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FLOOD PROFILES AND INUNDATED AREAS ALONG THE WHITE RIVER CHELAN COUNTY, WASHINGTON

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

1974

UNITED STATES DEPARTMENT OF THE INTERIOR

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In recognition of a worldwide trend to adoption of the metric system of measurements (SI or System Internationale), the following factors are provided for conversion of English values used in this report to metric values:

Multiply	By	To obtain
Inches	2.54	centimeters (cm)
Feet (ft)	0.3048	meters (m)
Miles (mi)	1.609	kilometers (km)
Square miles (mi^2)	2.590	square kilometers (km^2)
Cubic feet per second (ft^3/s)	0.02832	cubic meters per second (m^3/s)

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By John Savini, C. F. Schneider, and D. E. LaFrance

ABSTRACT

Flood profiles covering the main stem to river mile 11.0 (kilometer 17.7) of the White River in Chelan County, Wash., were developed in a 3-year field study (1970-72) in cooperation with the State of Washington Department of Ecology. Flood-frequency curves based on an average of a regional computation and a Log-Pearson Type III analysis of 18 years of record indicate that the 100-year flood will have a discharge of about 6,600 cubic feet per second, or about 186 cubic meters per second, at river mile 6.4, or kilometer 10.3. Discharge of a 50-year flood was computed to be about 6,300 cubic feet per second, or about 178 cubic meters per second. The greatest flood discharge during the study period occurred on June 10, 1972, and was 5,310 cubic feet per second, or about 150 cubic meters per second; such a discharge has a recurrence interval of 4 years. Most of the flood plain of the White River probably is inundated during a 100-year flood.

INTRODUCTION

During the 1970 fiscal year a part of the cooperative program of the U.S. Geological Survey with the State of Washington Department of Ecology involved the installation of flood-profile gages along the 11.0 miles (17.7 kilometers; km) of the White River above its mouth. The study was made to provide data on selected recurrence intervals and profiles of floods along the flood plain of the river. A summary of the flood-profile data collected for 1970-72, together with an analysis of flood characteristics, is given for the reach of

the stream studied. Water-surface elevations are based on sea-level datum of 1929, supplemental adjustment of 1947.

The critical review of the manuscript by J. E. Cummans and J. H. Bartells of the Geological Survey benefited the report.

DATA COLLECTION

River-Profile Stations

Crest-stage gages, which record the maximum stage, were installed in June 1970 at six sites on the White River (fig. 1). In addition, an existing stream-gaging station (profile station D) and the discontinued gage on Wenatchee Lake (profile station A) were utilized as profile gages. Station A is a lake-level gage on Wenatchee Lake, and is located 1.2 miles downlake from the river mouth, or at river mile -1.2. The eight gages (profile stations) extend from station A on the lake (Wenatchee River mile 57.4, or km 92.4) to station H on the White River at river mile 11 (km 17.7). The locations of these profile stations are described as follows:

Profile station in fig. 1	River mile	Location
On Wenatchee Lake:		
A	-1.2	NE¼NE¼ sec.24, T.27 N., R.16 E., on left shore 1.9 mi southeast of Telma, 1.2 mi downlake from the mouth of White River, and 3 mi uplake from the lake outlet.
On White River:		
B	2.2	SE¼SW¼ sec.10, T.27 N., R.16 E., on left bank at U.S. Forest Service bridge, 0.9 mi west of Telma.
C	4.9	SE¼SW¼ sec.4, T.27 N., R.16 E., on left bank 2.1 mi northwest of Telma.

Profile station in fig. 1	River mile	Location
On White River--continued		
D	6.4	USGS gaging sta. 12459000 in NE¼NE¼ sec.5, T.27 N., R.16 E., on left bank 200 ft downstream from Sears Creek Bridge.
E	8.0	NE¼NE¼ sec.32, T.28 N., R.16 E., on left bank 3.9 mi northwest of Telma.
F	9.0	SE¼NW¼ sec.29, T.28 N., R.16 E., on left bank 4.9 mi northwest of Telma.
G	10.0	SW¼SE¼ sec.19, T.28 N., R.16 E., on left bank 5.4 mi northwest of Telma.
H	11.0	SW¼SE¼ sec.18, T.28 N., R.16 E., on left bank at the Napeequa crossing campground, 0.1 mi downstream from confluence of Napeequa River, and 6.4 mi northwest of Telma.

Streamflow Records

At river mile 6.4 (km 10.3; profile station D) the Geological Survey has operated a nonrecording gage from 1911 to 1914 and a recording gage since 1954 (USGS gaging sta. 12454000). The drainage area is 150 mi^2 (389 km^2) and the maximum discharge of 5,780 ft^3/s (164 m^3/s) occurred on May 26, 1958. Peak flows are generally within 10 percent of the daily mean flow. The datum of the gage is 1,881.92 feet (573.61 m) above mean sea level. The annual peaks for the period 1954-72 are presented in table 1. Note the rather small range in peak discharge. Also note that 10 of the annual peaks during the 18 years of gaging-station operation exceeded 5,000 ft^3/s (142 m^3/s).

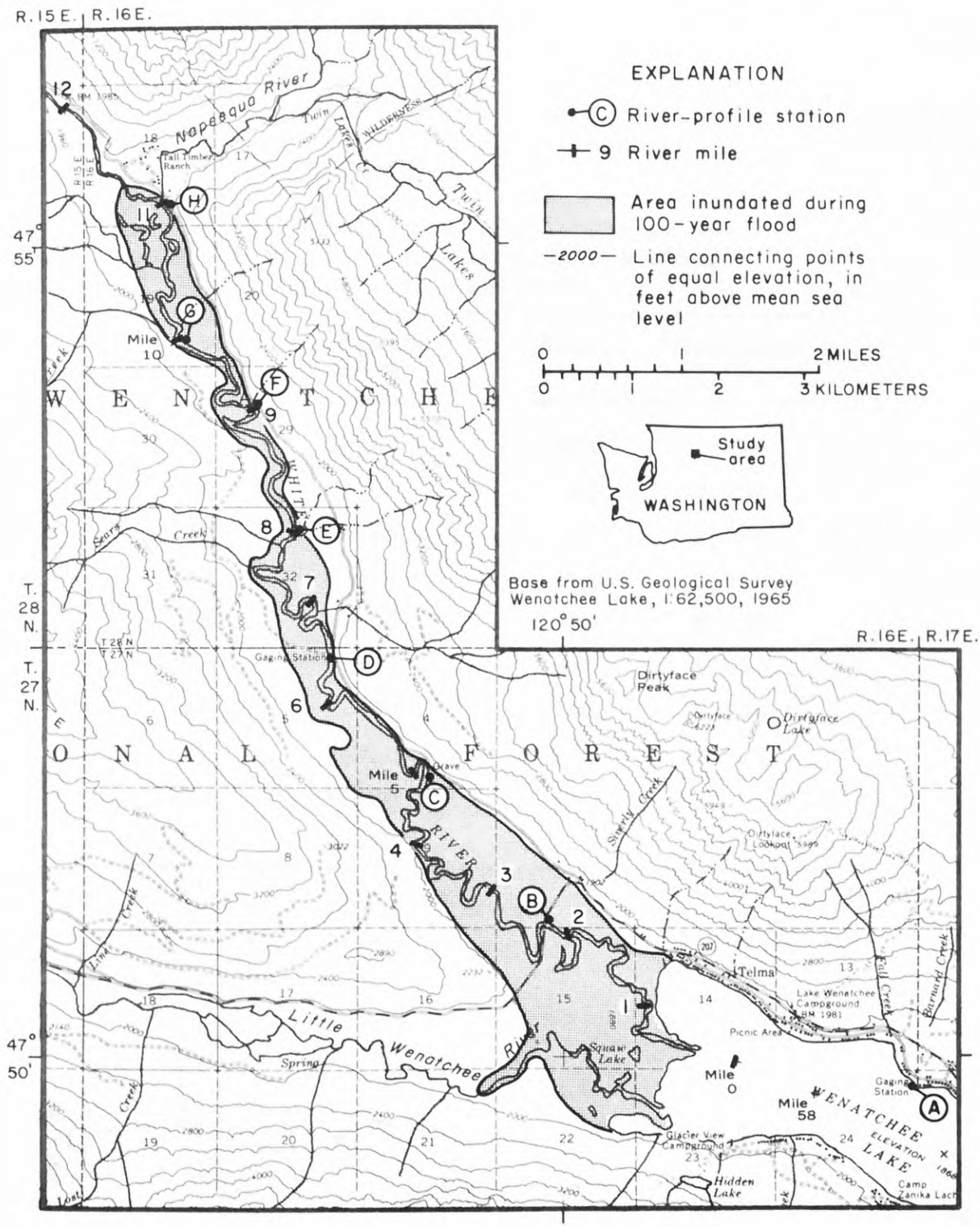

FIGURE 1.--Reaches of White River and Wenatchee Lake studied, locations of river-profile stations and river miles, and approximate area subject to inundation during a flood with 100-year recurrence interval.

TABLE 1.--Annual peak discharges of the White River at river-profile station D (USGS gaging sta. 12454000)

Water year	Discharge (ft^3/s)	Water year	Discharge (ft^3/s)
1955	5,360	1965	3,980
56	5,700	66	4,150
57	4,460	67	5,240
58	5,780	68	5,700
59	4,590	69	5,200
1960	4,320	1970	5,020
61	5,430	71	4,580
62	3,270	72	5,310
63	5,030		
64	4,480		

FLOODS

The White River and the Little Wenatchee River, the latter with a drainage area of 100 mi^2 (259 km^2) above its mouth, are the two principal streams emptying into Wenatchee Lake, and they comprise the headwaters of the Wenatchee River. The meander scours on the flood plain of the White River indicate that flooding has occurred frequently in the study reach. The largest flood in recent years probably occurred in late May 1948 but there is no record available for the White River for that flood. Another large flood occurred in December 1921 but little is known of that event.

The only direct professional observations of flooding on the White River during the 1954-72 period of operation of the gaging station (river-profile station D) were those of B. N. Aldridge (written commun., June 12, 1955). On that date 5,050 ft^3/s (143 m^3/s) was measured at a river gage elevation of 1,894.65 ft (577.49 m) and a lake elevation of 1,877.14 ft (572.15 m). Aldridge described the entire flat between the gage and road just above Wenatchee Lake as being under water. He had to drive through water in three places to reach the gaging station and wade through water with depths as great as 2.5 ft (0.76 m) to reach the cableway on the left bank. On the right bank the water was over the bank for about one-half mile (0.8 km). Both of these overflow areas were in heavy brush and appeared to consist largely of ponded water. Also, there was considerable overflow upstream from the gage, most of which returned to the channel above the gage. By pacing off the distance along the logging road which runs west from the gage, measuring occasional depths, and timing small drift, Aldridge estimated the overflow bypassing the measuring section at the gage as 150 ft^3/s (4.25 m^3/s). He found about 1,300 ft (396 m) of roadway under water as much as 0.8 ft (0.24 m) but mostly at 0.1- and 0.2-ft (0.030- and 0.061-m) depths. An additional 650 ft (198 m) of roadway had been under water during the peak earlier in the day. The road to the gage and the logging road have been raised since Aldridge's observations.

Aldridge reported the flow at the Little Wenatchee River road passing through five culverts 5 or 6 ft (1.52 or 1.83 m) in diameter as well as over the road. By 1963 the road had been raised and the wooden Forest Service bridge replaced by a concrete bridge with much-improved hydraulic conveyance.

Extensive flooding occurred at the gaging station (site D) on June 4, 1961, at a gage elevation of 1,895.00 ft (577.60 m) and a discharge of 5,230 ft^3/s (148 m^3/s). On June 10, 1972, at an elevation of 1,894.55 ft (577.46 m) and a discharge of 4,730 ft^3/s (134 m^3/s), overflow occurred around the gage, with a water depth of about 1 ft (0.3 m). Streamflow records indicate that parts of the study reach have been subject to inundation for periods as long as 6 days but usually inundation lasts for 3 days or less.

The greatest flood discharge during the 3-year study period (1970-72) occurred on June 10, 1972, and was 5,310 ft^3/s (150 m^3/s), which has a recurrence interval of 4 years. The second highest flood during the study period occurred on May 30, 1972, and had discharge of 5,150 ft^3/s (146 m^3/s), which has a recurrence interval of 3 years.

Flood Frequency

A flood-frequency curve (fig. 2), prepared from the average of a regional computation and a Log-Pearson Type III frequency analysis based on 18 years of record (1955-72) at the stream gage (profile station D), shows the 100-year flood to be about 6,600 ft^3/s (187 m^3/s). Discharge of the 50-year flood was computed to be about 6,300 ft^3/s (178 m^3/s).

Flood Profiles

Table 2 presents elevations at each river-profile station for floods having recurrence intervals of 50- and 100-years and elevations for the peak discharge of June 10, 1972. River-profile station A is a lake gage and the water-surface elevation may be different for floods of the same magnitude on the upstream tributaries, depending on the stage of Wenatchee Lake during the floods. Wenatchee Lake has a surface area of 3.82 mi^2 (9.89 km^2).

Flood profiles of the flood of June 10, 1972, and of the 100-year flood are shown in figure 3.

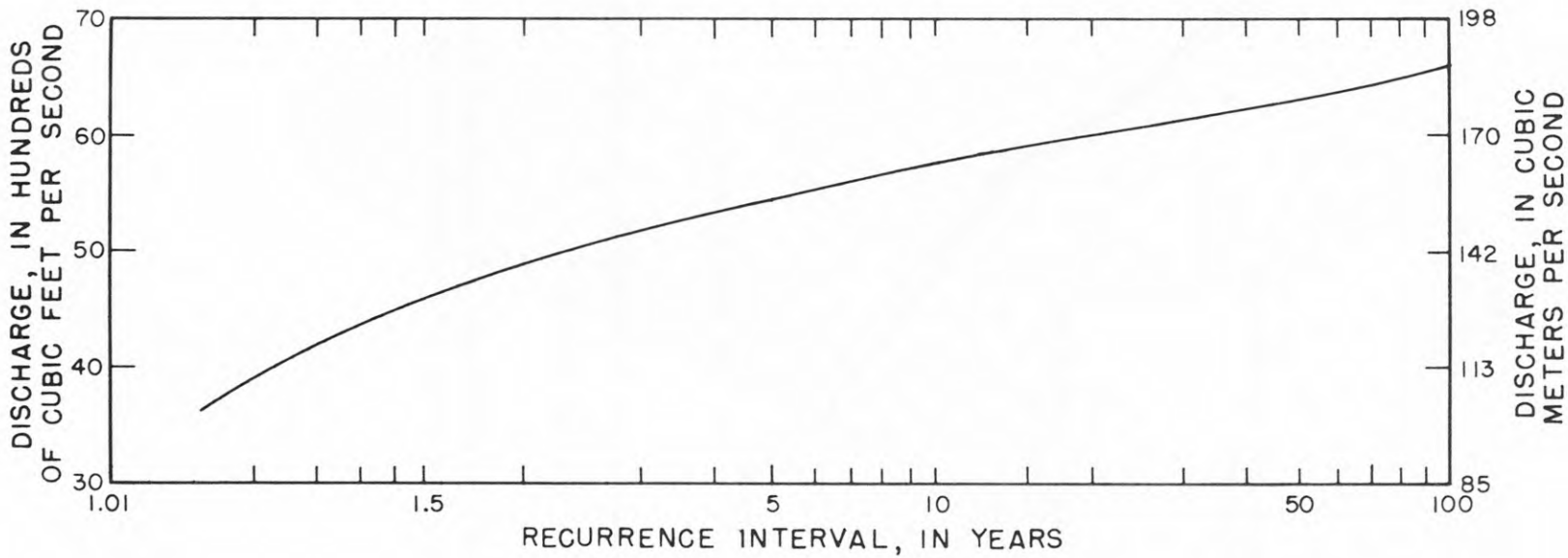

FIGURE 2.--Flood-frequency curve for White River at profile station D (USGS gaging station 12454000). From data for 1955-71.

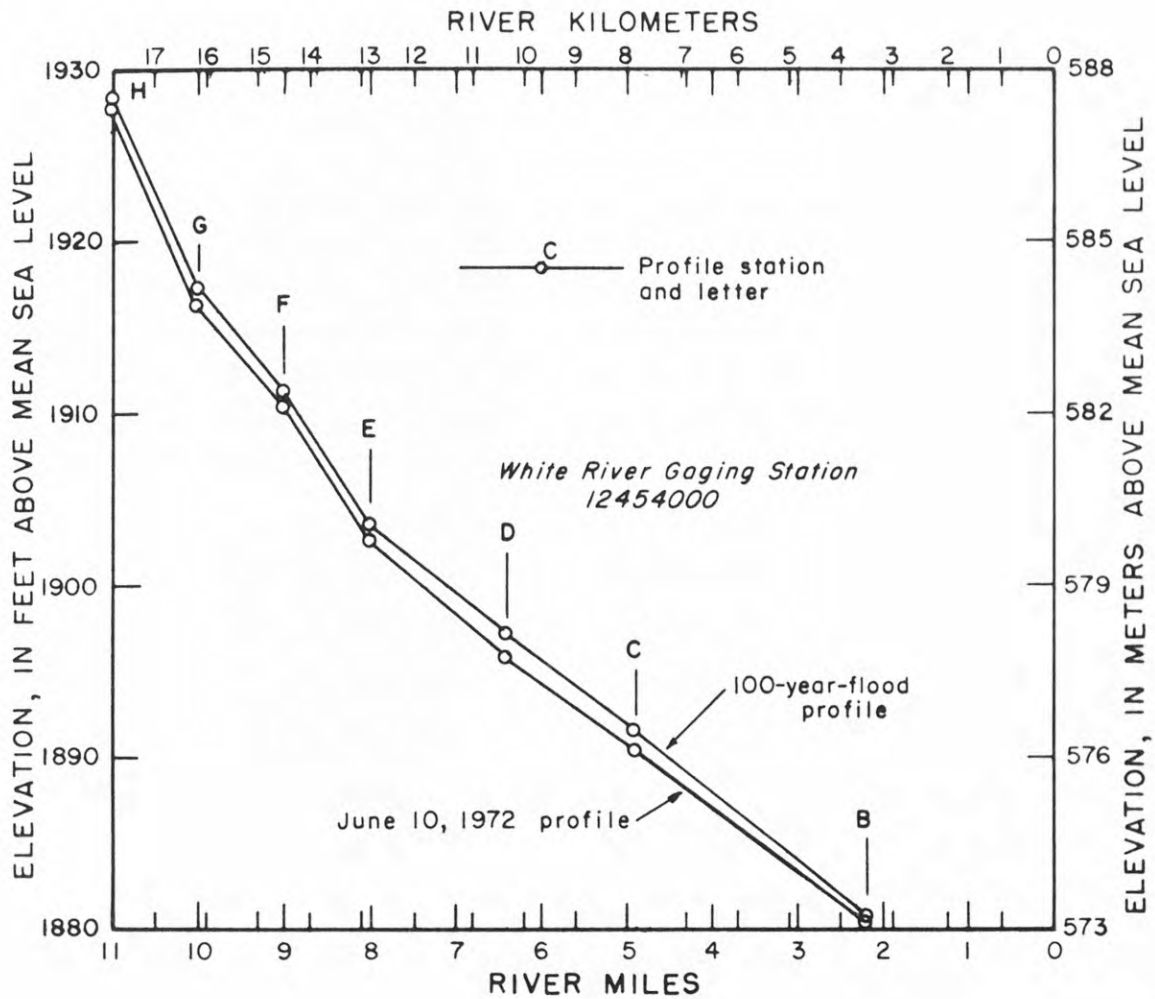

FIGURE 3.--Flood profiles along White River, for flood of June 10, 1972, and for flood with 100-year recurrence interval.

TABLE 2.--Elevations of flood crest at river-profile stations along the White River, for 50- and 100-year floods and for the flood of June 10, 1972

River-profile station	Water-surface elevation (ft above mean sea level)		
	50-year flood	100-year flood	June 10, 1972
B	1,880.95	1,881.20	1,880.32
C	1,891.90	1,892.20	1,890.37
D	1,897.18	1,897.63	1,895.63
E	1,903.60	1,903.85	1,902.49
F	1,911.45	1,911.90	1,910.34
G	1,917.15	1,917.50	1,916.25
H	1,928.55	1,928.80	1,927.78

The elevations of the 50- and 100-year floods were determined by logarithmic extension of the stage-discharge relation developed for each of the river-profile gages. Stage-discharge relations were developed for each of the river-profile stations by transferring data from the gaging station at river-profile station D to the other stations. Peak discharges at station D were plotted against recorded peak stages at the other stations as well as discharge and stage observations made at times stations were visited. The stage-discharge relations are defined to 5,310 ft^3/s (150 m^3/s), and extended by logarithmic plotting to the 100-year flood. The approximate area subject to inundation from a 100-year flood is shown in figure 1.

SUMMARY

The channel reach studied will contain discharges of nearly 4,700 ft^3/s (133 m^3/s) at the gaging station, river-profile station D, and at other points along the channel reach. Ten of the annual peaks occurring during the 18 years of gaging-station operation exceeded 5,000 ft^3/s (142 m^3/s). A study of streamflow records indicates that parts of the study reach have been subject to inundation for periods as long as 6 days but usually 3 days or less.

A 100-year flood will inundate much of the flood plain of the White River. The degree of inundation at the lower end of the reach will be somewhat variable depending on the concurrent contribution of discharge from the Little Wenatchee River and the stage of Wenatchee Lake.

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