are based on U.S. Coast and Geodetic Survey datum of 1929, supplemental adjustment of 1947.

In the west half of section 16, Medicine Creek (fig. 1) was flowing bankfull as reported by a resident. It was receiving Nisqually River overflows farther upstream and flowed toward a culvert through the railroad fill in the NE¼ sec.17. The culvert is unable to carry much flow and during this flood the area immediately upstream from the railroad fill was inundated. Some water also escaped through the county road tunnel in the center of the E½ sec.17. At the time of the flood, the elevation of the floodwater ponded at the upstream end of the tunnel was 26.45 feet. Since then, the road at the upstream end of the tunnel has been raised to elevation 26.9 feet.

The water overtopped the dike (elev. 20.9 ft) at river mile 3.5, on the left bank between the railroad trestle at station 3 and Old Pacific Highway (fig. 1). During the flood the water surface at this point was at 21.6 feet elevation, which may be slightly superelevated above the normal profile as the river channel is in a sharp turn to the north.

This flood also was observed at Franks Landing (station 4 on fig. 1) to be overflowing a part of the right bank, with water slightly more than 1 foot deep at the time of the peak stage (elev. 14.86 ft).

PEAK FLOW OF FEBRUARY 1972

The maximum discharge in the reach during the period of this study (1970-72) was 17,500 cfs on February 29, 1972. The flow was contained within the banks of the main channel and no flooding occurred.

FLOOD FREQUENCIES

A flood-frequency curve based on 25 years of data for the station near McKenna and developed from the log-Pearson Type III method of curve fitting, was adjusted to the 711-square-mile drainage area at the profile reach at Interstate Highway 5. The curve is based on observed flow records as affected by operation of the Alder and La Grande Reservoirs. The flood-frequency curve indicates recurrence intervals for selected floods as follows:

Date	Discharge (cfs)	Recurrence interval (years)
Dec. 22, 1933	42,000	>100
Jan. 1965	25,500	13
Feb. 29, 1972	17,500	3.4

The discharge of floods having 50- and 100-year recurrence intervals are about 32,600 and 35,800 cfs, respectively.

The following table shows, at each profile station, the water-surface elevations of the flood peak of February 29, 1972, and the projected elevations of floods having recurrence intervals of 50 and 100 years. At two of the stations elevations are also shown for the floods of January 1965 and December 1933.

Date, or recurrence interval	Water-surface elevation at profile station (feet above mean sea level)					
	1	2	3	4	5	6
Feb. 29, 1972	42.09	27.77	19.42	12.54	11.17	9.24
January 1965				14.86	12.91	
December 1933				15.8	14.0	
50-year flood	44.4	30.0	23.2	15.4	13.4	10.7
100-year flood	44.6	30.4	23.5	15.7	13.6	10.8

The approximate profiles for the peak discharge February 29, 1972 and for the projected 100-year flood are shown in figure 2.

The 50- and 100-year elevations were determined by means of logarithmic extensions of the curves of stage-discharge relation that were developed at each of the profile stations. The water-surface elevations downstream from about river mile 3.2 are affected by backwater from tide.

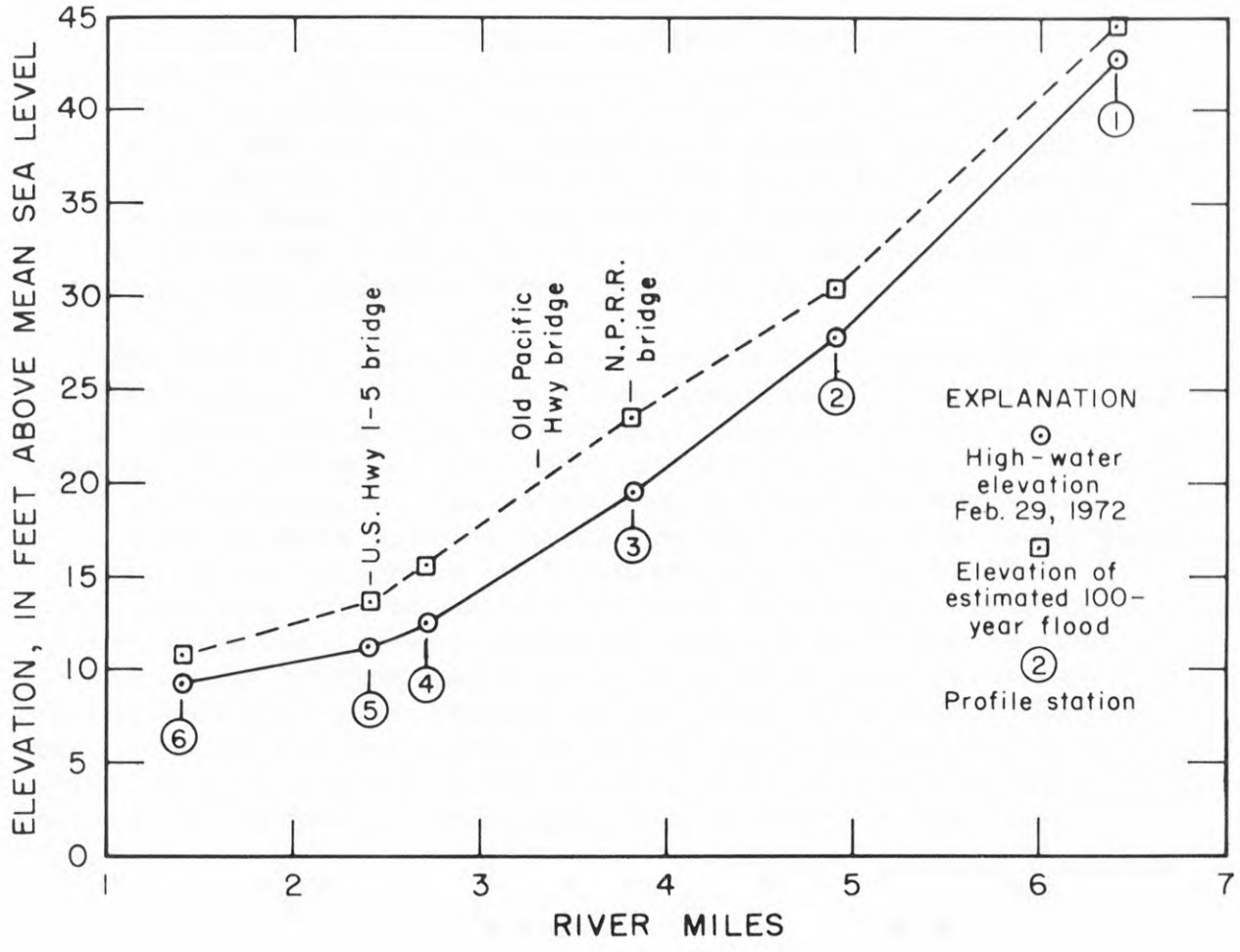

FIGURE 2.--Flood profiles at selected stations along Nisqually River.

The channel reach studied has been observed to contain flows as large as about 21,000 cfs (6-year recurrence interval) and the overbank flooding in some areas occurs noticeably at 25,500 cfs. (See comments on January 1965 flood.) At flows greater than 21,000 cfs, the right bank is subject to overflow from the railroad trestle downstream to the mouth, as is the left bank in section 21 near the head of Medicine Creek upstream from the railroad fill.

The depth of inundation (or flood height) near the east and west edges of the flood plain downstream from the trestle is not predicted by the main-channel flood profile. In general the ground at the edges of the flood plain is lower than at the banks of the river's main stem, and overflow will tend to seek a tidal height on the right bank (east side of the valley) probably at about station 6. On the left bank overflow will be westerly toward McAllister Creek upstream from the freeway crossing, and, if overflow is prolonged, some ponding could occur as high as the elevation of the banks of that channel in sections 37 and 41. The left bank of the main stem is diked sufficiently to prevent overflow from a point a few hundred feet downstream from Interstate Highway 5 (U.S. Hwy. I-5 on map) to the river mouth.

Alder and La Grande Reservoirs reduce flood peaks downstream, especially those of smaller magnitude; however, flood storage is not their principal function. The available data suggest that the reservoirs would have only limited effect on the reduction of extreme floods.