Floods of June 1964 in Northwestern Montana

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1840-B

Prepared in cooperation with the State of Montana and agencies of the Federal Government

Floods of June 1964 in Northwestern Montana

By F C BONER *and* FRANK STERMITZ

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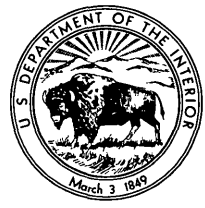

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DEFINITION OF TERMS AND ABBREVIATIONS

The terms and abbreviations of streamflow and other hydrologic data, as used in this report, are defined as follows

Gaging station is a particular site on a stream, canal, lake, or reservoir where systematic observations of gage height or discharge are obtained When used in connection with a discharge record, the term is applied only to gaging stations where a continuous record of discharge is obtained

Crest-stage station is a particular site where limited streamflow data are collected systematically over a period of years for use in hydrologic analyses

Cubic foot per second (cfs) is the rate of discharge of a stream whose channel is 1 square foot in cross-sectional area and whose average velocity is 1 foot per second The volume of water represented by a flow of 1 cubic foot per second for 24 hours is equivalent to 86 400 cubic feet 1 983471 acre-feet, or 646 317 gallons

Cubic feet per second per square mile (cfs per sq mi) is the average number of cubic feet of water flowing per second from each square mile of area drained, assuming that the runoff is distributed uniformly in time and area

Acre-foot (acre-ft) is the quantity of water required to cover an acre to a depth of 1 foot and is equivalent to 43,560 cubic feet or 325,851 gallons The term is usually used in relation to storage and volume of runoff

Runoff, in inches (in) is the depth to which the drainage area would be covered if all the runoff for a given time period were uniformly distributed on its surface

Drainage area of a stream at a specified location is that area, measured in a horizontal plane which is so enclosed by a topographic divide that direct surface runoff from precipitation normally would drain by gravity into the stream above the specified point Drainage area is expressed in square miles in this report

Contents is the volume of water in a reservoir or lake and is expressed in acre-feet Volume is computed on the basis of a level pool and does not include bank storage

Stage-discharge relation is the relation between gage height and the rate of flow

Time of day is expressed in 24-hour time, for example 12 30 a m is 0030, 1 30 p m is 1330 All times noted are Mountain Standard Time

FLOODS OF 1964 IN THE UNITED STATES

FLOODS OF JUNE 1964 IN NORTHWESTERN MONTANA

By F C Boner and Frank Stermitz

ABSTRACT

Northwestern Montana had the most severe floods of record along both sides of the Continental Divide following heavy rains of June 7–8, 1964 Precipitation during the 36-hour storm period was as much as 14 inches Streams were already high from late snowmelt runoff Soil moisture was also favorable for high runoff rates

The principal streams affected by the floods were the St Mary, Belly, and Waterton Rivers in the Hudson Bay basin, the Dearborn, Sun, Teton, and Marias Rivers in the Missouri River basin, and the Flathead River upstream from Flathead Lake in the Columbia River basin

Peak discharges on streams in the flood area ranged from about 2 to 11 5 times the probable 50-year flood The peak discharge of 5,740 cfs (cubic feet per second) of Street Creek at the international boundary, from 6 0 square miles of drainage area, was 10 3 times the 50-year flood On Teton River near Farmington the peak discharge (54,600 cfs) was 11 5 times the 50-year flood from a drainage area of 105 square miles Maximum discharge of Middle Fork Flathead River at Essex (75,300 cfs) was 3 9 times the 50-year flood and was 4 times the maximum discharge during the previous 25 years of record

The operation of irrigation and flood-control reservoirs did much to reduce flood peaks and damage, however, the failure of Swift Dam on Birch Creek and Lower Two Medicine Dam on Two Medicine Creek caused complete destruction of numerous buildings and bridges along downstream reaches

Total flood damage in Montana was estimated at $55 million Thirty lives were lost, 350 persons were injured, and about 8,700 persons were evacuated during the highwater period Damage in excess of $1 million in Canada was reported

This report has been prepared to furnish hydrologic data for detailed planning Included are discussions of antecedent hydrology and the meteorology of the storm, a description of the floods, information on flood damage, maps of principal urban inundation, flood profiles, discussions of storage regulation previous floods, flood frequency, deposition and degradation of stream channels, and detailed information of stage, discharge, and reservoir contents for the May–June period

INTRODUCTION

Past records of peak flow, loss of life, and property damage were greatly exceeded in the brief floods of June 1964 in northwestern Montana Streams rose rapidly following precipitation of as much as 14 inches in a 36-hour period on June 7–8 The melt of mountain snow contributed to the peak flows The flood area, which lies along both sides of the Continental Divide, is outlined in figure 1

The region of highest runoff is a rugged timbered mountain area that, on the eastern front, rises abruptly from grassy glaciated plains and low foothills of about 4,500 feet altitude to the Continental Divide in a distance of 20 to 30 miles Sheer cliffs, hundreds of feet high, lie just east of the crest. The western slopes are generally not as steep Numerous peaks of 7,000 feet to more than 9,000 feet altitude are found throughout the entire mountain area Marias Pass, lying at the southern edge of Glacier National Park, has an altitude of 5,236 feet The principal streams affected by the floods were the Dearborn, Sun, Teton, and Marias Rivers in the Missouri River basin; the Flathead River above Flathead Lake in the Columbia River basin, and the St Mary, Belly, and Waterton Rivers in the Hudson Bay basin (fig 2)

Thirty persons lost their lives, nearly all during the rapid rise of streams on the morning of June 8 Damage to transportation facilities accounted for more than half of the total damage of $55 million.

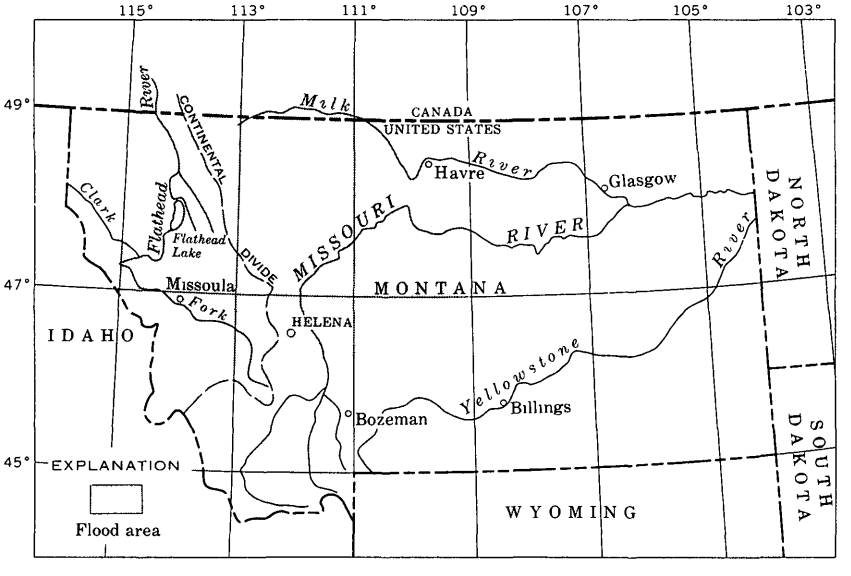

FIGURE 1—Area covered by this report

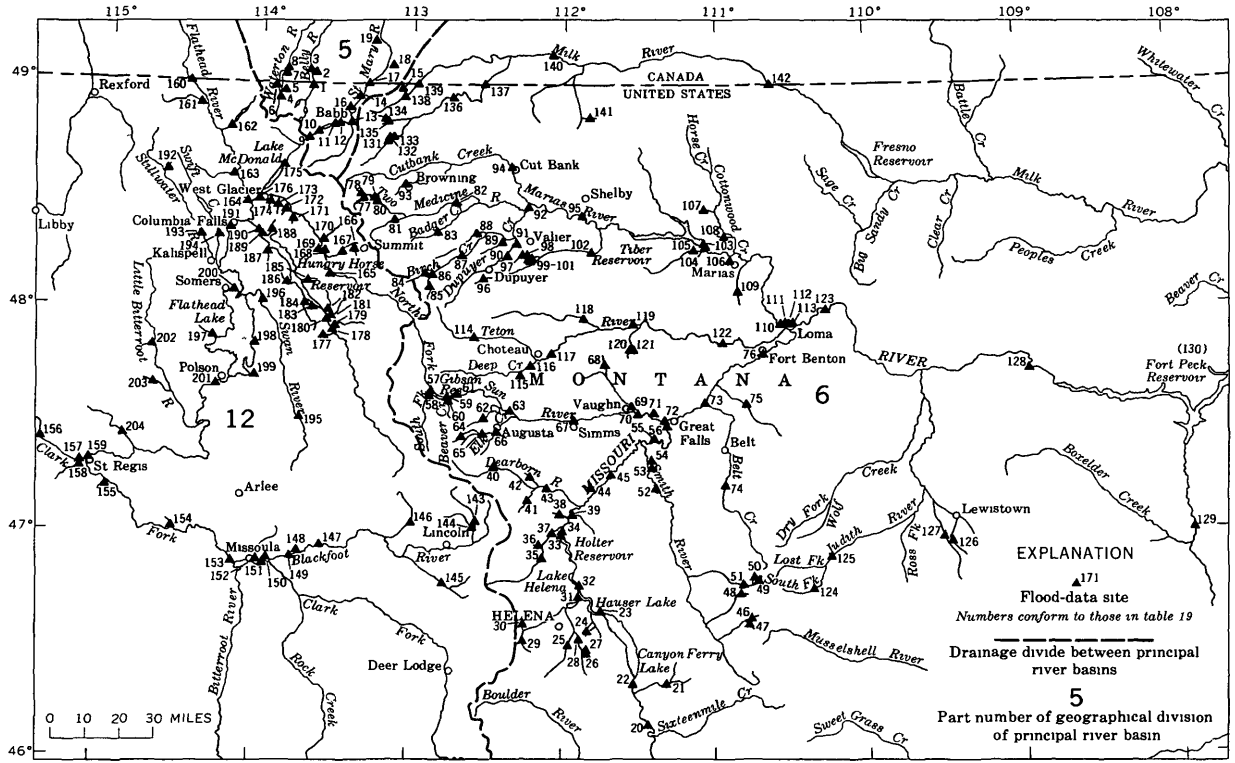

FIGURE 2.—Location of flood-data sites

The amount of damage prevented by reservoir storage and flood control systems has been estimated to be greater than the damage actually caused by the flood

The need for documentation of this outstanding flood prompted an interagency meeting at Great Falls, Mont., on June 12 to arrange for the coordinated gathering and exchange of hydrologic information and its presentation in a comprehensive and readily available report. This resulting report includes discussions of antecedent hydrology and the meteorology of the intense storm, a description of the floods, information on flood damage, maps of principal urban inundation, flood profiles, discussions of storage regulation, previous floods, flood frequency, deposition and degradation of stream channels, and detailed information of stage, discharge, and reservoir contents for the May–June period.

ACKNOWLEDGMENTS

The aid of the many individuals, corporations, and governmental agencies who furnished data and assistance for this report is gratefully acknowledged. The Bureau of Reclamation, the Corps of Engineers of the Department of the Army, and the U.S. Forest Service assigned men and equipment for the collection of supplementary precipitation data under the direction of the U.S. Weather Bureau, for the indirect discharge measurement surveys conducted by the U.S. Geological Survey, and for the quantitative measurements of remaining snow cover conducted by the Soil Conservation Service. Collection of field data necessary for the computation of peak discharge by indirect methods and the calculation of detailed records of discharge were greatly aided by the work of technical personnel of the Water Resources Division of the U.S. Geological Survey from other States detailed to the flood area. Data furnished by all governmental agencies are specifically acknowledged where they appear in the text.

ANTECEDENT HYDROLOGIC CONDITIONS

The primary cause of the record floodflows was the intense high-volume rain of June 7–8, although antecedent streamflow, mountain snowmelt, and abundant soil moisture had some bearing. Streams were still at high stages on June 6 in most of the mountain area because of snowmelt runoff and scattered rains of late May. There was considerable snow cover in the high mountains and some snow in well-sheltered areas at slightly lower altitudes prior to the heavy rains. Snow measurements and observations made after the flood indicate the net snowmelt contribution to flooding from the higher mountains

may not have been highly significant. The rain-induced snowmelt at slightly lower altitudes and in shaded areas may have been a significant factor in some drainage basins

Soil moisture was near field capacity in areas recently bared of snow and was presumably above normal in the foothill areas because of cool weather and above-average precipitation in April and May The meteorological features of the storm of June 7–8 are covered in detail by the U S Weather Bureau in a separate section of the report (p B16) Five major factors affecting antecedent conditions are discussed in the following sections

PRECIPITATION

Precipitation during January to April 1964 was nearly equal to the 4-month normal for the standard period 1931–60, but that for May was nearly double the normal. The January–May monthly precipitation totals for 1964 and normals, shown in parentheses, for six Weather Bureau stations are shown, in inches, in the following table

Weather station	Altitude (ft)	January	February	March	April	May
Great Falls	3,664	0 65 (0 61)	0 52 (0 74)	1 74 (0 92)	1 91 (0 98)	3 36 (2 10)
Gibson Dam	4,590	1 03 (0 75)	0 45 (0 63)	0 75 (0 93)	1 57 (1 28)	6 19 (2 63)
Summit	5,213	5 95 (4 26)	2 50 (3 54)	4 30 (3 08)	3 55 (2 78)	7 15 (2 86)
Babb 6NE	4,300	0 15 (0 80)	0 26 (0 91)	0 93 (1 06)	1 91 (1 56)	5 61 (2 58)
West Glacier	3,154	3 74 (3 13)	1 33 (2 42)	3 68 (1 81)	1 50 (1 87)	4 62 (2 36)
Kalispell	2,965	1 24 (1 37)	0 50 (1 00)	1 26 (0 60)	0 60 (1 04)	2 56 (1 97)

The general snowfall of May 2–3 was the heaviest on record for May at Kalispell and Missoula and near record at Helena (U S Weather Bureau, 1964) Precipitation in that storm ranged from about 2 to 4 inches There was little precipitation thereafter until May 27–29 when significant amounts of rain fell along the summit and east of the Continental Divide The higher mountains may have received some snow in the storm of May 27–29. There was little or no rain in June until the storm of June 7–8, which is treated in detail in a separate section Cumulative precipitation at West Glacier in the Flathead River drainage basin, Summit on the Continental Divide at Marias Pass, and Gibson Dam and Great Falls in the Sun River drainage for May 1 to June 6 is shown in figure 3 The daily precipitation at Summit for March through June is shown as a bar graph in the lower part of figure 5

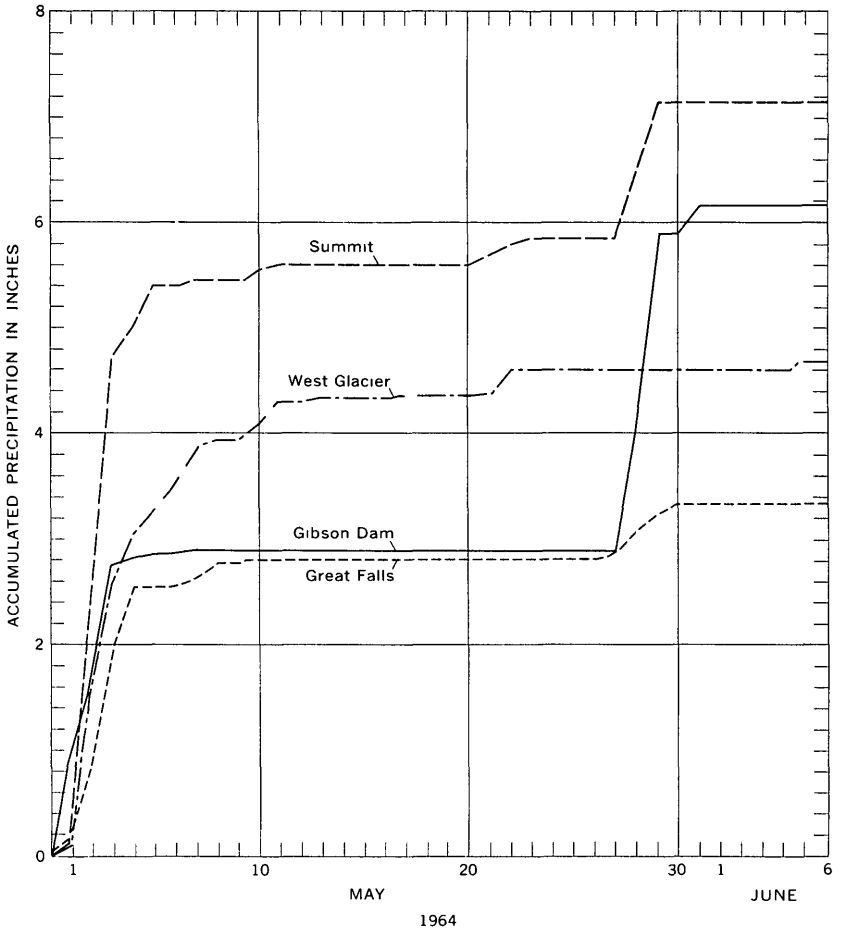

FIGURE 3.—Accumulation of precipitation at four weather stations May 1 to June 6, 1964

TEMPERATURE

Below-normal temperatures of March to May delayed the usual mountain snowmelt pattern. As a result, many streams were at a high level and there still was a significant amount of high-altitude snow when the intense rains began. The January–May mean monthly temperatures for 1964 and departure from normal, in parentheses, for six Weather Bureau stations in the mountain and foothill area are shown, in degrees Fahrenheit, in the following table.

Weather station	Altitude (ft)	January	February	March	April	May
Great Falls	3,664	28 7 (+6 6)	33 0 (+9 2)	26 9 (−3 8)	42 3 (−1 3)	54 8 (+1 8)
Gibson Dam	4,590	27 4 (+4 7)	29 9 (+5 4)	27 0 (−2 6)	39 4 (−0 3)	47 6 (−0 6)
Summit	5,213	21 0 (+5 6)	24 1 (+6 1)	20 9 (−2 7)	32 8 (−1 0)	40 8 (−2 8)
Babb 6NE	4,300	23 6 (+4 1)	30 2 (+9 3)	22 4 (−4 4)	36 7 (−1 6)	46 2 (−1 4)
West Glacier	3,154	27 5 (+6 4)	27 7 (+3 4)	28 8 (−2 6)	39 1 (−2 7)	48 8 (−2 3)
Kalispell	2,965	24 6 (+4 8)	23 9 (−0 6)	27 9 (−3 9)	40 7 (−3 0)	49 7 (−2 5)

Temperatures of January and February had little or no effect on the flood Although temperatures of early March were sufficiently high to melt much of the snow in the plains and the exposed foothill area, the March mean temperatures were genreally lower than those of the 2 prior months The below-normal temperatures of late March delayed the progress of mountain snowmelt and may have contributed to the above-normal soil moisture that existed when the heavy rains began Daily maximum and minimum temperatures for Gibson Dam, Babb 6NE, and West Glacier are shown in figure 4 for April through June 1964 These stations are in mountain valleys near the Continental Divide The weather station at Summit, on the Continental Divide, is at a higher altitude (5,213 ft) than any other station in the flood area. Daily mean and daily normal temperatures at Summit for March to June 1964 are shown on figure 5 with a graph of cumulative departure from 32° F The base of 32° for mean daily temperatures is sufficiently high to indicate snowmelt conditions during parts of the day at this altitude and reasonably continuous melt at lower altitudes The relative coolness of the last half of April and early May is very evident

SNOW COVER

Snow survey data are collected for their index value in making forecasts of volume runoff from mountain areas These surveys are made in mountain areas where precipitation data are not generally available The successive surveys made during the season supply data of accretion and depletion of the snowpack However, they cannot be more than an approximate measure of the snow-water supply in a watershed at any given time because of wide variations in snow cover due to altitude, orographic effects, and susceptibility to melt In general, the last regular snow surveys are made about May 1, subsequent data are too few to be fully representative Following the flood, the Soil Conservation Service, with the assistance of various Federal agencies, supervised the snow surveys of June 16–18, 1964

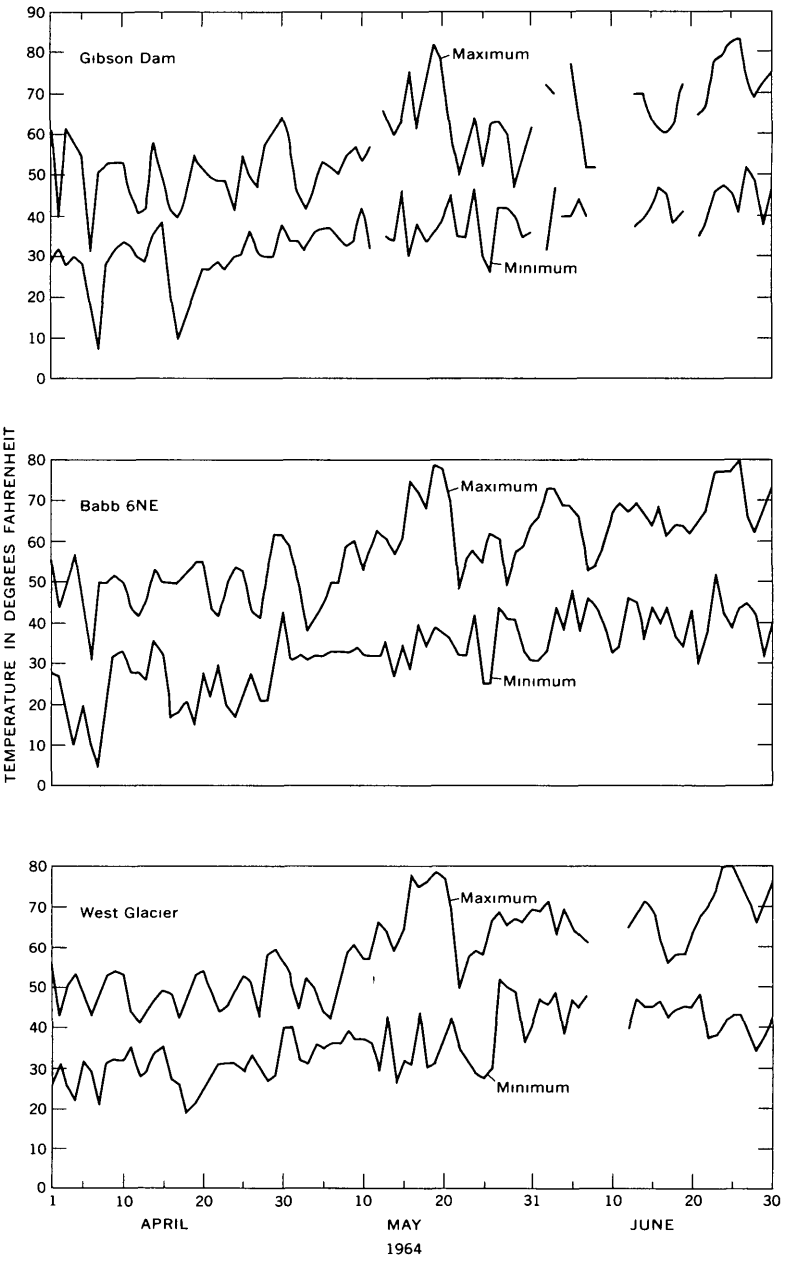

FIGURE 4.—Maximum and minimum temperatures at three weather stations April to June 1964

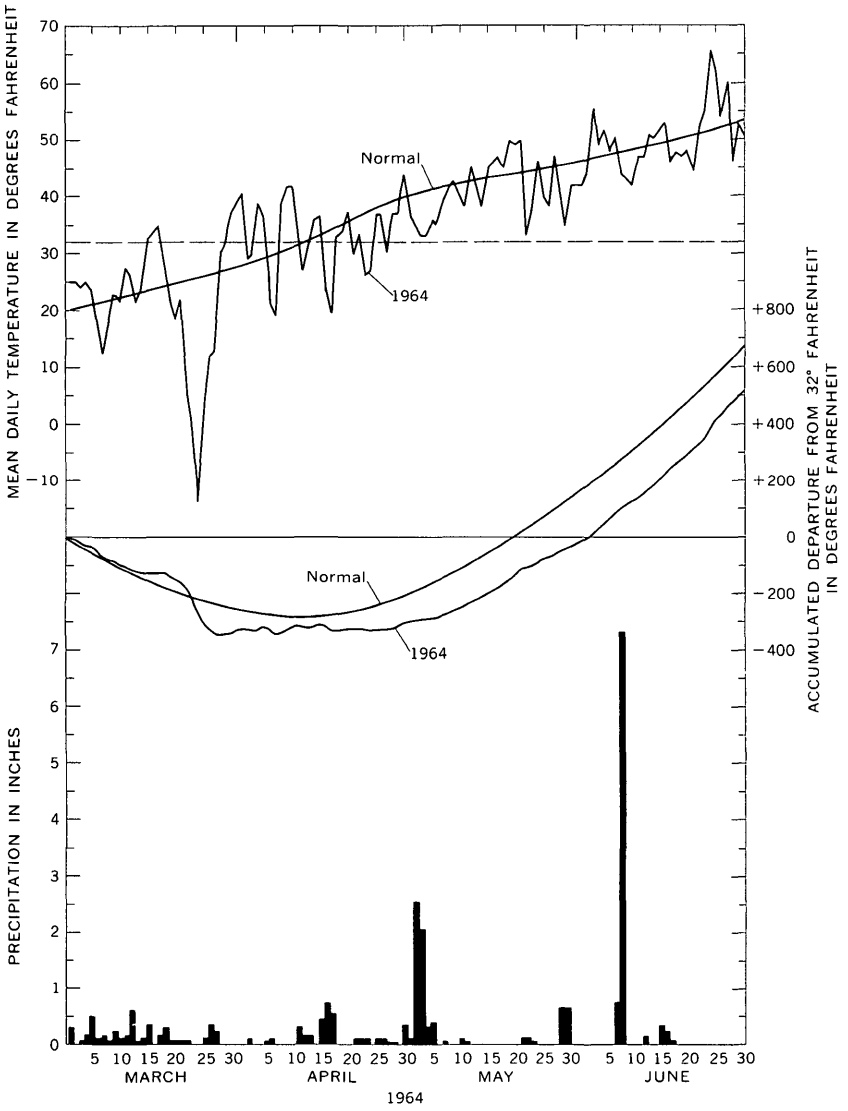

FIGURE 5.—Mean daily and daily normal temperature, accumulated departure of mean daily and daily normal temperature from 32° F, and daily precipitation at Summit, March to June 1964

The locations of the snow courses are shown on figure 6. The identification numbers used are those assigned by the Soil Conservation Service. Table 1 lists the average water equivalent of the snow at

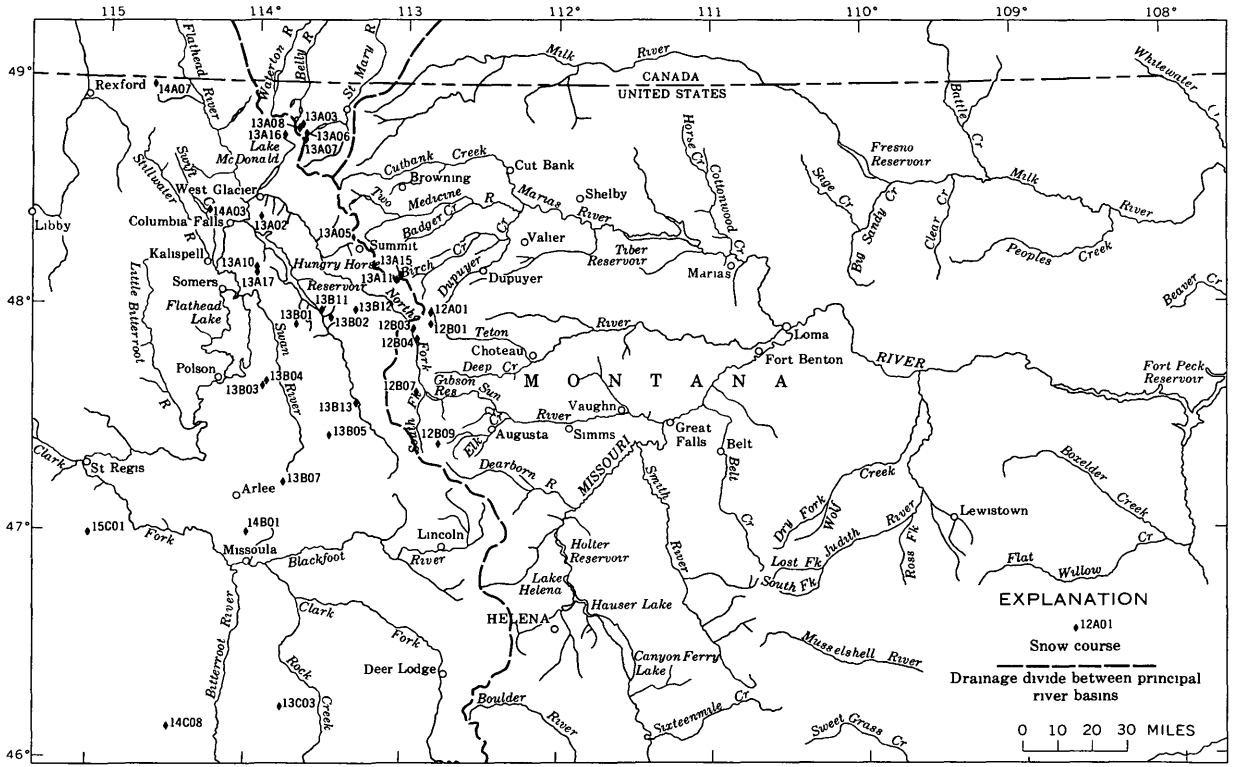

FIGURE 6—Approximate location of snow courses Snow-course numbers conform with those on table 1

each snow course as determined by the monthly or semimonthly snow surveys made by many Federal, State, and private organizations The water equivalents of the snow expressed as percentage of the 1943–57 average, are given by watersheds, in table 2

TABLE 1 —*Water equivalent of snow, in inches, at selected snow courses by basins, March–June 1964*

[Figures in parentheses are 1943–57 average water equivalent of snow, in inches]

Snow course No	Snow course Name	Altitude (ft)	March 1	April 1	May 1	May 15	June 1	June 15
Flathead River above Middle Fork Flathead River								
14A03	Hell Roaring Divide	5,770	23 8 (26 9)	35 8 (31 7)	38 8 (28 7)	42 5	28 2	1 5
14A07	Weasel Divide	5,450	30 7 (29 6)	36 8 (33 4)	37 8 (34 7)	36 4 (31 4)	21 8	5 0
Middle Fork Flathead River								
13A11	Beaver Lake	5,900	17 9	22 8	30 9	-----	-----	-----
13B12	Gunsight Lake	6,300	30 2	41 0	50 9	-----	-----	-----
13A05	Marias Pass	5,250	12 0 (17 4)	16 4 (20 3)	16 6 (15 7)	-----	-----	-----
13A16	Mineral Creek	4,000	18 4 (20 4)	22 8 (23 9)	21 0	-----	-----	-----
South Fork Flathead River								
13A02	Desert Mountain	5,600	12 2 (14 1)	17 2 (16 6)	16 5 (13 0)	-----	1 5	-----
13B13	Holbrook	4,530	9 8 (9 9)	13 8 (10 1)	5 0 (1 2)	-----	-----	-----
13B02	Spotted Bear Mountain	7,000	11 3 (14 8)	17 3 (15 6)	16 5 (12 6)	-----	-----	0
13A10	Strawberry Lake	5,600	32 2 (33 7)	44 8 (42 5)	53 6 (40 0)	-----	-----	-----
13B11	Twin Creeks	3,580	12 2 (11 2)	16 0 (10 6)	9 8 (0 8)	-----	-----	-----
Swan River								
13B04	Fatty Creek	5,500	20 4	26 6	28 0	-----	11 8	-----
13B01	Trinkus Lake	6,100	35 3 (36 3)	46 3 (41 5)	55 2 (41 4)	-----	-----	-----
13B05	Upper Holland Lake	7,000	28 0 (28 4)	39 0 (34 3)	46 8 (36 8)	-----	-----	20 0
Flathead River below Middle Fork Flathead River								
13B03	Big Creek	6,750	35 6 (36 6)	47 4 (43 4)	51 6 (48 4)	-----	48 4 (39 7)	-----
13A17	Camp Misery	6,400	37 0	51 1	57 0	-----	-----	38 0
13B07	North Fork Jocko River	6,330	41 0 (38 3)	53 3 (44 4)	58 1 (44 7)	59 2	41 8 (28 1)	24 2

TABLE 1.—*Water equivalent of snow, in inches, at selected snow courses by basins, March–June 1964*—Continued

Snow course No	Snow course Name	Altitude (ft)	March 1	April 1	May 1	May 15	June 1	June 15
	St Mary River							
13A03	Iceberg Lake	5,600			39 4 (27 1)			
13A07	Mount Allen	5,700			50 8 (47 3)			
13A06	Piegan Pass	5,500			45 2 (38 4)			
13A08	Ptarmigan	5,800			46 6 (37 8)			
	Marias River							
13A15	Badger Pass	6,900	29 4	39 6	46 4			
	Teton River							
12A01	Freight Creek	6,000	11 2 (14 9)	15 2 (17 4)	19 6			0
12B01	West Fork	6,000	9 4 (14 0)	14 2 (17 7)	18 3			
	Sun River							
12B09	Five-Bull	5,700	5 4 (6 2)	5 8 (7 5)	6 6			
12B07	Goat Mountain	7,000	9 8 (10 7)	11 5 (12 4)	12 6 (9 2)			0
12B04	Wrong Creek	5,700	13 5 (14 8)	16 8 (16 2)	17 4			0
12B03	Wrong Ridge	6,800	17 3 (20 4)	22 0 (23 1)	25 6			2 6
	Others							
15C01	Hoodoo Creek	5,900	37 4 (46 0)	49 8 (53 2)	55 2 (46 9)			18 3
13C03	Skalkaho Summit	7,260	20 5	26 4 (27 1)	29 0 (25 8)	28 8	19 6	8 6
14B01	TV Mountain	6,800	14 0 (14 9)	19 6 (19 0)	22 6 (21 0)			3 6
14C08	Twin Lakes	3,580	36 4	47 6	54 9			27 4

TABLE 2.—*Water equivalent of snow by drainage basin, March–June 1964, as percentage of 1943–57 average*

Drainage basin	March 1	April 1	May 1	June 1
Flathead River above Middle Fork Flathead River	95	111	121	
Middle Fork Flathead River	80	89	106	
South Fork Flathead River	93	114	151	
Swan River	98	112	131	
Flathead River below Middle Fork Flathead River	102	114	118	133
Total Flathead River	95	110	128	
St Mary River			121	
Marias, Teton, & Sun Rivers (includes Marias Pass snow course)	80	89	117	

P E. Farnes, Soil Conservation Service, Snow Survey Supervisor for Montana (written commun), gave the following résumé of snow cover in the flood area

> Snow surveys made near the first of March indicated the water accumulated in the snow pack was about 5 percent below the 1943–57 average in the Flathead River drainage above Flathead Lake and 20 percent below average in the Marias, Teton, and Sun River drainages * * * Snow-water equivalent near the first of April was 110 percent of average in the Flathead [basin], and 89 percent of average in the Marias, Teton, and Sun River headwaters Many courses at high elevations, particularly in the Flathead River drainage, showed increases of 10 to 14 inches of water during March
>
> During April 1964 there was very little melt even at lower elevations and almost all courses showed an increase in water equivalent during April Many low elevation courses had the highest May 1 water equivalent since record began As of May 1, the water equivalent in the Flathead River drainage is estimated at 128 percent of the 1943–57 average and that in the Marias, Teton, and Sun River drainages at 117 percent of that average Very little melt occurred to May 15 and the few higher courses then measured showed increases in water equivalent Melting on a large scale began in mid-May, dropped off somewhat a week later, and resumed at a sustained high rate in the last few days of May Saturated mountain soils and a ripe snow pack contributed to the rapid response of streamflow to the heavy precipitation of June 7–8 The snow-melt contribution to the peak flows was greatest on the west slopes of the Continental Divide because of heavier snow cover

The accumulation and depletion of snow water is depicted in figure 7 for a few of the snow courses listed in table 1

Knowledge of the snow cover immediately prior and subsequent to the heavy rains of June 7–8 is vague Streamflow records, presented in a later discussion, indicate that a substantial amount of snowmelt had occurred in the lower and middle altitudes U S Geological Survey engineers reported that there appeared to be little melt of high-altitude snow in the Flathead River drainage basin as late as June 2. In the course of an aerial reconnaissance of June 11 to appraise flood damage to stream gaging stations, one of the authors made some general observations of mountain snow cover when visibility permitted The highest mountains in the Middle Fork Flathead River drainage basin had considerable snow cover and there was more extensive snow cover in the South Fork Flathead River drainage basin The highest mountain peaks in the Dearborn and Sun River drainage basins were largely snow covered and some snow appeared to be newly fallen A brief glimpse into the Swiftcurrent Creek drainage basin above Many Glacier gave the impression of complete snow cover. Farnes and Cook (1964) noted that the mountain snowpack remaining on June 16–18 was still above normal and could contribute to further flooding

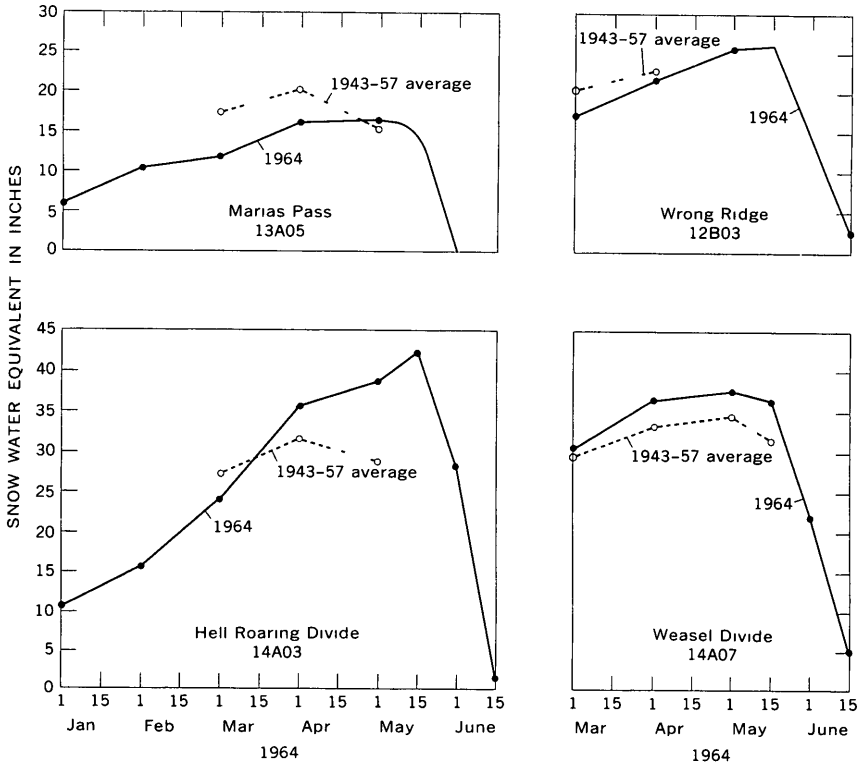

FIGURE 7.—Water equivalent of snow at selected snow courses

SOIL MOISTURE

The soil mantle in most of the mountain area is relatively thin, and soil moisture was probably near field capacity just prior to the flood. The widespread snow and rain of the first few days of May, the general prevalence of snow cover until about May 20, and substantial rains along and east of the Continental Divide on May 27–29 support the assumption.

Soil-moisture data are being collected at Desert Mountain near Coram, in the Flathead River basin, and at Summit, on the Continental Divide, by the Soil Conservation Service (1964). Soil-moisture content in a profile depth of 54 inches for the Desert Mountain and Summit stations is shown in the following table.

Station	Period of record	Water content of soils (inches)			
		Field capacity	June 1		
			Normal	Range of data of record	1964
Desert Mountain	1957–59, 1962–63	8 4	8 6	8 4–8 8	8 9
Summit	1950–52, 1957–63	6 5	5 8	5 4–6 1	6 1

On July 1 the soil moisture at these two stations was approximately normal

The general rain and snow of May 2–3, and above-average precipitation for May, probably resulted in at least normal soil moisture in the foothill area before the June 7 storm

STREAMFLOW

Streamflow was well below average in the flood area prior to winter and continued to be relatively low through May 1964. Monthly flows of the Marias River near Shelby for the months of January through May were 59, 54, 26, 31, and 81 percent, respectively, of the 1948–62 averages The March flow was the second lowest for that month since 1902 and the April flow was the fifth lowest. Monthly flows of the Middle Fork Flathead River near West Glacier for the months of January to May were 62, 55, 52, 42, and 84 percent, respectively, of the 1948–62 averages. The March flow was the second lowest since records began in 1940 and the April flow was the third lowest

The 1964 daily discharge and 1948–62 approximate average daily flow of Middle Fork Flathead River near West Glacier for the period of March through June are plotted in figure 8 The three hydrographs of figure 9 illustrate the same general discharge pattern east of the Continental Divide Further reference to figures 3, 4, and 5 may be helpful in visualizing the effect of curent precipitation and temperature upon streamflow The greater response of Middle Fork Flathead River and Swiftcurrent Creek to the warmer weather that began about May 30 may indicate relatively greater areal snow cover in those basins at that time Moist soils, high streamflow, and substantial snow cover at high altitudes accentuated the effect of the intense storm of June 7–8

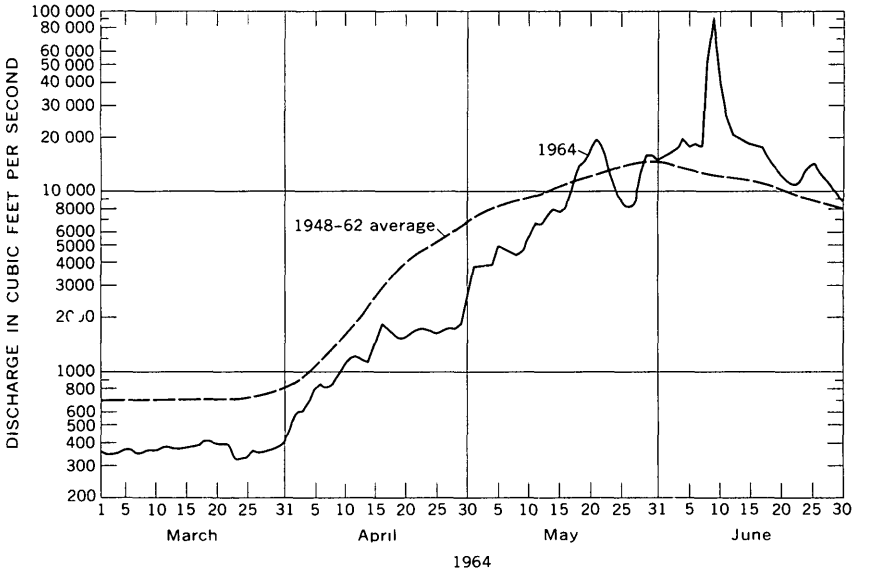

FIGURE 8.—Discharge of Middle Fork Flathead River near West Glacier, March to June 1964

METEOROLOGICAL DEVELOPMENTS CONTRIBUTING TO THE FLOOD

By R. A. DIGHTMAN, U. S. Weather Bureau

INTRODUCTION

Any attempt to describe the meteorology of a storm of sufficient magnitude to produce the extremely heavy rains observed June 7–8, 1964, along the north half of the Continental Divide in Montana, involves the problem of describing complex atmospheric motions and processes. Large-scale motions controlling the Montana storm covered large parts of the Northern Hemisphere. Medium-scale features included general orographic effects and wind patterns near the surface. Small-scale effects were local in extent (limited to small areas) and included effects of wind channeling in "dead-end" mountain valleys, local instability, and others. In view of the many-faceted importance of this storm and the resulting floods, these features will be treated in some detail.

The physical processes of the atmosphere that produce the upward air motion which finally causes precipitation are well known. They are summarized in some detail in a U. S. Weather Bureau (1960b) technical paper, and are covered in texts by Petterssen (1956), Haltiner and Martin (1957), and others. Accordingly, this summary of storm meteorology is limited to brief descriptions of some of the

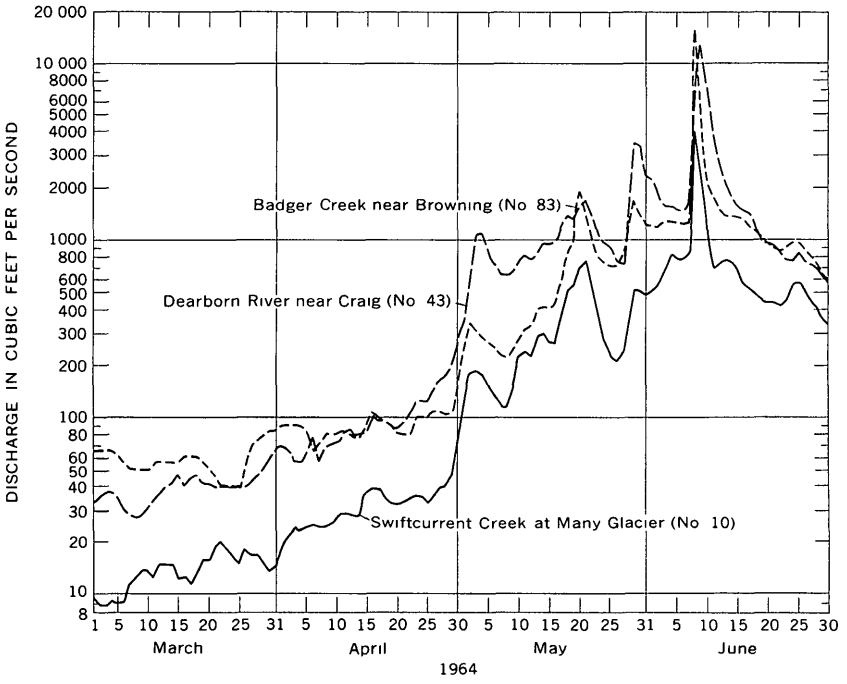

FIGURE 9—Discharge at selected gaging stations east of the Continental Divide, March to June 1964 Numbers in parentheses conform with those in table 19 and on figure 2

atmospheric processes involved, to their interrelationships and dimensions, and to an areal depiction of the resulting precipitation. For a more complete discussion of the physical mechanisms involved, use of the references at the end of this report is recommended.

SYNOPTIC FEATURES

The climatic history of Montana (U S Weather Bureau, 1960a) points to an annual rainy season from about May 20 to June 30, during which nearly all the heavy east-slope rainstorms of record have occurred Obviously then, it is during this 40-day period that general atmospheric conditions are most likely to be favorable for producing rains in central Montana. Seasonally, by early June, the southern half of the United States has warmed much more rapidly than has northern Canada Circulations resulting from this annual thermal gradient have lost little of their late-winter and early-spring energy by early June, while airmasses from southern latitudes (Gulf of Mexico sources in particular) may carry larger quantities of water vapor than is possible earlier in the season at lower temperatures Meteorological developments of early June 1964 fit this general pattern

At the beginning of June 1964, moist air from the Gulf of Mexico was spreading north and north-northwest over the western plains and central Rocky Mountains, carried northward on generally southerly (from south quadrant) winds ahead of a series of low-pressure centers over and just east of the Continental Divide This moist air, becoming involved in a series of slow-moving but quite energetic circulations, caused the first half of June to be very wet over much of the West These and other larger scale features are discussed by Dickson (1964) By the afternoon of June 7, when rains associated directly with the flood disaster started, the airmass still carrying much of its original Gulf of Mexico-source moisture was entering the northeast quadrant of a low-pressure area, which centered over Wyoming but covered most of the Rocky Mountain area of the United States This cyclonic circulation extended vertically into the upper levels of the troposphere, with the vortex at 500 mb (millibar), about 18,000 ft msl (feet above mean sea level) and by 1700 hours, June 7, was centered just northeast of Boise, Idaho

By 1700 hours, June 7, rain had become general over the affected area Surface and 500-mb maps for that time are shown in figure 10 The most important large-scale features are the circulations, shown by these two maps, involving the strong westward tilt of the vortex between surface (about 900 mb) and the 500-mb level, the tilt suggests flow from easterly directions over north-central Montana This phenomenon was observed at this time at all levels to well above 500-mb Dewpoints near ground surface were very high for the season, they ranged from about 55°F in eastern and central Montana to about 60°F in northeast Wyoming and the Dakotas and indicated the high water-vapor content of the airmass Precipitable water (U S Weather Bureau, 1961) from the surface to 500-mb had reached 1 09 inches at Glasgow and probably exceeded 1 inch over most of northern Montana north and east of Great Falls—a very large amount for this altitude (3,000–4,000 ft msl), latitude, and season

All the features described above were involved in the early phases of the storm and were magnified to a considerable extent by the fact that the observed easterly flow was traveling upslope in the affected area—sharply upslope the last 10 miles or so just east of the Rocky Mountain ridge For 1700 hours, June 7, figure 10 (bottom) shows a well-defined cold front at about 5° latitude north of the Canada-Montana border This front entered the circulation system late in the storm (figs 11, 12) with significant effects, as will be noted By 0500 hours, June 8, exceedingly heavy rain had become general on the high eastern slopes along the Continental Divide In the very hard hit area between Browning and West Glacier, some of the heaviest rains

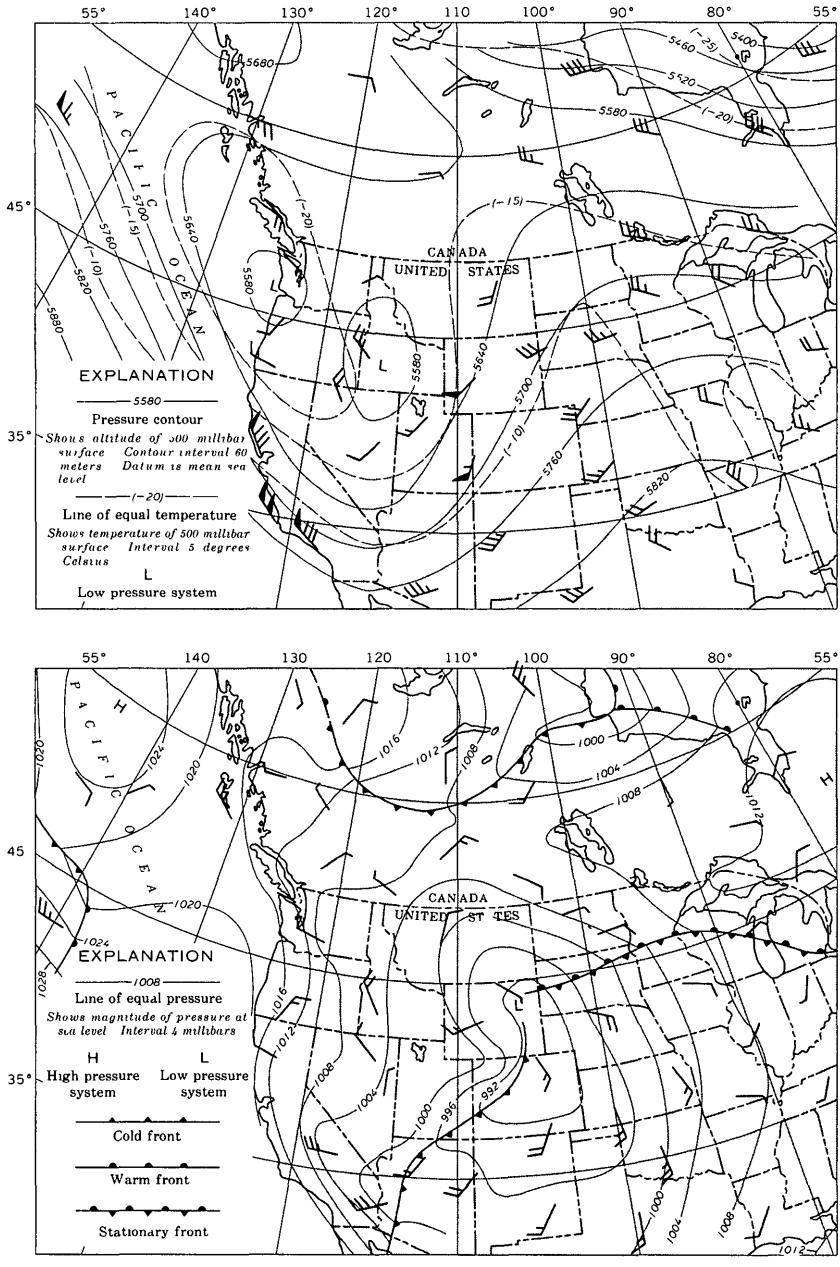

FIGURE 10—The 500-millibar surface (top) and sea-level pressure (bottom), 1700 hours June 7, 1964 Note position of arctic front north of international boundary between Alberta and Montana Note also the sea-level to 500-millibar westward tilt of vortex structure which is associated with a deep flow of moist air from the east over northern Montana Wind-velocity symbol shafts are oriented with the wind direction, each flag represents 50 knots each full barb represents 10 knots, and each half barb represents 5 knots

reached into enough drainage area of the Middle Fork Flathead River to produce the highest discharge rates on record for the Flathead River at Columbia Falls and other points The physical processes involved in the atmosphere had changed very little by the morning of June 8, but between sea level and the 500-mb level (fig 11) there was an even stronger westward tilt of the vortex than 12 hours earlier, this indicated that a deep and fairly strong easterly flow had persisted during the night Figure 11 (bottom) shows the cold front from the north entering the nothern edge of the area of heaviest rains. This cold front, as it moved southward, undoubtedly played a key role by imparting an important upward-motion component to the airmass during the last several hours of the storm, as well as sustaining the upslope wind pattern In general, the rain ended about 4 hours earlier in the northern part of the storm near Browning and East Glacier, than in southern areas about 100 miles away near Gibson Dam and Augusta

By 1700 hours, June 8, rains had ended in the flood area except for a few light showers By that time, the surface low-pressure center had moved to central South Dakota and Nebraska (fig 12, bottom) The primary circulation at 500 mb (fig 12, top) had also moved eastward, but with considerable weakening A new 500-mb low had appeared to the southwest over northern California These phenomenona had reduced the effectiveness of the easterly flow over north-central Montana early in the day; but as the easterly flow diminished, the cold wedge from the north continued to supply storm winds from the northeast and continued vertical lifting of the airmass and thus extended the duration of heavy precipitation by about 4 hours

All ingredients necessary for rain in the affected area were present a large supply of relatively warm moist air, lifting of this air by several methods, and large-scale atmospheric motions that sustained these overlapping effects for several hours The sustained vertical motion necessary to produce the rates of precipitation observed in this storm may be estimated roughly by use of a method attributed to Fulks (1935), later modified and condensed by Petterssen (1956), Thompson and Collins (1953), and others Assuming that (1) precipitation rates were 0 50–1 00 inch per hour (rates of 0 50–0 60 in per hr were actually measured on recorders at Summit and Gibson Dam), (2) the precipitating layer was about 16,000 feet thick (4,000–20,000 ft msl), (3) the surface temperature was 50°F and decreased vertically at about 3 3°F per 1,000 feet (the saturated adiabatic rate at lower levels), and (4) the rate of condensation was approximately equal to the rate of precipitation, then vertical speeds from about 75 to 150 cm per sec (centimeters per second) would be required (Petterssen,

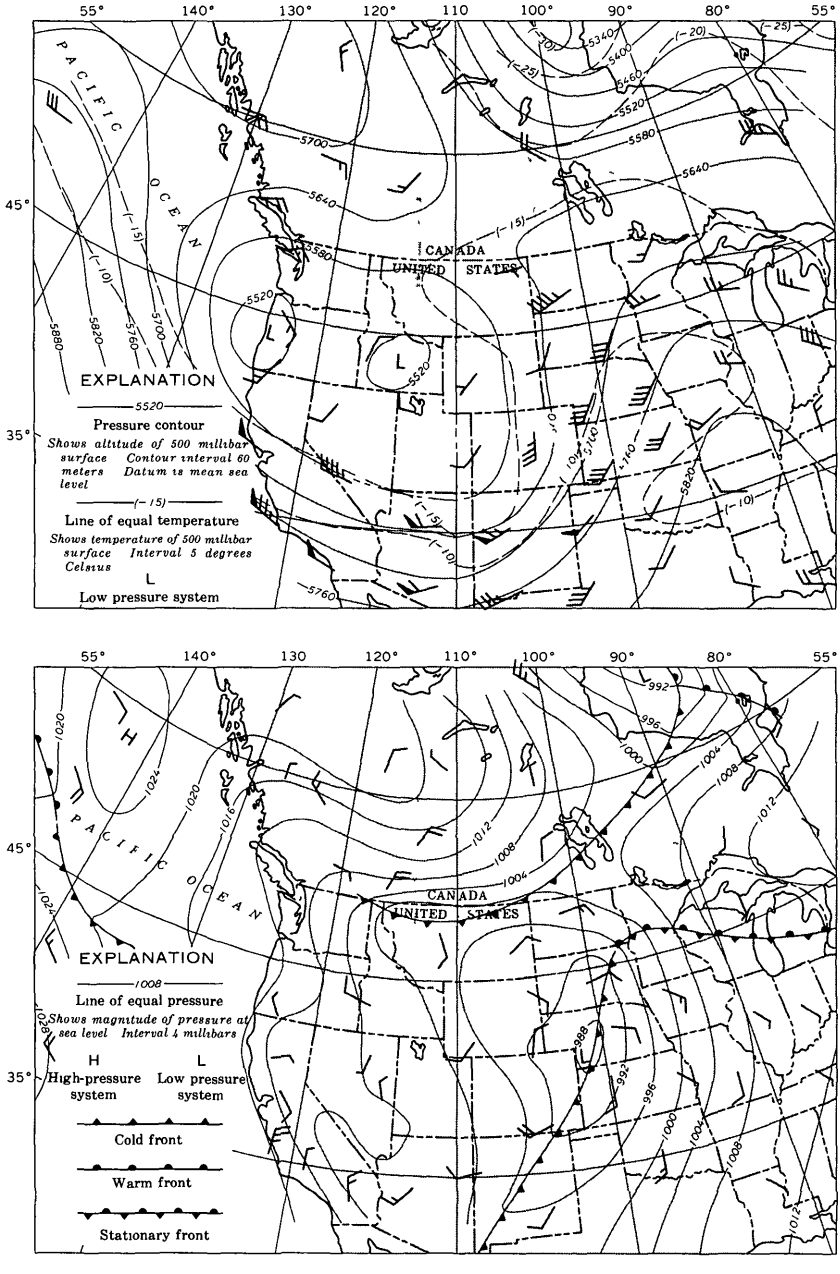

FIGURE 11 —The 500-millibar surface (top) and sea-level pressure (bottom), 0500 hours, June 8, 1964, after heavy rain had persisted about 12–16 hours over flood headwaters Note (1) The advance to the arctic front into northern Montana, (2) The maintenance of depth and strength of the flow of moist air from the east Wind-velocity symbol shafts are oriented with the wind direction, each flag represents 50 knots, each full barb represents 10 knots, and each half barb represents 5 knots

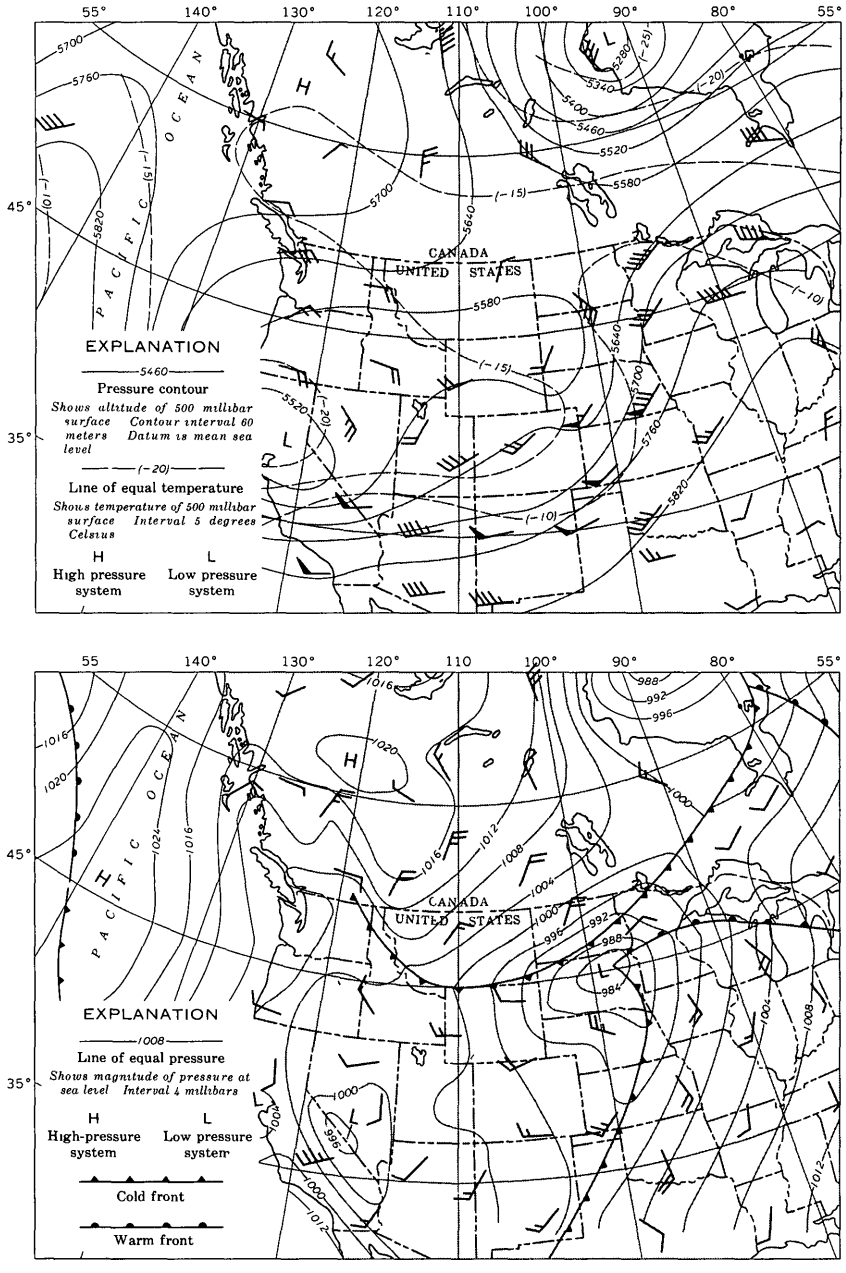

FIGURE 12.—The 500-millibar surface (top) and sea-level pressure (bottom), 1700 hours, June 8 1964. By this time, rains had either stopped or diminished to light as the cold-front wedge effectively cut off the low-level flow of moist air from the east. Wind-velocity symbol shafts are oriented with the wind direction; each flag represents 50 knots; each full barb represents 10 knots, and each half barb represents 5 knots.

(1956). If we assume that winds in the precipitating layer were easterly at about 30 knots, air involved would have to rise orographically from about 4,000 feet to the average altitude of the Continental Divide in this area, or to about 8,000 feet—a rise of about 4,000 feet in about 20 statute miles The largest part of the lift could be expected at, or just east of, the ridge line, and this actually is the location of the centers of heaviest storm precipitation If we use a lift of 200 feet per statute mile at a speed of 30 knots normal to the ridge line, by simple arithmetic, we arrive at an orographic component of 1 94 ft per sec (feet per second), or 59 cm per sec. Orographic lifting was probably most strong in the lower few thousand feet of the precipitating layer and was probably replaced, to an indeterminate extent, by convection in middle and upper parts of the layer.

Orographic lifting therefore appears to have been an extremely important factor In the rugged areas in the northern center of heaviest rain (fig 13), where lifting of 1,000 feet is possible in less than 5 miles, the orographic lift component was undoubtedly greater than 59 cm per sec and possibly exceeded 100 cm per sec by a considerable margin Other factors contributing to upward motion include vertical variation of vorticity advection, the Laplacian of temperature advection, the Laplacian of the latent heat of condensation, and low-level friction effects With an orographic lift of 60–100 cm per sec to build upon, these factors could account for the lifting necessary for rains with rates of up to an inch per hour in the heaviest rainfall areas (fig. 13).

Many of the medium-scale atmospheric processes and motions of this storm have been touched upon in preceding paragraphs Upslope, for example, sometimes is considered to be medium scale; but in this storm, it was part of large-scale motions on a front more than 100 miles wide Vorticity, convergence, and instability also were important parts of the general circulation in the heavy-storm area The general flow pattern of the atmosphere at lower levels is shown in figure 14 The maps (depicting winds at about 2,000 ft above the surface and at 5,000 ft msl at 1700 hours, June 7) show very clearly the trajectory of the airmass involved in the storm The airmass moved northward, then westward over northern Montana into the storm circulation It was this moisture-laden air at the lower levels of the troposphere that fed the vertical motions in the storm centers The flow of water vapor was strong and steady in the early stages of the storm, but was cut off by the action of the cold front (figs 10, 11) in the storm's later stages.

A few medium-scale features require comment The channeling effect of mountain valleys, the angle of flow incidence to mountain ridges, and the effects of nearly parallel ridges almost normal to the

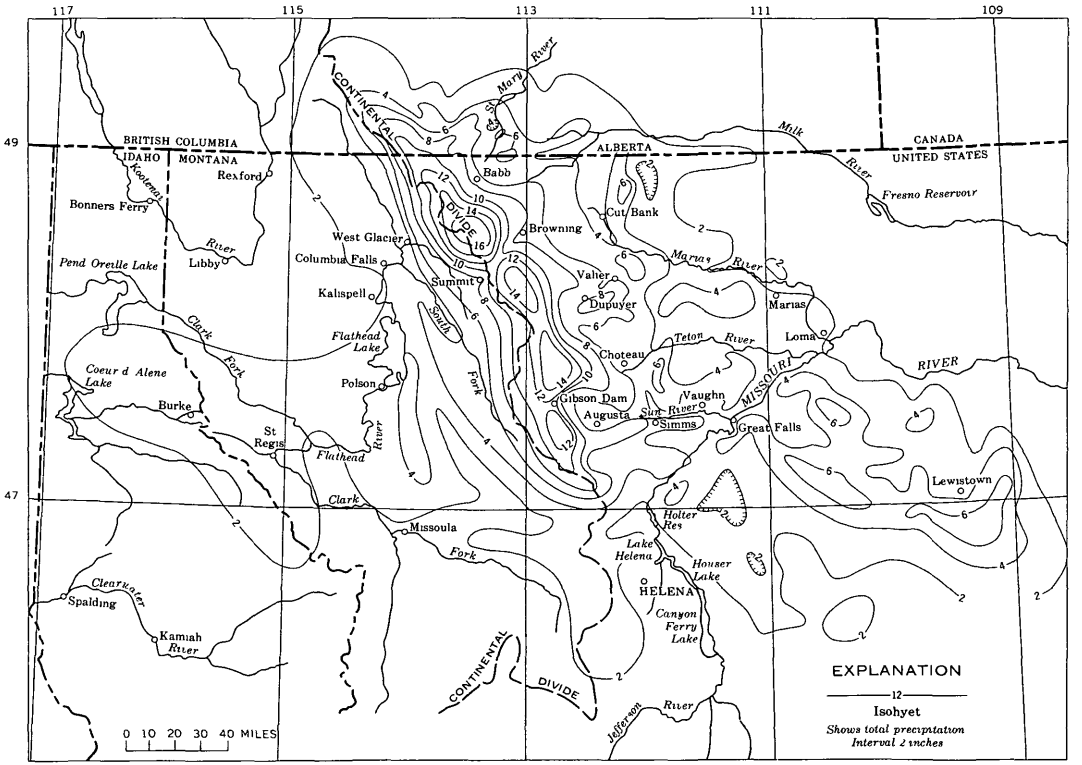

FIGURE 13.—Total precipitation for June 7–8, 1964. Note centers of high intensity rainfall near crest of Continental Divide. Highest centers estimated because of lack of measurements in mountains. Owing to the natural variability of rainfall in rugged mountain country such as this, caution is recommended in interpolating from this chart.

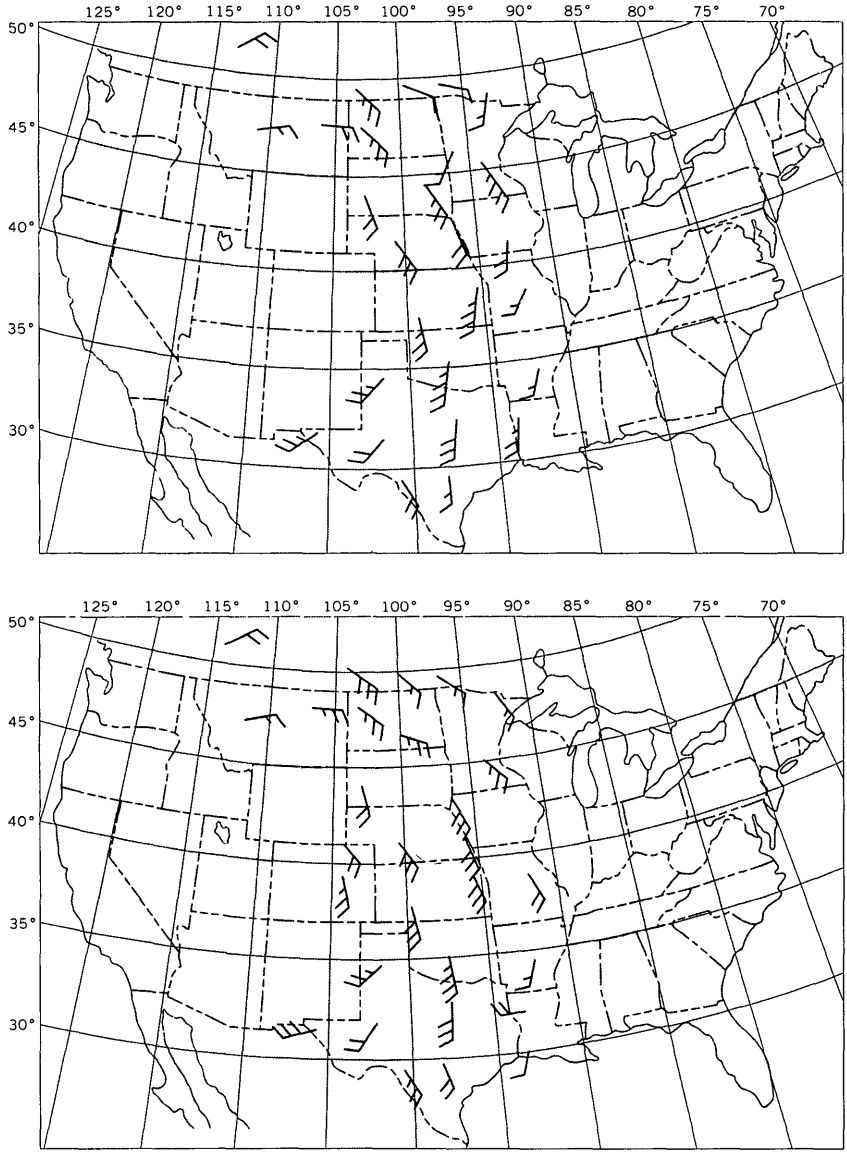

FIGURE 14.—Windflow at about 5,000 feet above mean sea level (top) and 2,000 feet above land surface (bottom) into Montana from the Gulf of Mexico at 1700 hours, June 7, 1964. Wind-velocity symbol shafts are oriented with the wind direction, each full barb represents 10 knots, each half barb, 5 knots.

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general flow no doubt caused important local variations in rainfall rates However, observations and measurements were not sensitive enough or were too sparse to detect such local variations with certainty Mass rainfall curves for several stations within the storm's boundaries, but still some distance from the heaviest centers, show a remarkable steadiness in the rates at which precipitation accumulated (fig 15) Thus, although the degree to which each factor acted to produce precipitation varied during the storm, the integrated effect changed little during the principal 30-hour storm period

The flood-producing precipitation over the Flathead River basin and other basins to the west of the Continental Divide appears to have exceeded the magnitudes that can be accounted for by the drift, with the wind, of snow and rain formed in the rising air above the eastern

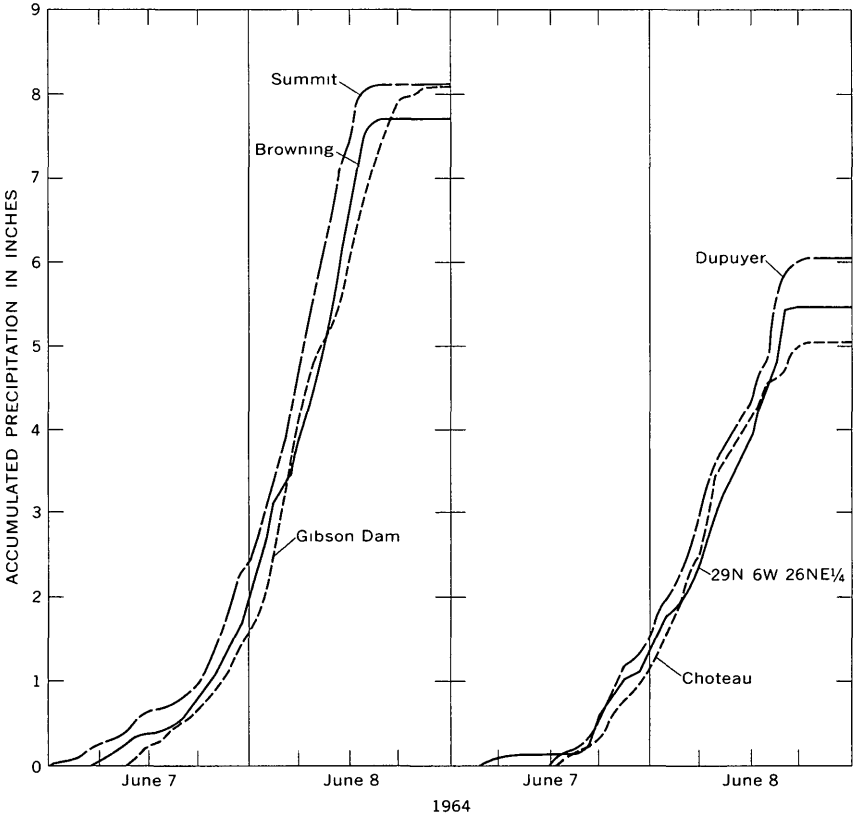

FIGURE 15.—Mass curves of accumulation of precipitation with time from recording precipitation gages in (or on edge of) storm area, June 7–8, 1964

slopes, though no calculations have been made to confirm this. It is surmised that this heavy lee-side precipitation was, in part, the result of convective cells, which were set off by the windward lift but which sloped with the wind and extended to the lee side This concept is depicted schematically in figure 16

RAINFALL PATTERN

With the moist easterly flow impinging upon the eastern slopes along the Continental Divide where the orographic lift was large and steady, it should not be surprising that the area of heaviest rains was along or just east of the divide ridge for a north-south distance of more than 100 miles The impact of the storm was staggering (the magnitude of the resulting flood disaster is covered elsewhere in this report), determination of precipitation amounts was delayed several days because of disrupted travel facilities and communications. With cooperation from U S Army Corps of Engineers, Bureau of Reclamation, U.S. Forest Service, U.S. Geological Survey, and U S Weather Bureau, a survey of the area was conducted during the week of June 15 to find sources of precipitation measurements which might help to reconstruct the storm and to outline the areas of heaviest rain-

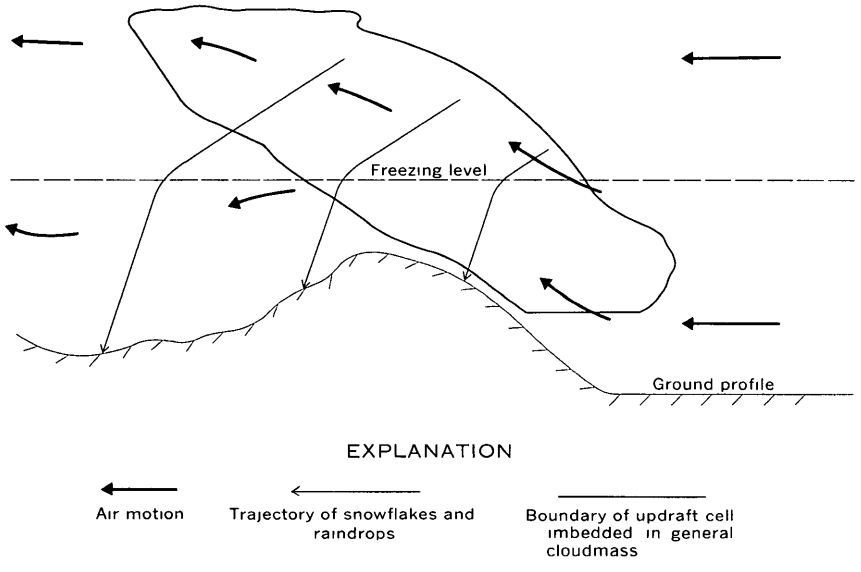

FIGURE 16.—Concept of a precipitation-releasing updraft cell that is formed on a windward slope and leans with the wind Upper part of cell lies above lee valley

fall Hundreds of good-quality measurements were reported However, the scarcity of observers severely limited information for the mountain areas where the heaviest precipitation occurred Through the generous help of the Canada Department of Agriculture, Regina, Saskatchewan, about 200 measurements were made available for the southern Alberta area of the storm All these measurements are listed in tables 3, 4, 5, and 6, and were used in preparing the isohyetal chart for the storm (fig 13)

Table 3 lists precipitation measurements from regular weather observing stations, table 4 lists supplementary reports from privately owned gages or other receptacles, table 5 contains precipitation data from the Canada Department of Agriculture and the Canada Department of Transport measurements, table 6 gives amounts of precipitation, taken hourly, some of which are shown graphically in figure 15 Most of these amounts were plotted and used in locating isohyets. The heavy-precipitation centers were very well located but their magnitude and extent are partly based upon peak stream discharges of 500 cfs per sq mi or more and several precipitation measurements of 10 inches or more The altitude of the freezing level remained higher than mountain ridges throughout the storm area, and the effect upon snowmelt runoff was an important consideration It appears that the snowmelt contribution to peak discharge was probably minor in the hardest hit areas

TABLE 3 —*Precipitation, in inches, at U S Weather Bureau gages, storm of June 7–8, 1964*

[(A) indicates 6-hr-reporting station, 24 hr begins at 0500 hr (R) indicates recording rain gage station, 24 hr ends at 2400 hr]

County and station	Precipitation collected on— June 7	June 8	Total precipitation
Cascade County			
Cascade 5 S	1 12	1 95	3 07
Cascade 20 SSE	58	1 42	2 00
Great Falls WB Airport (A)	2 02	1 33	3 35
Kings Hill (R)	77	1 36	2 13
Millegan (R)	67	52	1 19
Power 6 SE	01	3 70	3 71
Sun River 5 SW	93	2 54	3 47
Ulm 8 SE (Truly)	68	2 28	2 96
Chouteau County			
Brady (Aznoe)	46	1 92	2 38
Fort Benton	18	2 76	2 94
Fort Benton 20 N (R)	92	1 69	2 61
Geraldine	26	2 85	3 11
Highwood (R)	69	2 52	3 21
Highwood 7 NE	1 78	2 06	3 84
Loma 1 WNW	34	99	1 33
Lonesome Lake	23	81	1 04
Shonkin 7 S	53	4 99	5 52
Fergus County			
Denton	84	2 43	3 27
Hilger	53	1 62	2 15
Lewistown FAA Airport (R)	1 12	1 86	2 98
Flathead County			
Creston	51	1 80	2 31
Hungry Horse Dam	58	2 22	2 80
Kalispell WB Airport (A)	64	1 17	1 81
Kila	41	1 00	1 41
Olney 1 SE	1 49	31	1 80
Pleasant Valley 4 SE	22	88	1 10
Summit (R)	78	7 31	[1] 8 09
West Glacier	47	3 47	3 94
Whitefish 5 NW	63	3 11	3 74
Polebridge	58	2 02	2 60
Glacier County			
Babb 6 NE	1 06	2 97	4 03
Browning (R)	2 03	5 65	[2] 7 68
Cut Bank Airport (R)	82	2 29	3 11
Del Bonita	78	2 93	3 71
East Glacier	1 15	6 80	7 95
Santa Rita 14 N	41	2 62	3 03
Granite County			
Drummond Aviation (A)	70	79	1 49
Philipsburg ranger station	10	1 44	1 54
Judith Basin County			
Hobson	90	2 85	3 75
Moccasin experiment station	2 10	1 70	3 80
Raynesford 1 W	60	5 17	5 77
Stanford 2 NE	95	2 85	3 80
Utica 11 WSW	68	3 39	4 07
Lake County			
Bigfork 10 S	64	2 20	2 84
Polson Airport	43	2 50	2 93
Polson Kerr Dam	73	1 70	1 43
St Ignatius	84	2 56	3 40
Swan Lake (R)	24	3 44	3 68

See footnotes at end of table

TABLE 3.—*Precipitation, in inches, at U S Weather Bureau gages, storm of June 7–8, 1964*—Continued

[(A) indicates 6-hr-reporting station, 24 hr begins at 0500 hr (R) indicates recording rain gage station, 24 hr ends at 2400 hr]

County and station	Precipitation collected on— June 7	June 8	Total precipitation
Lewis and Clark County			
Augusta	0 97	3 71	4 68
Augusta 11 WNW	2 39	4 08	6 47
Austin 1 W	41	1 64	2 05
Canyon Creek	37	1 72	2 09
Canyon Ferry power house	31	87	1 18
Gibson Dam	1 01	7 80	8 81
Helena 6 N	25	77	1 02
Helena WB Airport	54	49	1 03
Holter Dam	61	1 49	2 12
Lincoln 14 NE	73	3 74	4 47
Lincoln ranger station	22	2 27	2 49
Marysville	25	2 97	3 22
Liberty County			
Tiber Dam	31	1 62	1 93
Lincoln County			
Fortine 1 N	69	68	1 37
Meagher County			
Fort Logan 3 ESE	78	86	1 84
Lennep 5 SW	36	1 49	1 85
Martinsdale 3 NNW	44	1 16	1 60
White Sulphur Springs	50	1 23	1 73
White Sulphur Springs 10 N	64	68	1 32
Missoula County			
Missoula WB Airport	55	1 10	1 65
Missoula 2 WNW	40	1 47	1 87
Seeley Lake ranger station (R)	70	55	1 25
Pondera County			
Conrad	20	3 59	3 79
Dupuyer (R)	1 55	4 48	6 03
Valier	33	4 50	4 85
Powell County			
Deer Lodge 3 W	03	1 07	1 10
Elliston	50	2 05	2 55
Ovando 1 SW	18	1 02	1 20
Ovando 7 WNW	19	87	1 06
Silver Lake	00	1 63	1 63
Sanders County			
Lonepine 1 WNW (R)	40	1 83	2 23
Teton County			
Blackleaf	1 24	4 70	5 94
Bynum 4 SSE	53	4 12	4 65
Choteau (R)	1 14	3 89	5 03
Dutton 6 E (R)	83	1 88	2 71
Fairfield	62	5 76	6 38
Pendroy	12	5 26	5 38
Toole County			
Ethridge	2 05	1 70	3 75
Galata 16 SSW	32	2 91	3 23
Shelby Airport	38	2 70	3 08
Sweetgrass	46	2 52	2 98

[1] 24 hr, 1700 hours to 1700 hours
[2] Manual gage total, 8 05 inches

TABLE 4.—*Supplemental precipitation data from privately owned gages, or other receptacles, storm of June 7–8, 1964*

Location			Precipitation (inches)	Type of gage	Evaluation of record
Section	Township north	Range			
Cascade County					
8	22	1 E	4 8	Glass tube	Fair
22	22	1 E	4 9	do	Good
4	22	2 E	6 0	do	Fair
20	22	2 E	5 25	do	Good
24	22	2 E	4 0	do	Do
28	22	3 E	4 75	do	Do
6	22	4 E	4 1	Wedge type	Do
23	22	4 E	4 1	Rectangular	Do
33	22	4 E	4 0	Glass tube	Do
20	22	5 E	3 6	do	Do
9	21	2 W	4 3	do	Do
25	21	2 W	3 8	do	Fair
1	21	1 W	2 5	do	Do
13	21	3 E	6 3	do	Good
15	21	3 E	3 5	Straight-sided bucket	Fair
21	21	3 E	4 0	Glass tube	Good
27	21	3 E	4 25	do	Fair
20	21	4 E	3 65	do	Good
25	20	3 W	5 5	do	Do
35	20	2 W	4 0	do	Do
21	20	1 W	4 5	Coffee can	Fair
7	20	2 W	4 7	Glass tube	Good
11	20	2 W	4 1	do	Do
12	20	2 W	4 2	do	Do
32	20	1 E	3 85	Wedge type	Do
Great Falls	20	4 E	3 65	Various	Do
26	20	4 E	4 8	Glass tube	Do
22	19	3 W	3 5	Wedge type	Fair
33	19	2 E	3 5		Good
21	19	4 E	4 7	Glass tube	Do
26	19	4 E	3 2		Fair
31	19	4 E	4 4	Glass tube	Good
7	19	5 E	3 94		Do
29	19	7 E	3 2	Glass tube	Do
19	18	2 W	5 0	Wedge type	Do
8	18	1 W	3 5	Glass tube	Do
Cascade	18	1 W	5 5	do	Fair
30	18	2 E	3 0	do	Do
18	18	4 E	3 25	do	Good
35	18	4 E	3 5	Glass tube	Do
11	16	2 W	4 00	Wedge type	Do
8	16	2 E	2 20	do	Do
	16	5 E	3 9	Glass tube	Do
	15	7 E	3 80	Wedge type	Do
Chouteau County					
27	27	10 E	1 68	Glass tube	Good
4	26	9 E	3 5	do	Do
19	26	10 E	2 75	do	Do
34	25	3 E	3 75	do	Fair
12	25	6 E	2 3	do	Good
35	25	7 E	3 2	do	Do
30	25	8 E	2 5	do	Do
31	25	14 E	0 7	do	Do
34	24	3 E	3 90	do	Do
8	24	5 E	3 0		Fair
3	24	6 E	3 0–3 2	Glass tube	Do
27	24	6 E	3 4	do	Good
28	24	7 E	3 0	do	Do

TABLE 4.—*Supplemental precipitation data from privately owned gages, or other receptacles, storm of June 7–8, 1964*—Continued

Location			Precipitation (inches)	Type of gage	Evaluation of record
Section	Township north	Range			
Chouteau County—Continued					
15	23	3 E	4 25	Wedge type	Good
25	23	3 E	4 4	Glass tube	Do
36	23	3 E	4 35		Do
30	23	5 E	5 35	Glass tube	Do
5	23	6 E	3 4	do	Do
30	23	6 E	3 5	do	Fair
33	23	7 E	4 0	do	Good
Ft Benton	23	8 E	3 55	do	Do
9	23	10 E	2 7	do	Fair
33	23	11 E	1 9	do	Good
	22	6 E	3 8	do	Do
7	22	7 E	4 10	do	Do
	22	7 E	3 6	do	Do
32	22	9 E	5 0	do	Do
6	21	7 E	3 8	do	Do
15	21	9 E	6 5		Do
26	21	12 E	3 5	Glass tube	Do
7	21	14 E	3 0	do	Do
18	20	8 E	3 0	do	Do
18	20	9 E	4 2	do	Do
26	20	12 E	4 10	do	Do
Fergus County					
26	19	12E	3 5–4 0	Glass tube	Fair
22	19	13 E	3 7	Rectangular	Do
7	19	15 E	4 1	Glass tube	Do
3	18	13 E	3 5	do	Good
2	18	14 E	3 75	Wedge type	Fair
21	18	15 E	3 5	Glass tube	Good
12	18	21 E	1 9	do	Do
29	18	21 E	4 10	do	Do
3	18	23 E	1 65	do	Do
27	17	15 E	3 85	do	Do
23	17	18 E	2 5	do	Do
31	16	16 E	4 82	do	Do
28	16	18 E	3 4	do	Do
15	16	23 E	1 25	do	Do
17	15	16 E	4 0	Rectangular	Do
14	15	17 E	3 8	Glass tube	Fair
18	15	19 E	4 0	do	Good
29	15	21 E	7 25		Do
21	15	22 E	3 5	Glass tube	Fair
Moore	14	16 E	4 32	Wedge type	Good
11	14	19 E	5 5	Glass tube	Do
11	14	21 E	3 5	do	Do
17	14	21 E	5 9		
13	12	24 E	2 0	Glass tube	Good
Garmill	11	16 E	3 5	do	Do
Flathead County					
6	37	22 W	3 25	Tobacco can	Fair
23	35	21 W	3 18	8-in standard rain gage	Good
28	33	20 W	2 25	do	Do
Lake McDonald	33	18 W	10 0	5-gal pail	Fair
Apgar	32	19 W	3 51		

TABLE 4.—*Supplemental precipitation data from privately owned gages, or other receptacles, storm of June 7–8, 1964*—Continued

Location			Precipitation (inches)	Type of gage	Evaluation of record
Section	Township north	Range			
Flathead County—Continued					
31	31	21 W	2 40	Glass tube	Good
16	30	20 W	3 40	8-in standard rain gage	Do
8	30	19 W	3 13	do	Do
	29	19 W	4 5	3-×6-in	Do
36	27	20 W	2 42	8-in standard rain gage	Do
	27	19 W	4 0	Gallon can	Do
28	27	13 W	5 55	8-in standard rain gage	Do
12	26	20 W	2 5		Do
20	26	19 W	2 4	Glass tube	Do
5	25	19 W	3 0	do	Do
17	25	15 W	4 49	8-in standard rain gage	Do
9	24	19 W	3 6	6-in plastic	Do
Glacier County					
3	37	16 W	+6 5	Bucket, sloping sides	Fair
1	37	14 W	4 8	Bucket, 11-in diam, straight rough sides	
	37	14 W	6 0	Glass tube	Good
21	36	14 W	7 40	Wedge type	Do
23	36	14 W	7 29	do	Do
Duck Lake	36	13 W	5 0	Barrel	Fair
32	36	12 W	6 0	Coffee can, 6-in deep	Good
21	35	16 W	5 5	USGS tipping bucket	Do
14	33	9 W	4 5	5½-in glass tube	Do
3	33	7 W	4 2	do	Fair
13	33	5 W	5 3		
30	32	13 W	14 5	50-gal drum	Fair to good
8	32	12 W	9 0	5-gal pail	Good
9	32	12 W	10 0+	35-gal oil drum	Fair
11	32	5 W	4 9	6-in glass tube	Good
18	31	12 W	11 0	5-gal bucket	Fair
6	31	8 W	4 5	6-in glass tube	Good
Granite County					
30	6	15 W	1 65	Glass tube	Good
15	5	14 W	1 60	do	Do
Judith Basin County					
5	18	8 E	3 5	Glass tube	Fair
24	18	8 E	4 8	do	Good
3	18	9 E	2 9	do	Fair
12	18	9 E	4 0	do	Good
1	18	10 E	4 5	2-lb coffee can	Do
7	18	10 E	4 0	Glass tube	Fair
35	18	11 E	5 0	do	Do
27	17	9 E	5 0	do	Do
25	17	10 E	4 9	do	Do
5	16	8 E	6 0	do	Do
17	16	9 E	7 25	do	Good
19	16	13 E	4 5	do	Fair
2	16	14 E	3 6	do	Good
12	15	12 E	4 5	do	Do
7	15	13 E	4 05	Glass tube, 1-16×-in	Do

TABLE 4.—*Supplemental precipitation data from privately owned gages, or other receptacles, storm of June 7–8, 1964*—Continued

Location			Precipitation (inches)	Type of gage	Evaluation of record
Section	Township north	Range			
Judith Basin County—Continued					
	15	14 E	4 2	Glass tube	Good
14	14	12 E	5 75	do	Do
24	14	13 E	4 3	do	Do
12	14	15 E	6 0	do	Do
28	14	15 E	7 0	do	Fair
8	13	12 E	4 5	do	Do
19	13	14 E	4 6	do	Good
1	12	14 E	3 5	do	Fair
Lake County					
20	26	19 W	2 75	Wedge type	Good
30	25	20 W	2 97		
29	25	19 W	2 35		
3	24	21 W	3 00	Glass tube	
19	24	21 W	3 25		
2	24	19 W	4 0±	Wedge type	Do
9	24	19 W	3 6	do	Do
21	24	19 W	4 5±	do	Do
33	24	19 W	4 2	do	Do
15	23	19 W	3 5	do	Do
4	22	19 W	[1] 4 0		Fair
29	22	17 W	2 2	Pail, sloping sides	Do
Lewis and Clark County					
31	22	8 W	8 0	5-gal pail	Fair
27	21	8 W	6 47	8-in standard rain gage	Good
35	21	7 W	5 1	Glass tube	Fair
23	20	10 W	10 0		Do
12	20	8 W	6 1	Glass tube	Do
13	20	8 W	6 0	Rectangular	Do
35	20	7 W	5 75	Glass tube	Good
8	20	5 W	5 0	do	Do
8	20	4 W	7 4	do	Fair
20	19	8 W	12 75	do	Good
35	19	8 W	8 3	do	Do
6	19	8 W	13+	Coffee can	Fair
5	19	8 W	11 25	Glass tube	Do
4	19	8 W	10+	do	Do
28	19	7 W	5 8	do	Good
32	19	7 W	8 0	do	Fair
13	18	8 W	8 0	do	Do
24	18	7 W	5 5	2-lb coffee can	Do
7	18	6 W	6 0	Glass tube	Good
20	17	6 W	4 5+	do	Poor
1	16	6 W	6 1	do	Good
4	16	5 W	4 3	do	Fair
4	15	7 W	8 0	5-gal can	Good
30	15	3 W	1 97	8-in standard rain gage	Do
4	14	2 W	3 8	Glass tube	Do
Liberty County					
15	33	4 E	1 4	Funnel gage	Good
22	33	5 E	85	Wedge type	Do
25	33	5 E	0 8	Glass tube	Do
4	31	4 E	1 8	5-in glass tube	Do

See footnote at end of table

TABLE 4.—*Supplemental precipitation data from privately owned gages, or other receptacles, storm of June 7–8, 1964*—Continued

Location			Precipitation (inches)	Type of gage	Evaluation of record
Section	Township north	Range			
Liberty County—Continued					
5	30	6 E	2 0	5-in glass tube	Good
15	29	4 E	4 4		Do
15	29	4 E	4 0		Do
2	29	6 E	2 1	5-in glass tube	Do
29	28	7 E	2 2	5½-in glass tube	Do
Lincoln County					
29	37	27 W	1 27	Wedge type	Good
Meagher County					
	14	3 E	1 90	Wedge type	Good
26	13	5 E	2 5	Glass tube	Fair
2	12	4 E	2 8	do	Good
26	11	8 E	1 70	do	Fair
33	10	4 E	2 4	do	Do
14	10	6 E	2 75	do	Do
3	9	6 E	2 25	do	Do
9	9	10 E	1 90	do	Good
14	8	6 E	2 05		Fair
18	8	6 E	2 25	do	Do
27	8	9 E	1 82	Can	Good
11	8	11 E	3 10	Glass tube	Do
36	8	9 E	1 82		Do
6	7	6 E	2 05	Glass tube	Fair
1	7	8 E	99		Do
28	7	8 E	2 05	20-gal oil drum	Do
6	7	10 E	2 34	Can	Good
30	7	11 E	3 4	Glass tube	Fair
23	6	6 E	1 70	do	Good
Missoula County					
28	16	14 W	2 0	1-lb coffee can	Good
15	16	16 W	2 0	Pail	Do
11	21	17 W	2 43	8-in standard rain gage	Do
24	15	20 W	2 99	Wedge type	Do
11	19	17 N	2 5	8-in standard rain gage	Do
Pondera County					
34	31	5 W	6 0	4-in glass tube	Good
8	30	4 W	6 0	do	Fair
15	30	3 W	5 5	do	Good
23	30	2 W	4 27	4-in glass tube	Fair
27	29	8 W	8 01	do	Good
3	29	6 W	7 0	do	Do
21	29	6 W	5 9	do	Fair
10	29	4 W	6 5	do	Good
4	29	3 W	5 5	do	Fair
22	28	7 W	8 5	5-in glass tube	Good
3	28	6 W	6 02	Standard, 8-in manual	Very good
33	29	5 W	4 75	do	Good
34	29	5 W	4 81	Recorder	Very good
26	29	6 W	5 34	do	Do
22	28	6 W	8 05+		Fair

TABLE 4.—*Supplemental precipitation data from privately owned gages, or other receptacles, storm of June 7–8, 1964*—Continued

Location			Precipitation (inches)	Type of gage	Evaluation of record
Section	Township north	Range			
Pondera County—Continued					
28	28	4 W	4 5	5-in glass tube	Good
12	28	2 W	4 1	do	Fair
36	28	2 W	4 3	do	Do
6	28	1 W	4 80	4-in glass tube	Do
15	28	1 E	4 20	do	Good
15	28	2 E	3 50	do	Fair
29	27	3 W	5 5		Do
21	26	2 W	3 5	5-in glass tube	Good
28	27	2 W	4 7		Fair
32	27	1 W	2 9		Do
14	27	1 E	3 5		Good
15	27	2 E	4 0		Do
22	27	2 E	4 6	1¼-in tube	Do
23	26	1 E	3 0	5-in glass tube	Fair
Heart Butte	29	10 W	11 0	Washtub	Do
Powell County					
4	15	13 W	1 5		
21	15	12 W	1 3		
22	15	11 W	2 2		
31	15	11 W	2 04		
18	15	10 W	3 0		
28	15	10 W	1 65		
Sanders County					
30	22	23 W	3 40		
Teton County					
13	27	8 W	7 5	Glass tube	Fair
26	27	7 W	6 4	do	Do
22	27	5 W	6 5	do	Good
21	27	4 W	6 5	do	Do
23	26	8 W	6 7	do	Do
3	26	6 W	6 0	do	Do
12	26	5 W	4 0	Rectangular	Fair
19	26	5 W	4 75		Good
23	26	4 W	4 7	Glass tube	Do
28	26	3 W	4 5	do	Do
9	25	8 W	9 0	Wedge type	Do
25	25	7 W	8 0	do	Fair
18	25	5 W	4 65		Good
25	25	3 W	4 0	Glass tube	Do
1	25	2 W	4 85	do	Do
12	24	5 W	4 73	do	Do
13	24	5 W	5 5	do	Fair
25	24	5 W	5 21	8-in standard ram gage	Good
14	24	4 W	5 0	Glass tube	Do

TABLE 4.—*Supplemental precipitation data from privately owned gages, or other receptacles, storm of June 7–8, 1964*—Continued

Location			Precipitation (inches)	Type of gage	Evaluation of record
Section	Township north	Range			
Teton County—Continued					
1	24	3 W	4 05	Glass tube	Good
34	24	3 W	5 5	do	Do
11	24	1 W	3 3	do	Do
17	24	1 W	3 25	do	Do
28	24	1 E	3 6	do	Do
22	24	2 E	3 5	do	Do
18	23	3 W	4 1	do	Do
	23	2 W	5 5	do	Do
28	23	2 W	4 8	do	Do
25	23	1 W	3 5	do	Do
3	23	1 E	3 6	do	Do
23	23	1 E	4 15	do	Do
23	23	1 E	3 75	do	Do
33	23	1 E	3 80	do	Do
5	23	2 E	3 1	do	Do
18	23	2 E	3 5	do	Do
33	22	9 W	13+	Coffee can	Fair
32	22	9 W	10 5	Glass tube	Good
9	22	7 W	7 5	2-in diam	Do
27	22	6 W	6 32	Funnel top with 1 10 ratio	Do
34	22	6 W	6 50	2-in diam	Do
20	22	5 W	7 08	Glass tube	Do
35	22	5 W	7 5	Glass tube	Do
4	22	3 W	4 2	do	Do
36	22	3 W	4 3	do	Do
1	22	2 W	5 3	do	Do
8	22	2 W	6 65		Do
26	22	2 W	5 01	Glass tube	Do
	22	2 W	4 2	do	Do
10	22	1 W	5 3	do	Do
18	21	5 W	5 25	do	Do
14	21	4 W	5 5	do	Do
15	21	4 W	5 5+	do	Do
1	20	3 W	4 0	do	Do
27	25	9 W	13 0	Pail and bucket	Do
Toole County					
Galata	31	3 E	2 0	5-in glass tube	Good
Sunburst	36	2 W	2 0	do	Fair
20	37	2 W	2 1	Glass tube	Do
2	36	4 W	2 2	do	Good
28	36	3 W	2 0	do	Fair
2	35	4 W	6 4	do	Good
33	35	2 W	2 5	do	Fair
21	35	1 E	1 5	do	Good
16	34	4 W	4 0	do	Fair
11	34	3 W	3 0	do	Do
2	34	1 W	1 5	do	Do
6	33	3 W	3 1	do	Good
6	33	3 W	3 25		
26	33	2 W	3 0	Glass tube	Fair
19	33	1 W	2 5	do	Good
22	33	3 E	1 7	do	Do
18	32	4 W	4 6		
35	32	4 W	5 3	Glass tube	Good
34	32	3 W	4 0	do	Fair
4	32	2 E	2 0	do	Good

TABLE 4.—*Supplemental precipitation data from privately owned gages, or other receptacles, storm of June 7–8, 1964*—Continued

Location			Precipitation (inches)	Type of gage	Evaluation of record
Section	Township north	Range			
Toole County—Continued					
34	32	3 E	3 85	Glass Tube	Good
16	31	2 W	4 7	do	Do
26	31	2 W	4 1	do	Fair
4	31	1 W	3 5	do	Do
27	31	1 E	2 25	do	Good
30	30	1 W	3 3	do	Do
7	30	2 E	2 25	do	Do
3	30	3 E	2 0	do	Do
12	29	2 E	3 2	do	Do

[1] About

TABLE 5 —*Supplemental precipitation data from the Alberta, Canada, area north of the Montana boundary, storm of June 7–8, 1964*

Canada Department of Agriculture measurements

Section or locality	Township north	Range	June 7–8 duration (hours)	Total precipitation (inches)	Gage	Evaluation
NE¼ 23	3	25	25	4 0	11- by 15-in pail	Good
NW¼ 17	3	24	24	4 0	12- by 15-in pan	Do
SW¼ 34	2	24	23	5 0	⅝-in glass	Do
NW¼ 19	3	24	24	5 0	do	Do
NE¼ 19	2	23	24	4 5	do	Do
NW¼ 36	1	24	24	5 5	Department of Transport	Do
NW¼ 29	1	24	24½	5 5	⅝-in glass	Do
SW¼ 16	1	23	24	5 2	do	Do
SW¼ 2	1	23	24	3 9	Department of Transport	Do
SW¼ 3	1	22	25	4 2	do	Do
SE¼ 15	1	24	25	6 5	⅝-in glass	Do
SW¼ 10	1	25	24	6 5	do	Do
SW¼ 1	2	25	24	6 5	do	Do
NW¼ 4	3	24	24	5 5	Department of Transport	Do
NW¼ 20	3	23	24	3 4	½- by 4-in glass	Fair
SW¼ 3	4	23	24	3 5	do	Do
NW¼ 28	4	23	24	2 5	⅝-in glass	Good
NE¼ 32	3	24	24	4 5	do	Do
SE¼ 13	4	25	24	4 5	⅝-in glass	Do
SE¼ 19	3	24	24	3 8	½-in glass	Do
NW¼ 25	4	23	24	3 0	⅝-in glass	Do
SW¼ 1	4	23	24	4 5	do	Do
Magrath, Alberta			24	1 13	Department of Transport	Do
NE¼ 7	5	21	24	1 65	do	Do
NW¼ 14	4	22	24	3 4	¾-in glass	Do
NW¼ 31	2	21	24	3 25	½-in glass	Do
NE¼ 7	2	21	24	3 6	⅝-in glass	Do
SW¼ 7	2	20	24	4 5	½-in glass	Do
NE¼ 10	1	21	24	2 5	⅝-in glass	Do
NW¼ 16	1	20	24	4 0	do	Do
NE¼ 23	1	20	24	3 25	do	Do
SW¼ 7	1	19	24	3 75	¾-in glass	Do
SW¼ 2	2	17	24	2 63	⅝-in glass	Do
NE¼ 14	1	17	24	4 75	1¼- by 6-in glass	Do
NE¼ 28	1	17	24	3 0	⅝-in glass	Do
SW¼ 17	1	17	24	3 0	½-in glass	Do
SW¼ 1	1	17	24	4 5	⅝-in glass	Do
SE¼ 18	1	16	24	4 5	¾-in glass	Do
SE¼ 25	1	16	24	3 5	⅝-in glass	Do
SE¼ 1	3	17	24	3 2	½ in glass	Do
NE¼ 7	3	16	24	3 0	½-in glass	Do
SW¼ 11	3	17	24	3 5	¾-in glass	Do
NE¼ 19	3	17	24	3 0	do	Do
SW¼ 16	4	18	34	2 8	⅝-in glass	Do
SE¼ 25	4	19	24	3 32	Department of Transport	Do
SW¼ 20	3	19	24	4 0	⅝-in glass	Do
NE¼ 34	4	20	24	2 5	¾-in glass	Do
NW¼ 13	5	21	24	2 7	⅝-in glass	Do
SE¼ 4	5	21	24	3 0	do	Do
NE¼ 9	4	22	24	3 25	½-in glass	Do
NW¼ 28	5	25	24	2 3	¾-in glass	Do
Glenwood, Alberta			24	2 44	Department of Transport	Do
NW¼ 20	2	23	24	4 42	do	Do
NE¼ 14	5	30	24	1 92	do	Do
NW¼ 17	4	29	24	4 0	⅝-in glass	Do
NW¼ 31	1	18	24	3 5	do	Do
NE¼ 6	5	28	24	2 5	do	Do
SE¼ 14	5	29	25	2 9	do	Do
NE¼ 35	2	28	25½	5 5	Department of Transport	Fair

TABLE 5 —*Supplemental precipitation data from the Alberta, Canada, area north of the Montana boundary, storm of June 7–8, 1964*—Continued

Canada Department of Agriculture measurements—Continued

Section or locality	Township north	Range	June 7–8 duration (hours)	Total precipitation (inches)	Gage	Evaluation
NE¼ 26	2	28	25½	5 48	Department of Transport	Good
NE¼ 23	2	28	26	6 0	11-in diam 5-gal oilcan	Do
NE¼ 14	2	28	26	6 49	Department of Transport	Do
SE¼ 19	2	27	26½	7 25	½-in glass	Do
SE¼ 4	2	27	32	6 75	11-in diam bucket	Fair
SE¼ 3	2	27	25½	6 50	⅝-in glass	Good
SE¼ 20	2	27	27	7 75	11-in diam pail	Do
NW¼ 7	2	28	30	6 36	Department of Transport	Do
NW¼ 4	2	28	27½	7 5	½-in glass	Do
Belly River ranger station			30	8 5	Department of Transport	Do
NW¼ 22	2	27	26½	7 0	11-in diam pail	Do
SE¼ 6	3	26	26	5 5	½-in glass	Do
NW¼ 1	3	27	26	6 5	do	Do
SW¼ 10	3	27	29½	7 0	11-in diam pail	Do
NE¼ 9	3	26	25½	7 0	do	Do
NE¼ 7	3	27	25	3 5	do	Do
NE¼ 36	2	26	24	4 0	10 5-in pail	Do
NE¼ 15	2	26	26½	6 5	⅝-in glass	Do
SE¼ 17	2	26	30	7 0	11-in diam pail	Do
NE¼ 12	2	27	28	6 75	⅝-in glass	Do
NE¼ 24	1	27	32½	8 5	do	Do
SE¼ 10	1	27	32	7 5	11¼-in diam pail	Do
SW¼ 14	1	27	26	7 0	6 ¾-in diam pail	Do
SE¼ 14	1	27		7 0	11¼-in diam pail	Do
NW¼ 19	1	26	27	6 5	⅝-in glass	Do
NE¼ 33	1	26	25	4 5	5¼-in pail	Do
SE¼ 35	1	26	27½	5 5	4-in diam can	Fair
SE¼ 9	2	25	24	6 0	⅝-in glass	Do
NE¼ 30	2	24		6 0	11-in diam pail	Good
NE¼ 12	3	26		5 0	⅝-in glass	Do
NE¼ 32	2	25	25	4 0	do	Do
SW¼ 35	1	23	27	5 0	do	Do
SE¼ 23	2	25	26	5 0	do	Do
SW¼ 20	1	25	24	5 0	do	Do
SW¼ 23	1	25	27	5 3	do	Do
NE¼ 20	3	29	24	3 87	Department of Transport	Do
NE¼ 24	3	29	30	5 25	do	Do
NW¼ 21	2	29	23	7 5	⅝-in glass	Do
NW¼ 12	2	26		5 5	do	Do
SW¼ 19	2	25	26	5 25	3-in diam can	Do
SW¼ 3	1	27	29	8 0	11-in diam bucket	Do
NW¼ 4	4	29	27½	4 5	¾-in glass	Do
SW¼ 2	1	25	31	4 63	Department of Transport	Do

TABLE 5 —*Supplemental precipitation data from the Alberta, Canada, area north of the Montana boundary, storm of June 7–8, 1964*—Continued

Canada Department of Transport measurements

Location	Total precipitation (inches)	Location	Total precipitation (inches)
Caldwell	5 46	St Mary Dam	2 96
Carway	4 60	Beaver Mines	3 16
Mountain View	7 09	Carbondale lookout station	1 91
Mountain View bridge	5 94	Cardston	3 44
Waterton Lakes Belly River	8 50	Castle ranger station	3 07
Waterton Lakes Red Rock	[1] 8 39	Hailstone Butte	1 68
Waterton Lakes ranger cabin	6 47	Kananaskia lookout station	3 70
Waterton Park headquarters	[2] 9 07	Magrath	1 93
Waterton Dam	2 24	Pincher Creek West	1 87

[1] 1 01 in also fell June 5–6
[2] 0 45 in fell June 5–6

TABLE 6 —*Hourly precipitation, in inches, at U S*

[Tr,

June \ Hour	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200
24-1202 Browning,												
7-8	0 31	0 25	0 51	0 25	0 10	0 03 35	0 03 38	0 09 34	0 05 43	0 06 54	0 09 48	0 01 56
24-1737-3 Choteau,												
7-8	0 18	0 26	0 16	0 26	0 33	0 17	0 46	0 45	0 22	0 16	0 18	0 18
24-2173 Cut Bank,												
7-8	0 15	0 07	0 14	0 07	0 21	0 15	0 19	0 23	0 14	0 22	0 13	0 15
24-2571 Dupuyer,												
7-8	0 31	0 12	0 20	0 12	0 35	0 38	0 42	0 16	0 21	0 17	0 15	0 20
24-2584 Dutton,												
7-8	0 02	0 02	0 14	0 24	0 23	0 13	0 02	0 05	0 05	0 04	0 09	0 04
24-3119 Fort Benton,												
7-8	0 01	0 02	0 17	0 07	0 06	0 21	0 11	0 07	0 13	0 05	0 19	0 13
24-3489 Gibson Dam,												
7 8	0 18	0 22	0 52	0 56	0 61	0 48	0 34	0 35	0 17	0 02 19	0 06 39	0 13 41
24-4120-3 Highwood,												
7-8	0 06	0 13	0 20	0 15	0 19	0 03	Tr	0 18	0 20	0 26	0 09	0 12
24-4143-4 Hilger,												
7-8	0 05	0 04	0	0 01	0 02	0 10	0 32	0 04	0 16	0 12	0 03 14	0 05 0 13
24-4663-4 Kings Hill,												
6 7-8	0	0	0	0	01	01	0 01 01	0 02 0	0 01 0	0 01 0	0 02 01	0 05 26

Weather Bureau weighing rain gages, storm of June 7–8, 1964

trace]

1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Daily total (inches)	Storm total (inches)	Duration (hours)
Glacier County														
0 01 56	0 03 41	0 03 13	0 10 05	0 14	0 14	0 13	0 14	0 22	0 13	0 22	0 39	2 03 5 65	7 68	35
Teton County														
0 11	0 05 27	0 05 07	0 05 11	0 05 21	0 10 09	0 13 02	0 21	0 13	0 10	0 10	0 17	1 14 3 89	5 03	30
Airport, Glacier County														
0 14	0 01 27	0 03 06	0 08	0 13	0 08	0 10	0 09	0 08	0 11	0 06	0 05	82 2 29	3 11	26
Pondera County														
0 07 35	0 05 15	0 05 71	0 05 29	0 13 14	0 15 03	0 24 02	0 19	0 27	0 05	0 11	0 19	1 55 4 48	6 03	31
Teton County														
0 01 05	0 01 08	0 07	0 08 10	0 09 31	0 08 13	0 11 05	0 07 01	0 01 01	0 10	0 10	0 17	0 83 1 88	2 71	33
Chouteau County														
0 11	0 06	0 09 04	0 01 06	0 12 08	0 34 10	0 08 02	0 05	0 06	0 16	Tr	0 01	0 92 1 69	2 61	29
Lewis and Clark County														
0 04 47	0 05 27	0 13 36	0 07 30	0 05 27	0 08 20	0 12 05	0 15 04	0 11 07	0 16 04	0 23	0 18	1 60 6 49	8 09	37
Chouteau County														
0 27	0 11	0 23 10	0 06 09	0 03 10	0 03 06	0 03 11	0 02 06	0 10 01	0 05	0 09	0 05	0 69 2 52	3 21	31
Fergus County														
0 07 10	0 05 10	0 04 10	0 01 04	0 01 02	0 02	0 01	0 03	0 03 05	0 17 02	0 04	0 03	0 53 1 62	2 15	36
Cascade County														
0 03 08 24	0 01 14 16	0 09 14	0 03 16	0 01 07	0 03 04	0 02 05	0 03 02 06	0 06 08 06	0 06 12 06	03 02	0	0 19 77 1 36	2 13	41

TABLE 6.—*Hourly precipitation, in inches, at U S*

June \ Hour	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200
24-4985 Lewistown												
7											0 04	0 12
8	0 48	0 15	0 12	0 12	0 10	0 10	0 05	0 07	0 11	0 11	04	02
24-7978-1 Summit												
7		0 02	0 01	0 07	0 07	0 05	0 03	0 05	0 03	0 10	0 13	0 06
8	0 27	33	35	40	45	54	52	46	40	46	54	30
Grinnell Creek gaging												
7					0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1
8	0 2	0 2	0 2	0 2	2	2	3	3	2	2	2	2
NE¼ sec 34, T 29 N, R 5 W,												
7					0 01	0 01	0 01					
8	0 21	0 06	0 16	0 27	27	26	30	0 23	0 36	0 22	0 21	0 26
NE¼ sec 26, T 29 N, R 6 W,												
7					0 04	0 04	0 01	0 01				
8	0 15	0 19	0 09	0 09	18	28	31	26	0 28	0 16	0 30	0 18

[1] USGS tipping bucket on water-stage recorder

Weather Bureau weighing rain gages, storm of June 7–8, 1964—Continued

1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Daily total (inches)	Storm total (inches)	Duration (hours)
Airport, Fergus County														
0 10 05	0 10 04	0 06 01	0 05 02	0 02 02	Tr 01	Tr -	Tr -	0 02 - -	0 34 -----	0 08 --	0 19 - -	1 12 1 62	- 2 74	- 32
Flathead														
0 02 44	0 03 15	0 05 07	0 06	0 06	0 10 --	0 22 --	0 19 -	0 32 --	0 29 -	0 29 - ---	0 16 - -	2 41 5 68	-- --- 8 09	- 38
station,[1] Glacier County														
0 1 2	0 1 2	0 1	0 2 -	0 2 --	0 2 -	0 2 -- -	0 2 - -	0 1	0 1	0 1	0 1	2 5 3 0	-- 5 5	- - 34
Pondera County														
--- 0 08	0 02 23	0 26 15	0 05 03	0 21 02	0 14	0 17	0 06 -	0 02	0 10 -	0 31	0 15 - -	1 52 3 32	4 81	- -- 28
Pondera County														
--- -- 0 41	0 01 15	0 03 33	0 03 61	0 12 03	0 29 01	0 12 - --	0 17 ---	0 15 - -	0 06	0 02 -	0 32 - -	1 42 4 02	- 5 34	- 29

MISCELLANEOUS NOTES

In connection with the strong upslope winds along the Continental Divide and the heavy spillover or lee-side precipitation (fig 16) previously described, it is worth noting that a large number of persons contacted for supplemental precipitation measurements commented upon the strength of the north to east windflow toward the storm's centers At the Federal Aviation Agency station at the Cut Bank Airport (the nearest hourly observation station to any of the storm's heaviest rainfall centers), hourly wind readings confirm the strength of the northeast windflow from midnight until after noon June 8 The observations show that the wind direction ranged from northeast to east-northeast during the storm's heaviest period, with speeds frequently gusting to more than 40 mph (miles per hour) The same set of observations also confirms that the cold front from the north entered the northern parts of the affected area at about the time the map measurements were taken (0500 hr, June 8, fig 11)

Because Glasgow appears to have been near the center of the moist airstream flowing into the storm area, upper air observations made there just before the storm and during its early stages should reveal the general character of the airmass involved The Glasgow radiosonde observation made at 1700 hours, June 7, is shown in figure 17 It shows, among other things, very high mixing ratios—from nearly 12 grams of water vapor per kilogram of dry air at the surface to 2 6 g per kg (grams per kilogram) at 500 mb The observed lapse was conditionally unstable up to 500 mb, but the greatest degree of conditional instability was between the surface and about 7,000 ft msl This layer of greatest instability was at the bottom of the larger layer (reaching to higher than the 500-mb level) that appears to have been heading for the storm activity a few hundred miles to the west The Glasgow sounding was used to calculate precipitable water (surface to 500 mb) content, which at that time was 1 09 inches, and the average relative humidity for the same layer was 84 percent

An additional item of more than passing interest was the lack of thunderstorms in the heavy-precipitation areas In view of the sparsely populated nature of the areas where the heaviest rains fell, it cannot be concluded that thunderstorms did not occur, but it is noteworthy that none was reported on June 7 or 8 by any regular Weather Bureau station near any of the storm's several centers It seems likely that thunderstorms were widely scattered if they did occur, and that conditional instability release was mostly of a rather even intensity and fairly continuous The steadiness of the rainfall rates shown in figure 15 support, at least in part, such a hypothesis

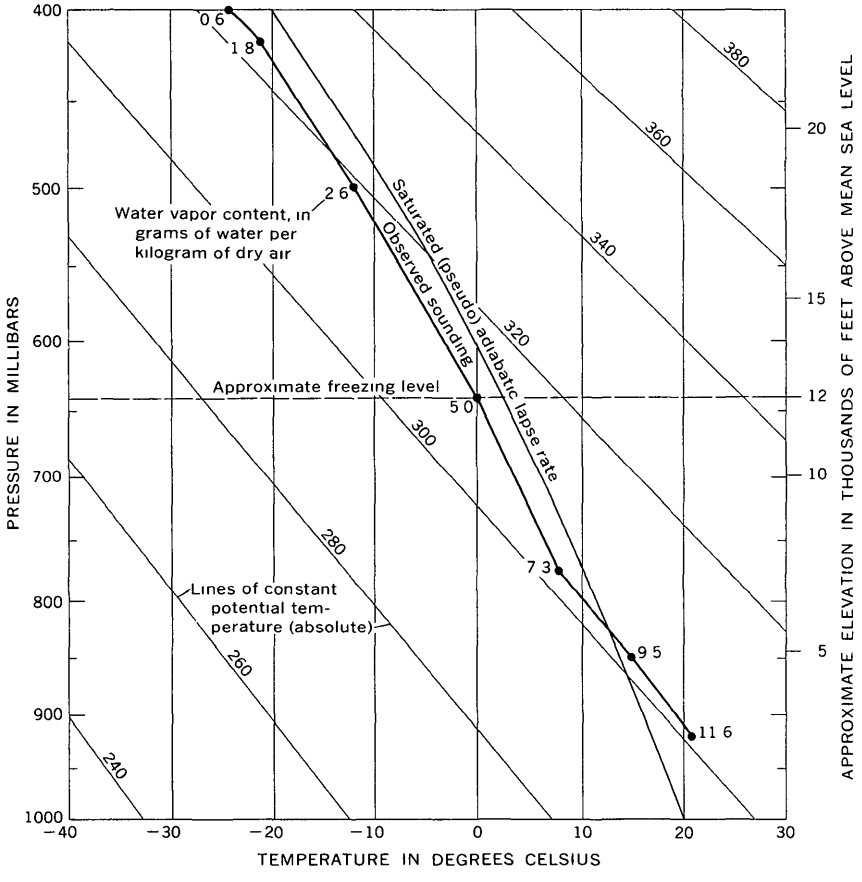

FIGURE 17.—Glasgow radiosonde observation at 1700 hours, June 7, 1964, sampling moist air enroute westward into storm area. The airmass was conditionally unstable from the surface (about 920 mb) to nearly 400 mb.

METEOROLOGICAL COMPARISON WITH PREVIOUS FLOODS

The record-breaking floods of 1964 and most previous Montana floods occurred in June when seasonal large-scale meteorological conditions may have been similar. Heavy rainstorms along and near the eastern side of the Continental Divide in late May and early June are clearly associated with floods of 1894, 1906, 1908, 1916, 1927, 1938, 1948, and 1953. Mountain snowmelt has generally filled stream channels to near capacity in the same period, and the degree to which floods have been rain induced is rarely as clear as in 1964. The noteworthy Springbrook storm of 1921 was centered a considerable distance from the mountains although general rains appeared to have had some effect on mountain runoff as well.

Precipitation data from regular stations for all these storms and a discussion of the flooding of June 1908 appear in the appropriate issues of the monthly publication "Climatological Data, Montana" by the U S Weather Bureau Streamflow data, like precipitation data, are more complete in later years and may be found in the yearly reports of the U S Geological Survey entitled "Surface Water Supply of the United States" Studies of the 1921 (Springbrook), 1906 (Warrick) and 1938 (Big Timber and Chessman Reservoir) storms have been discussed by the U S Weather Bureau and Corps of Engineers (1945) Meteorological and hydrologic features of the Marias River flood of 1948 are discussed in the Monthly Weather Review (Dightman, 1950) The 1953 flood, which was felt particularly in Great Falls area, was documented in a report of the U S Geological Survey (1957) An examination of the data reveals a fairly strong climatological similarity in the rain-induced floods that generally occur in June, but which may begin to develop in late May The major meteorological developments appear to be much the same While vertical motion maxima may be located in any part of the upper Missouri River drainage basin, including the Yellowstone River, depending on the parts of the general area traversed by the storm structures, all the storms received their moist air supply from the Gulf of Mexico as a result of general flow northward, then northwestward over the western plains States

The principal differences between previous storms and the 1964 storm were

1 The maximum vertical motion centers in 1964 were apparently located above the steepest eastern slopes of the northern Rockies, and were reinforced by a larger orographic vertical-motion component than was possible in any of the earlier record floods
2 The flow of moist air from the gulf was unusually direct, broad, and undisturbed until its arrival in the rain area
3 The timing of the entry of the cold front from the north into the rain area was critical—its "wedging" and continued upslope flow effects probably caused a few hours more of heavy rain than otherwise would have occurred

It would be difficult to design a combination of all factors more favorable for heavy rainfall than prevailed in this storm The timing of the interacting physical forces and other parameters could hardly be improved, and it is therefore not surprising that the dimensions of this storm closely approximate those of probable maximum precipitation described by the U S Weather Bureau (1960b)

DESCRIPTION OF THE FLOODS

The disastrous floods of June 1964 in northwestern Montana struck parts of the Hudson Bay, Missouri River, and the upper Columbia River basins The area of severe flooding extended about 200 miles northward along the Continental Divide from Helena to southern Alberta, Canada, in a band about 70 miles wide Flooding beyond this area was generally confined to the larger rivers having their sources along the Continental Divide.

The intense rain of about 30-hours duration, falling on the remains of the mountain snowpack, generally produced sharp peaks which were the highest of record at many gaging stations and greatly exceeded historical maximum stages on many streams The destruction of 200-year-old trees at public campgrounds noted by U S. Forest Service personnel and the uprooting of old trees and the channel enlargement described by others indicate the rare magnitude and extent of the 1964 floods The estimated flood damage of $55 million in Montana was never previously approached Newspaper accounts indicate that damage in Canada was in excess of $1 million

HUDSON BAY BASIN

The flood-producing area in the Hudson Bay basin is almost entirely in Glacier National Park in Montana and the adjoining Waterton Lakes National Park in Canada The principal streams in the flood area are the Belly, Waterton, and St Mary Rivers, which drain northeastward to the Saskatchewan River

Monetary damage in the Belly River drainage basin in the United States was light as there are no roads or habitations The peak stage on the Belly River near Mountain View, Alberta, was about half a foot lower than the previous known maximum stage of 1908 Severe flooding of the lowlands forced the evacuation of about 250 persons on the Blood Indian Reserve near Stand Off, Alberta. A Hutterite colony, north of Stand Off, was also threatened, and all 150 residents fled to higher ground No injuries to residents were reported, but more than 200 head of cattle and 300 sheep were believed drowned Flooding and bridge washouts closed most highways across the Belly River

Much of the town of Waterton Park, Alberta, bordering Waterton Lake, was inundated by flooding along the shoreline of Waterton Lake and by overbank flow of Cameron Creek The nearby Waterton Lakes National Park headquarters reported 9 07 inches of rain on June 7–8, and the 24-hour rainfall of 7 53 inches exceeded the previous record by 4 63 inches The lake level rose 4 feet in a 3-hour period

early on June 8 The park was closed, and nearly 150 residents of the townsite were evacuated and housed in the Prince of Wales Hotel A brief 70-mph north wind created waves that smashed boats at the Waterton Lake piers and blew down a wide strip of fir trees on the mountainside near the southern edge of the townsite Damage in the area was estimated at more than a million dollars. The peak discharge of 25,700 cfs on the Waterton River downstream from Waterton Lake exceeded the previous record of 1908 by 5 percent In Glacier National Park, runoff rates were probably as outstanding Street Creek, a tributary to the Waterton River with a drainage area of 6 square miles, had a peak flow of 5,740 cfs on June 8 Assignable monetary damage to the primitive United States drainage was light

Runoff was extremely high in the upper reaches of the St Mary River drainage basin The peak flow of Swiftcurrent Creek, a St Mary River tributary, at the outlet of Swiftcurrent Lake was treble the previous maximum of 2,250 cfs for the period of record beginning in 1912 The bridge at the lake outlet was submerged, and so about 50 employees at Many Glacier Hotel were isolated Lake Sherburne, which held the upstream floodflow of Swiftcurrent Creek, had a peak inflow of about 10,000 cfs from an area of 63 7 square miles The road between the town of Babb and the Many Glacier area was blocked by slides and gravel deposits and was washed out opposite the mouth of Boulder Creek The resort town of St Mary (fig 18) was evacuated when Divide Creek overflowed its banks Water was nearly 3 feet deep on the streets early on June 8 A highway employee drowned at St Mary when a roadway, undermined by Divide Creek, collapsed The peak discharge of 16,500 cfs on St Mary River downstream from Swiftcurrent Creek exceeded the previous maximum, however, the collection of streamflow records at this station has been intermittent

Kennedy Creek washed out a bridge on U S Highway 89 and a nearby section of the St Mary Canal on June 8 A Cardston, Alberta, man drowned after he drove his car into the highway washout St Mary Canal diverts water from the St Mary River near Babb and, after discharge into North Fork Milk River, serves irrigation needs along the Milk River in the United States A limited temporary supply for the canal was obtained by diverting Kennedy Creek into the canal from June 19 to July 11 Repairs to the canal were made and normal operation was resumed July 17 The peak flow of the St Mary River at the international boundary was 21,000 cfs, whereas the peak of 1908 was considered to be 40,000 cfs Lee Creek, which

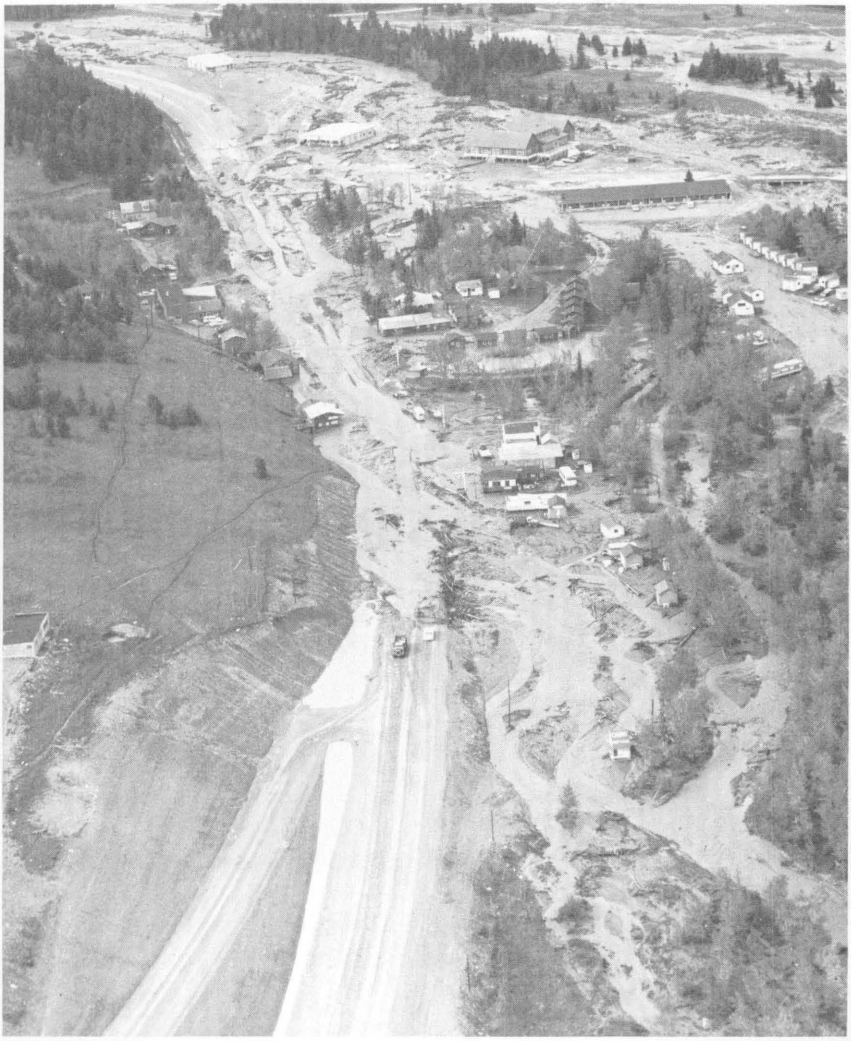

FIGURE 18.—Silt and debris deposits by Divide Creek at resort town of St. Mary. Photograph by Montana Highway Department.

heads in Glacier National Park, washed out the diversion dam for the municipal water supply at Cardston, Alberta, washed away six homes and several commercial buildings in Cardston, and drowned more than 100 cattle in a feed lot. Discharge hydrographs for selected gaging stations in the Hudson Bay basin are presented in figure 19.

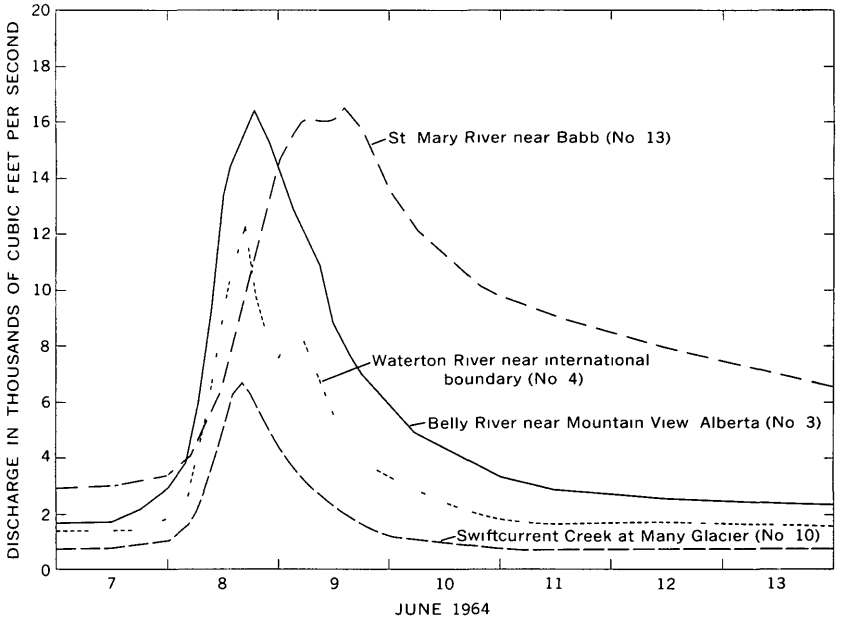

FIGURE 19.—Discharge at selected gaging stations in Hudson Bay basin, June 7–13, 1964. Numbers in parentheses conform with those given in table 19 and on figure 2

MISSOURI RIVER BASIN

The part of the Missouri River basin covered in this report is the main stem and intervening tributary drainage areas from Toston to Fort Peck Dam, except for Musselshell River and Dry Creek drainage basins. The Milk River basin upstream from Fresno Reservoir is also included. The flooding which occurred in local areas outside the above boundaries was of a lesser magnitude or was in an area where discharge information is lacking.

Peak flows of the Missouri River and tributaries upstream from Canyon Ferry Reservoir were not record high. Although Canyon Ferry Reservoir was nearly full on June 6, it held nearly all the upstream flood flow until June 12 when the passage of inflow did not cause additional flooding at Great Falls. Tenmile, Sevenmile, and Prickly Pear Creeks flooded adjacent lowlands in the Helena Valley and affected a few homes and ranches. The peak discharge of Tenmile Creek near Rimini was 556 cfs, whereas the peak of 1917 was 781 cfs.

One bridge was washed away and several sections of State Secondary Highway 434 were damaged by Wolf Creek near the town of Wolf Creek. The maximum flow of the Dearborn River apparently oc-

curred near the mountain front and diminished in a downstream direction because intervening tributaries had peaked earlier Somewhat hazy information from local residents indicates the peak stage and discharge of the Dearborn River in 1964 exceeded those of 1908 and intervening years throughout the river's length The sparsity of development along the narrow valleys of the Dearborn River and tributaries restricted property damage to a few ranches, approaches to a county bridge near Bean Lake, and the loss of two gaging stations Hardy Creek, a tributary to the Missouri River upstream from Cascade, undermined both piers of the bridge on U.S Highway 91, and closure of this bridge nearly doubled the road distance between Helena and Great Falls

Flooding along the Sun River was severe, particularly in the broader and more populous valley from Simms to Great Falls In the rather primitive area along the North and South Forks of Sun River above the Gibson Dam, summer homes, trails, and a gaging station were damaged or destroyed The irrigation reservoir formed by Gibson Dam below the confluence of the two forks began to overflow at about 1400 hours on June 8. Water spilling over the parapet walls of the concrete dam (fig. 20) reached a maximum depth of 3 23 feet between 1900 and 2000 hours on June 8. Beaver Creek, which enters the Sun River just below the dam, was also high and destroyed the access bridge to the dam and a large storage building

Much of the town of Augusta, on Elk Creek (locally called South Fork Sun River), was inundated Flooding, described as much worse than the "big flood of 1953," damaged 34 homes and 17 business establishments as water depths reached up to 3 feet The peak stage was reported to have occurred at about 2200 hours on June 8 An electrical powerline servicing the town was ripped out on the evening of June 9 Water over the road and the washed-out bridges on State Highways 287 and 20 nearly isolated the town until repairs were made

The valley of the Sun River below the mouth of Elk Creek is appreciably wider and the gradient, flatter Overbank flow affected many farms and residences, however, ample warning and organized evacuation minimized property damage, and no lives were lost The town of Sun River (fig 21) was completely flooded, and the nearly 100 residents were evacuated A new suburban residental area on the flood plain at Vaughn was flooded to an average depth of about 8 feet, and a number of homes were washed away The small community of Manchester, about 3 miles west of Great Falls, was almost completely inundated to depths up to 7 feet

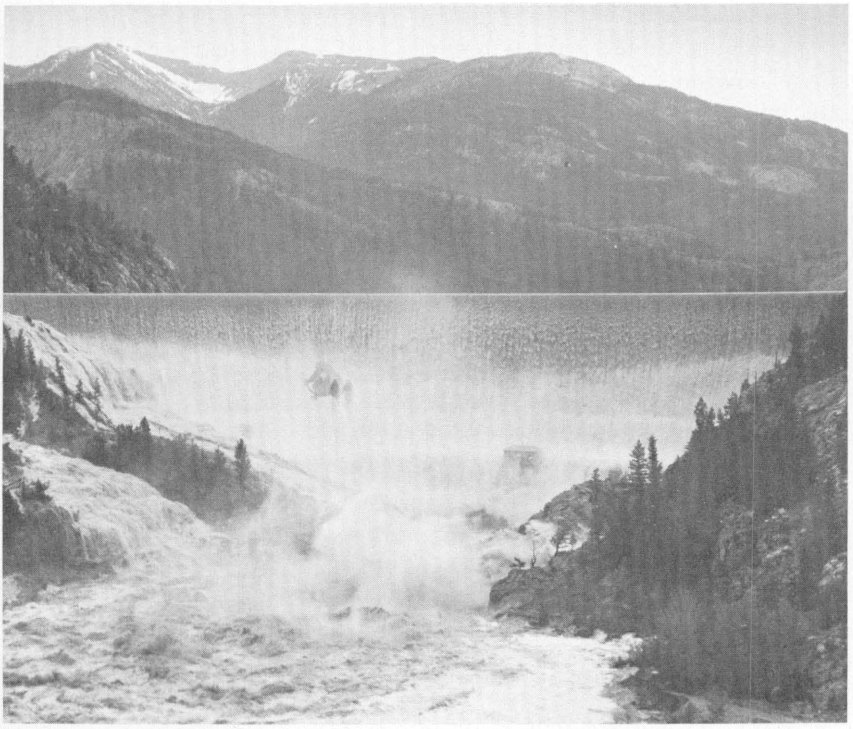

FIGURE 20.—Flow over parapet of Gibson Dam on June 9, 1964. Photograph by U.S. Forest Service.

The flat gradients of the Missouri River and Sun River at Great Falls caused considerable overbank flow of the low flood plains along both streams, and severe flooding lasted for several days. The Missouri River upstream from the Sun River held a fairly steady flow of about 22,000 cfs, which largely originated below Canyon Ferry Dam. Flood depths of 10–12 feet were noted on several homes in low-lying areas. Nearly 3,000 persons were evacuated from the flooded area, where 681 homes and 24 business establishments sustained various degrees of damage. At the 14th Street Bridge across the Sun River, the flood stage of 15 feet was exceeded from 2100 hours on June 8 to 0800 hours on June 15, and the peak occurred at 0100 hours on June 10. The peak stage on the Missouri River at the city of Great Falls waterplant, just upstream from the mouth of the Sun River, held steady between 0400 and 1200 hours on June 10. The extent of flooding at Great Falls is shown in the inundation map of figure 22, and figure 23 is a view of much of the flooded area at 1010 hours on

FIGURE 21.—Inundation of the town of Sun River on June 10, 1964. Photograph by United States Bureau of Reclamation.

June 10. Stage hydrographs for Sun River near Vaughn; Sun River at 14th Street Bridge, at Great Falls; and Missouri River above Sun River (at city waterplant), at Great Falls, are shown in figure 24.

The Missouri River is well entrenched in a narrow valley from Great Falls to the mouth of the Marias River, and Fort Benton is the only city or town adjacent to the river in that reach. Erosion damage in the vicinity of the Fort Benton sewage lagoon required construction of an emergency dike. Flooding of some lowland hay meadows was probable as stages approached those of 1953. Belt and Highwood Creeks, which are tributary in this reach, had peaks that were substantially less than the 1953 peaks. A washed-out railroad bridge lodged against the bridge on U.S. Highway 87 at Belt. Seventy youths at a camp in the upper Highwood Creek area were stranded because of several road washouts and the loss of more than 10 bridges.

Discharge and damage were high along the entire length of the Teton River, which enters the Marias River just above its mouth. A bridge, 1 mile downstream from the South Fork Teton River, was left high and dry when both approaches were eroded and the Teton River

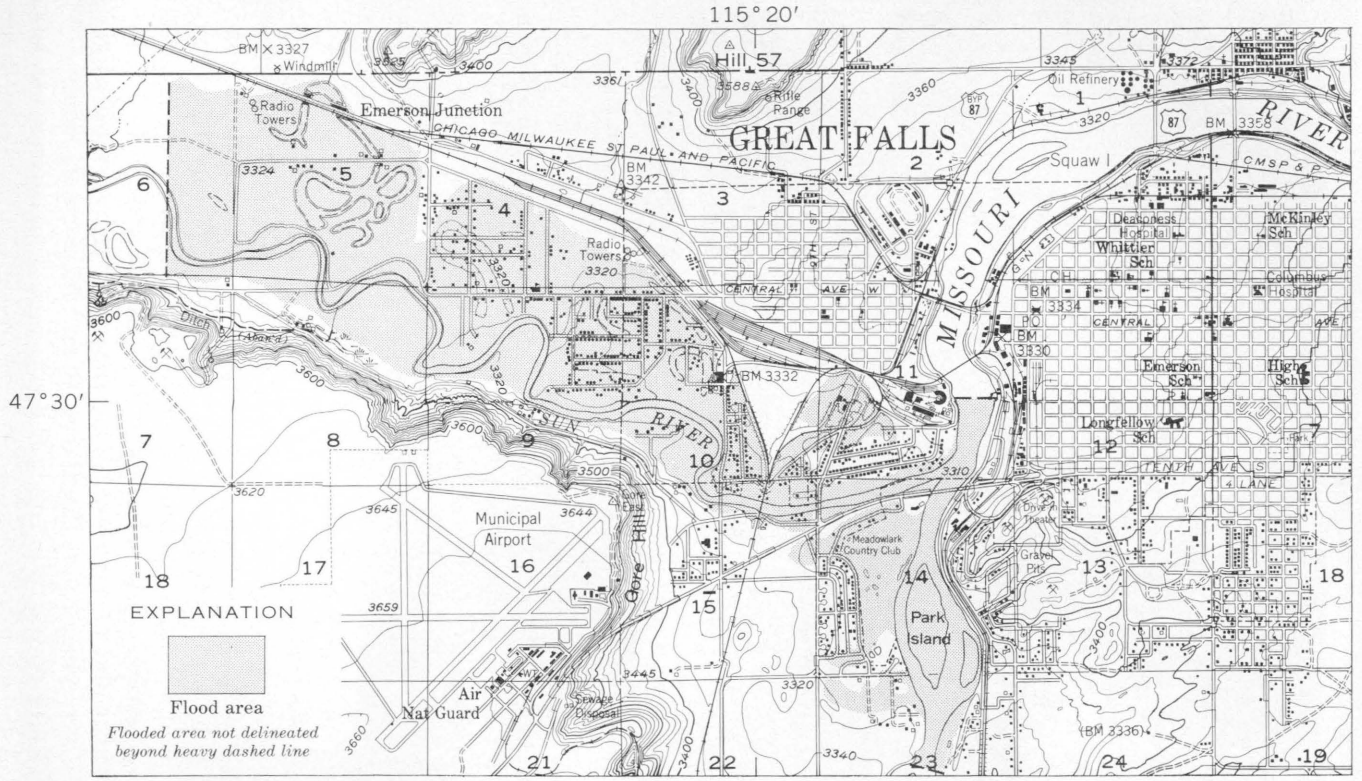

FIGURE 22.—Extent of flooding at Great Falls. Based on information furnished by the U.S. Army Corps of Engineers.

FIGURE 23.—View of city of Great Falls showing extent of flooding at 1010 hours, June 10, 1964. Photograph by Montana Highway Department.

cut a new channel several hundred feet south of the original channel. The many irrigation works along the river were destroyed, and there were several washouts on canals leading to offstream reservoirs. Floodwaters from the Teton River and a tributary, Spring Creek, combined to flood the town of Choteau (figs. 25, 26) on June 8. The entire population of nearly 2,000 residents was hastily evacuated as water as deep as 6 feet damaged 640 homes and business establishments. Deep Creek, which enters the Teton River downstream from Choteau, flooded low-lying areas and washed out the bridge on State Highway 287. U.S. Highway 89 was closed when one span of the Teton River bridge was destroyed.

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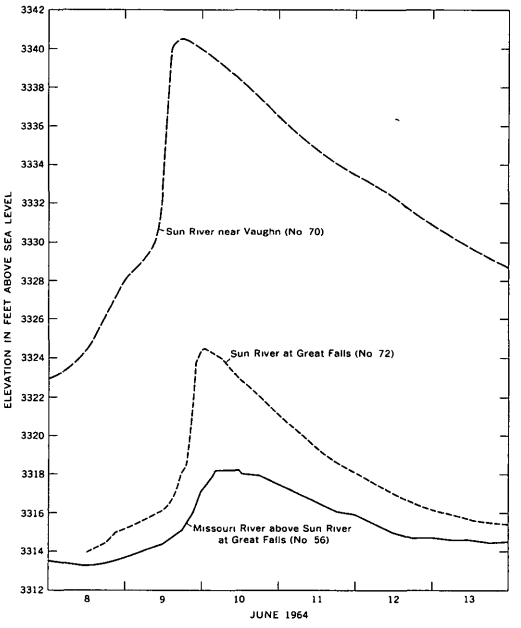

FIGURE 24.—Stage of Missouri River above Sun River at Great Falls, Sun River near Vaughn, and Sun River at Great Falls, June 8–13, 1964. Numbers in parentheses conform with those given in table 19 and on figure 2.

The Teton River occupies a rather narrow valley downstream from Choteau, and the peak flow increased slightly through tributary contributions as it moved downstream. The flood peak exceeded the normal channel capacity and flooded the bottom lands. U.S. Highway 91 was closed for several weeks after the bridge north of Dutton was destroyed, and overbank flow washed away much of the roadway across the valley. Only three of about eight bridges across the Teton River remained, and these required repairs to approaches. There was some damage to U.S. Highway 87 and the Great Northern Railway, which parallel the Teton River for a few miles near Loma. The scattered ranches in the narrow Teton River valley sustained considerable damage to lands, buildings, fences, and roads. The residents of Loma, at the mouth of the Teton River, were evacuated although no residential flooding resulted at this point.

Flooding in the Marias River basin upstream from Tiber Reservoir was widespread and extremely severe. It was compounded by failure of two irrigation dams and a community water supply dam. The failure of Swift Dam on Birch Creek (fig. 27) released more than 30,000 acre-ft of stored water shortly after 1000 hours, June 8, in

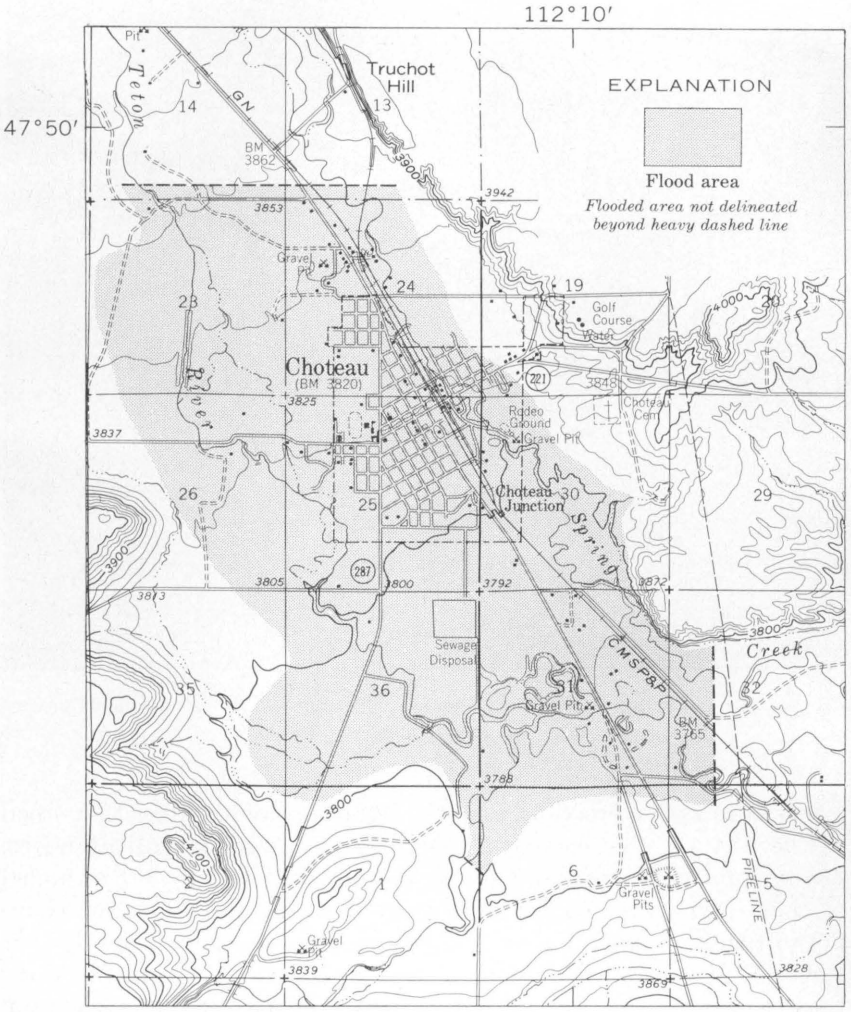

FIGURE 25.—Extent of flooding at Choteau. Based on information furnished by the U.S. Army Corps of Engineers.

what has been reported to be a very brief time. The instantaneous peak discharge of 881,000 cfs, calculated for an indirect measurement site 17 miles downstream from the dam, substantiates the reports of a sudden failure. The Birch Creek valley, downstream from the dam, presented a scene of vast devastation. All the trees and most of the

FIGURE 26.—Flooding in city of Choteau. Photograph by Montana Highway Department.

brush were swept away, as were the buildings and bridges that stood in the way of what has been described as a 20-foot wall of water. Masses of tree stumps and other floating debris were left stranded or choked irrigation canals miles away from the normal stream channel in the vicinity of Valier. . The flood wave moved so rapidly that very few people received advance warning. In all, 19 residents along the creek lost their lives. Of those who perished, eight were members of one family. Another family of four was last seen floating down mile-wide Birch Creek on a log raft. During the first 6 hours after dawn on June 9, more than 100 persons were airlifted out of isolated areas along the creek. Dupuyer Creek, a Birch Creek tributary, washed out a bridge on U.S. Highway 89, and water was a foot deep in the town of Dupuyer. Most basements were flooded, but the town's 125 residents did not evacuate.

The somewhat gradual failure of the dam on Lower Two Medicine Lake (fig. 28) in Glacier National Park released a flood wave on Two Medicine River on the afternoon of June 8. A radio station

FIGURE 27.—Remains of Swift Dam looking downstream from the reservoir area. Arrow points to a part of the right end of the upstream face of the dam. Photograph by Bureau of Reclamation.

warning did not reach all residents because electric power was disrupted and many persons living in river-bottom areas had little time to evacuate. A pickup truck carrying 17 persons stalled when the driver missed the trail across an inundated meadow and drove into a depression. The driver left in search of help. Two persons were pulled to safety with a spare tire attached to fence wire, five were rescued by boat, and the remaining nine died. Midvale Creek, a tributary to Two Medicine River, flooded parts of East Glacier; and South Fork Two Medicine River caused considerable damage to U.S. Highway 2 between East Glacier and Summit. At the gaging station on Two Medicine River, 11 miles southeast of Browning and 30 miles downstream from Lower Two Medicine Lake, the peak flow occurred about 3 hours prior to the failure of Lower Two Medicine Lake Dam. Badger Creek, which enters Two Medicine River downstream from that gaging station, washed out bridges and overtopped the roadway of U.S. Highway 89 (fig. 29). Two Medicine River, which includes

FIGURE 28.—Remains of Lower Two Medicine Lake Dam. Photograph by Bureau of Reclamation.

Birch Creek, joins Cut Bank Creek to form the Marias River. Willow Creek, a tributary to Cut Bank Creek, flooded many homes at Browning; and Cut Bank Creek washed out the bridge on State Secondary Highway 464.

The Marias River washed out a steel truss bridge on a county road north of Valier and the roadway to the south bridge approach on U.S. Highway 91 (fig. 30) south of Shelby. The flow of the Marias River was effectively stored in Tiber Reservoir until downstream floods had subsided. On June 8, Sullivan Reservoir, in an unnamed gulch about one-half mile from Shelby, breached and flooded a small part of the city north of the Great Northern Railway tracks. Two other upstream reservoirs on the same gulch were brimful, and the northern third of Shelby was evacuated on June 11 when additional rainfall seemed imminent.

Flooding along the Missouri River from the mouth of Marias River to Fort Peck Reservoir was confined to a few ranches and left silt deposits up to 2 feet deep in the James Kipp State Park. Big Spring

FIGURE 29.—Damage to Badger Creek bridge on U.S. Highway 89, typical of the many highway washouts caused by streams draining the eastern side of the Continental Divide. Photograph by Montana Highway Department.

Creek, a tributary of the Judith River, flooded 20 homes and 14 business establishments in a 3-block area of Lewistown. Cottonwood Creek, west of Lewistown, washed out the Glengarry bridge and a large culvert.

The Milk River basin flooded in the headwater area near Glacier National Park. State Secondary Highway 464 was closed for a time because several bridges and culverts and some roadway were lost. Low-lying ranch lands and a few other roads sustained some damage. Peak flows generally diminished below Del Bonita, and Fresno Reservoir near Havre prevented any downstream damage.

Discharge hydrographs for selected gaging stations, on streams tributary to the Missouri River, are presented in figure 31. The time distribution and relative magnitude of peak discharges at selected gaging stations on the Missouri River main stem are illustrated by the hydrographs in figure 32.

FIGURE 30.—Marias River flooding U.S. Highway 91 south of Shelby. Arrow indicates gaging station on left bank downstream from bridge. Photograph by Montana Highway Department.

UPPER COLUMBIA RIVER BASIN

The chief flood-producing area of the Columbia River basin was that part of the Clark Fork drainage basin which lies near the Continental Divide in the northern half of Montana. Severe flooding was confined to the upper reaches of the Blackfoot River and Flathead River drainage areas. A noteworthy exception is local flooding at Deer Lodge, where Cottonwood Creek, a Clark Fork tributary, damaged 100 homes, destroyed 2 bridges, and prompted the man-caused destruction of 2 other bridges, when lodged debris aggravated overbank flooding.

The water was a foot deep in the east end of Lincoln, and several miles of the highway to the east were flooded as the Blackfoot River and tributaries overflowed. Several bridge approaches were lost and seven persons were isolated along Landers Fork. The North Fork Blackfoot River peaked at 11,800 cfs contrasted to a peak of 4,380 cfs in 1948. Damage along the Blackfoot River, downstream from the

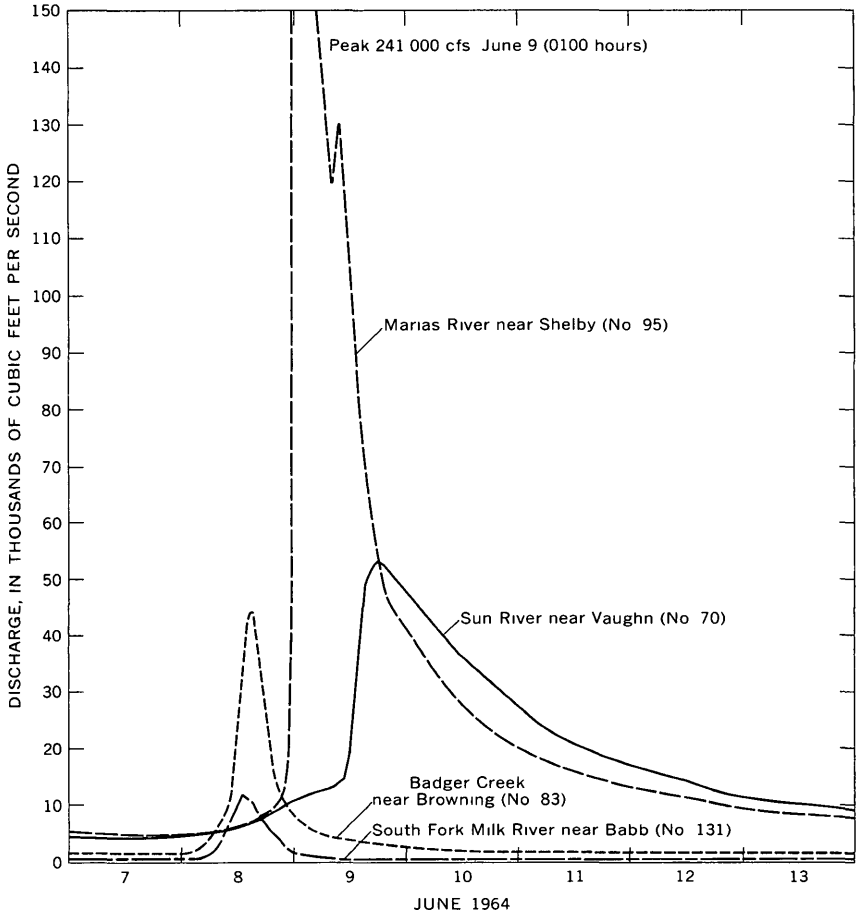

FIGURE 31 —Discharge at selected gaging stations in Missouri River basin, June 7–13, 1964 Numbers in parentheses conform with those in table 19 and figure 2

North Fork, was not severe although the peak of 19,200 cfs near the mouth was the highest since record began in 1940 With the entrance of the Blackfoot River flow, the peak of the Clark Fork above Missoula exceeded the 1948 peak by only 200 cfs The peak of 1908 was considerably higher at Missoula than either that of 1948 or 1964 Rattlesnake Creek, which enters the Clark Fork in Missoula, flooded a number of homes and littered gardens and lawns with debris Dikes and sandbagging prevented flooding of the low-lying Orchard Homes area along the Clark Fork in the southwest part of Missoula The peak flow of the Bitterroot River, which enters the Clark Fork just west of Missoula, was about 5 percent higher in 1948 than in 1964 At

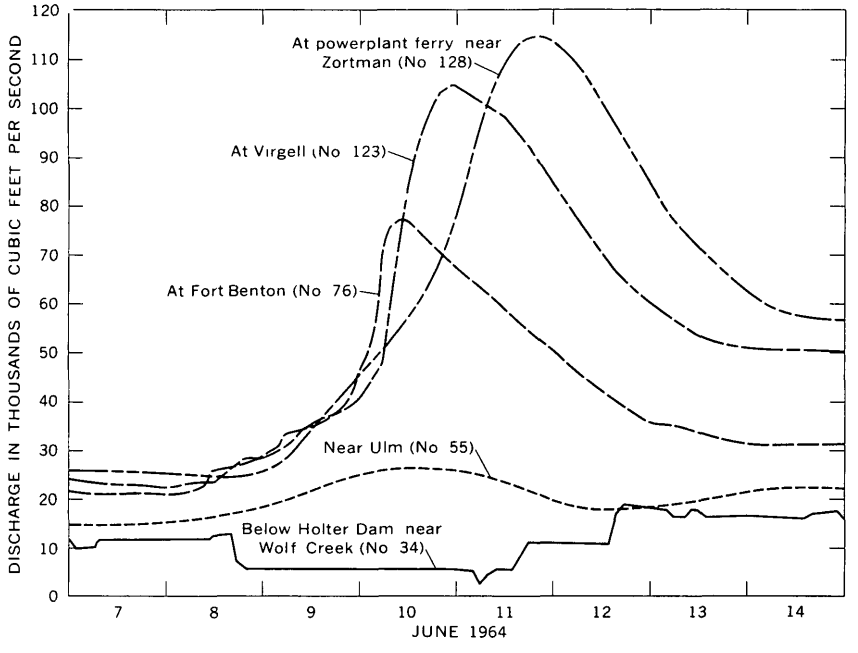

FIGURE 32.—Discharge at selected gaging stations on the Missouri River, June 7–14, 1964. Numbers in parentheses conform with those in table 19 and on figure 2.

St. Regis, about 25 miles upstream from the Flathead River, the Clark Fork peak discharge was about 13 percent greater in 1948. Discharge hydrographs at selected gaging stations on the Blackfoot River and Clark Fork are shown in figure 33.

The Flathead River basin upstream from Flathead Lake underwent the most severe flooding in modern times. All main bridges upstream from Columbia Falls were washed out or rendered unusable. Upstream from the Middle Fork Flathead River, the drainage of the main stem of the Flathead River is largely in public land that is sparsely settled. Recreational camping facilities at Big Creek and Tuchuck were on the flood plain and were extensively damaged by scour, silt, and debris. Nearly 70 percent of the damage reported in this drainage area was to roads and bridges. Peak discharge of the Flathead River at Flathead, British Columbia, near the international boundary was 16,300 cfs, or 1,700 cfs greater than the highest peak recorded during the past 35 years. Just upstream from the Middle Fork Flathead River, the 1964 peak flow was double the maximum peak of the previous 35 years of record. Eastern tributaries from

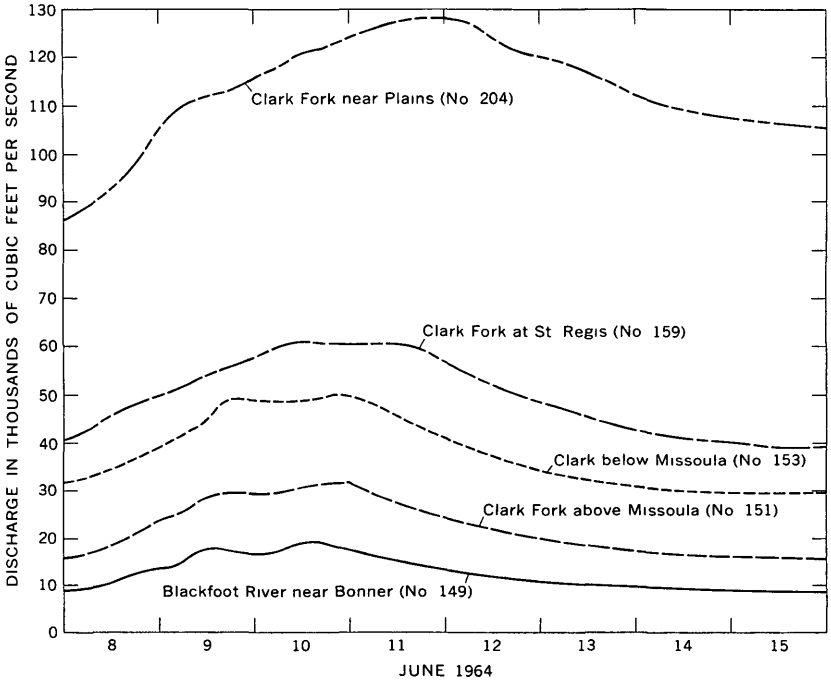

FIGURE 33.—Discharge at selected gaging stations on Blackfoot River and Clark Fork, June 8–15, 1964. Numbers in parentheses conform with those in table 19 and on figure 2.

Glacier National Park had higher unit runoff than western tributaries along the main stem Flathead River because of greater storm precipitation and snowmelt.

Extremely high runoff in the Middle Fork Flathead River drainage basin caused extensive damage to highways and railroads in narrow valleys along the southern edge of Glacier National Park. A natural gasline was broken, and nearly 17 miles of U.S. Highway 2 along both Bear Creek and the river literally disappeared (fig. 34). The peak discharge of Bear Creek near Essex was 8,380 cfs from a drainage area of 20.7 square miles. A steel bridge on U.S. Highway 2 across the Middle Fork Flathead River at Essex was washed away. The river at Essex peaked at 75,300 cfs, an amount five times the maximum discharge of the previous 25 years of record.

The mainline tracks of the Great Northern Railway sustained heavy damage from slides and washouts, principally by tributary streams; and at one point the Middle Fork Flathead River overtopped a tunnel portal (fig. 35). Two freight trains were marooned near Essex. Rail

FIGURE 34.—Damage to U.S. Highway 2 (arrows) along Bear Creek. Photograph by Montana Highway Department.

traffic was rerouted through Helena on Northern Pacific Railway tracks for about a month while repairs were being made.

In the Nyack Flats area, along the Middle Fork Flathead River downstream from Essex, 30 residents were evacuated by air. Typical damage to transportation facilities by fill and debris from tributary streams is shown in figure 36.

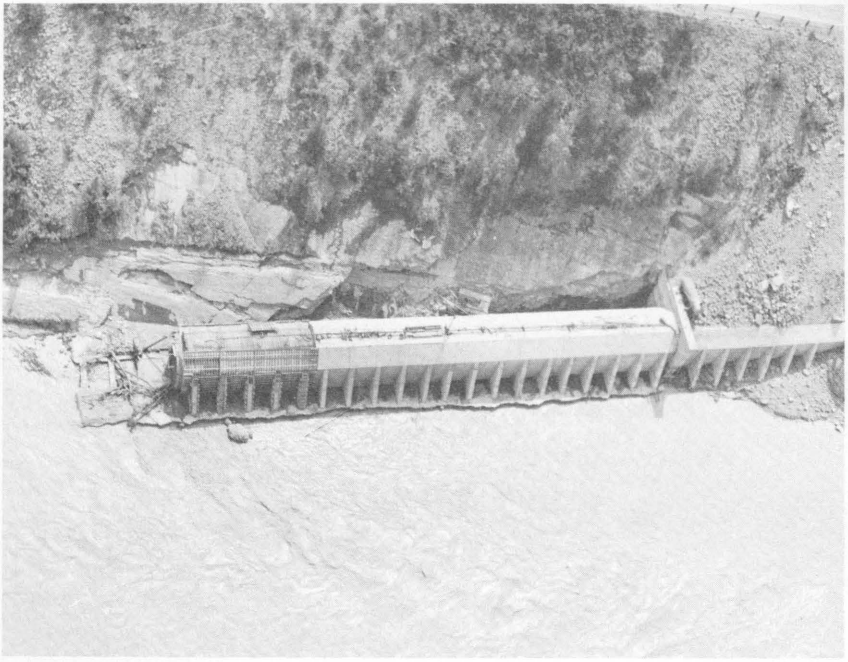

FIGURE. 35.—Great Northern Railway tunnel overtopped by Middle Fork Flathead River. Photograph by Guest Photo, Kalispell.

At West Glacier, the main highway bridge to the west entrance of Glacier National Park was damaged beyond repair. An old low single-arch concrete bridge was completely submerged, but the arch was not seriously damaged by drift. This bridge was redecked and restored for temporary use.

Downstream from West Glacier a rocky canyon constricted flow and, for a time, part of the Middle Fork Flathead River actually flowed upstream along McDonald Creek into Lake McDonald in Glacier National Park. Many homes, resorts, and lakeshore facilities were damaged. The peak flow of the Middle Fork Flathead River near West Glacier (downstream from McDonald Creek) reached about 140,000 cfs, or an amount four times the maximum peak of the previous 25 years of record.

Flow of the South Fork Flathead River was completely regulated at Hungry Horse Dam. Upstream from the dam widespread flooding damaged forest roads, trails, logging operations, and resort facilities. All roads in the area were closed because of washed-out bridges or approaches, slides, or roadway washouts. The previous peak of record

FIGURE 36.—Debris deposits at mouth of Moccasin Creek near West Glacier. Photograph by Guest Photo, Kalispell.

of South Fork Flathead River near the mouth, and prior to regulation, was 46,200 cfs in 1916. The computed 1964 peak inflow to Hungry Horse Reservoir was about 78,000 cfs.

The peak flow of the Flathead River at Columbia Falls, downstream from the three forks, was 176,000 cfs. Studies by the Corps of Engineers indicate that the peak at Columbia Falls would have been approximately 245,000 cfs if the South Fork Flathead River had not been regulated. Prior to this regulation, the previously recorded maximum peak was 102,000 cfs in 1948, and the historic peak of 1894 was 142,000 cfs. About 50 homes in the Columbia Falls area were damaged. The Anaconda Co. aluminum reduction plant continued operation with standby fuel instead of natural gas and by pumping from three ground-water wells on high ground.

Between Columbia Falls and Flathead Lake, the Flathead River flooded an extensive area of lowlands totaling approximately 25,000 acres. More than 350 homes were flooded east of Kalispell in the Days Acres area and the Evergreen area (fig. 37). The Evergreen area also contains many small businesses such as motels, drive-ins, gas stations and nurseries, recreation facilities, and a city park. The

FIGURE 37.—Flooded Evergreen area east of Kalispell. Photograph by Guest Photo, Kalispell.

Days Acres area was flooded about 4 hours after the Evergreen area was by water backingup in the Stillwater River. Several thousand gallons of gasoline from ruptured bulk tanks of the Jet Oil Co. joined the floodwaters and created a fire hazard east of Kalispell. Dikes along the lower Flathead valley near the lake held, but were badly cut by the high flows. The flooded area from Columbia Falls to Flathead Lake is shown in plate 1. The peak flow of the Swan River, a direct tributary to Flathead Lake, was about 4 percent less than the previous record of 1948 at the gaging station near Bigfork. Upstream at Strom's Store, near Condon, the 1948 peak discharge was exceeded by about 20 percent.

The peak stage of Flathead Lake at Somers was 2,894.27 feet, recorded at 1230 hours on June 12. This is the highest lake stage observed since upstream regulation by Hungry Horse Dam began in September 1951. The Corps of Engineers estimate a maximum stage of 2,896.8 feet would have occurred in 1964 if there had been uncontrolled outflow from Flathead Lake after May 1 and no flood-control storage in Hungry Horse Reservoir. The stage of 2,896.26 feet in

1933 is the highest lake stage since continuous record began in April 1909 The historic peak stage of 1894 was 2,900 feet All Flathead Lake elevations given are referenced to Somers datum To convert from Somers datum to datum of 1929, supplemental adjustment of 1947, subtract 1 00 feet Livestock losses in the Flathead River basin totaled nearly 1,200 with cattle, hogs, and pets making up the majority of drowned animals Three barge loads of animal carcasses were taken from Flathead Lake and buried in a central disposal pit Not one horse was in the group

At the outlet of Flathead Lake, at Kerr Dam, the Flathead River had a peak of 66,800 cfs The highest previous peak since record began in 1910 occurred in 1928 and was 82,800 cfs The 1894 historic peak discharge was computed to be about 110,000 cfs in a lake elevation-discharge study The relation of lake stages to inflow and outflow may be better understood if it is realized that a change of a foot in lake level is equivalent to a storage change of about 120,000 acre-ft

In the Jocko River Valley, U S Highway 93, south of Arlee, was flooded in two places by Agency Creek Many small bridges on county roads were damaged, washed out, or sustained approach damage Nearly 300 feet of Northern Pacific Railway track was washed out by the Jocko River near the Jocko Cabin Camp A local resident since 1915 reported he had never before seen flooding of this magnitude in the Jocko River Valley Revais Creek, a Flathead River tributary west of Dixon, washed out an approach to the bridge on U S Highway 10A

Discharge hydrographs for selected gaging stations in the Flathead River basin are shown in figure 38

EVALUATION OF FLOOD DAMAGE

The very rapid rise of streams near the Continental Divide left little time for protective measures Many of the 30 persons who lost their lives had little or no warning, some perished while attempting to reach safety or to save a few possessions Farther downstream, the warnings of flood as much as a day in advance reduced casualties and permitted saving of some property Nearly 350 persons were injured The Red Cross reported mass shelter and food were provided for about 8,700 persons during the highwater period Total damage in Montana was estimated by the Corps of Engineers (1964a, 1964b), U S Department of the Army, at $55 million after prompt detailed surveys by various agencies No monetary damage was assigned to the effect of the extensive scarring of stream channels upon fish and wildlife habitat Damage in excess of $1 million occurred in Canada

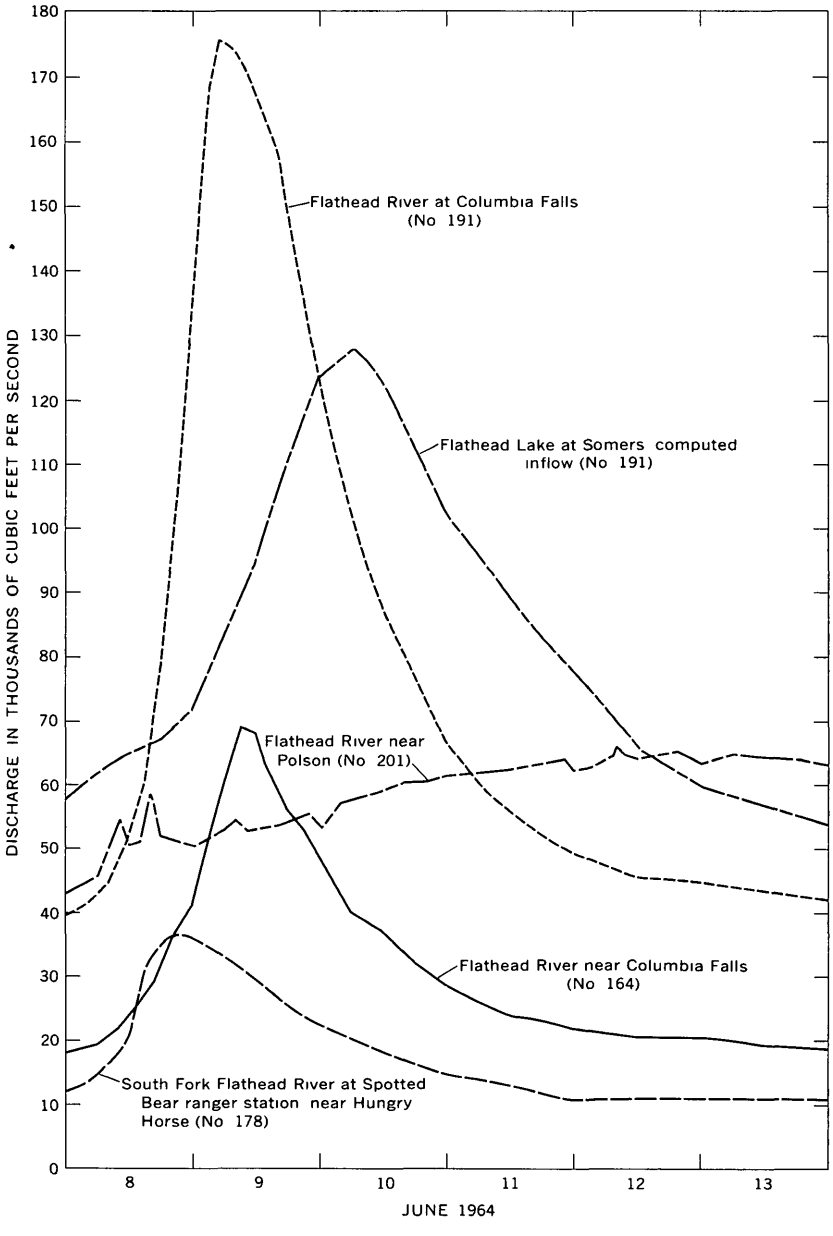

FIGURE 38.—Discharge at selected gaging stations in Flathead River basin, June 8–13, 1964. Numbers in parentheses conform with those in table 19 and on figure 2

249-795 O—67——6

The statistical breakdown of losses by principal stream basins and by categories was generally available in the compilation of damage prepared by the Corps of Engineers A major exception was in the extensive Lewis and Clark National Forest where subsequent breakdowns prepared by the U S Forest Service were inserted in the Corps of Engineer listings No stream-basin breakdowns were available for public domain and public facilities in that part of Glacier National Park lying east of the Continental Divide This area includes much of the Hudson Bay drainage and small parts of the Marias and Milk River basins

DAMAGE EAST OF CONTINENTAL DIVIDE

Flood damage east of the Continental Divide (table 7) in the Hudson Bay and Missouri River basins totaled $30,714,500 In the headwater areas, in the Lewis and Clark National Forest, almost all the fish habitat on 155 miles of major stream channels and 320 miles of minor stream channels sustained severe damage No monetary value was assigned to the loss of fish and wildlife habitat Alluvium, ranging from a few inches to several feet in depth, was deposited at the mouths of most small streams It was estimated that slightly more than 3,000 acres of flood plains was denuded in the Lewis and Clark National Forest Much of the heavy sediment load that reached the larger streams was deposited along the flatter reaches outside the National Forest

Downstream from the headwater areas, an estimated 120,400 acres of land was inundated by the flooding waters More than 5,500 persons were evacuated from their homes, and damage to 1,870 homes and 186 business establishments was reported

TABLE 7 —*Summary of flood damage east of the Continental Divide by basins*

[Based on damage estimates compiled by the U S Army Corps of Engineers and the U S Forest Service]

Stream basin	Rural	Urban	Transportation	Total
Sun River	$4,107 700	$4,913,000	$3,302,800	$12,323,500
Marias River	9,220,000	1,262,900	5,037,200	15,520,100
Missouri River main stem	36,400	142,700	293,000	472,100
Others [1]	372,900	132,500	1,893,400	2,398,800
Total	13,737,000	6,451,100	10,526,400	30,714,500

[1] Includes public domain and facilities in Glacier National Park

RURAL DAMAGE

Rural damage (table 8) to crops, farmsteads, fences, irrigation works, national-forest facilities, and lands totaled nearly $14 million Damage to more than 300 farmsteads and rural nonfarm residences, stored feed and grain, and farm equipment and the loss of livestock

represented about 25 percent of the total, or about $3 5 million Flood damage to irrigation works throughout the area was about $3.7 million, about 50 percent of which was accounted for by the loss of Swift Dam on Birch Creek and Lower Two Medicine Lake Dam. Erosion and deposition of debris, silt, and weed seeds onto farmland account for 17 percent of the total rural damage Crop and pasture losses amounted to about 17 percent of the total, and the major part of the crop loss was in the irrigated areas Debris-laden streams caused nearly $700,000 damage to fences in the stream valleys

The remaining 8 percent of the total rural damage was to gravel pits, recreation facilities, various U.S. Forest Service facilities, and rural schools The costs of evacuation and care of rural inhabitants, clearing of debris jams from streams, and stabilization of streambanks at critical points, particularly at campgrounds in the Lewis and Clark National Forest were also considered Forty-five percent of the Forest Service telephone lines were destroyed, and the remaining telephone lines sustained 10–50 percent damage In Glacier National Park damage to buildings, utilities, and campgrounds totaled nearly $400,000

TABLE 8 —*Rural flood damage east of the Continental Divide*

[Based on damage estimates compiled by the U S Army Corps of Engineers and U S Forest Service]

Stream	Acres flooded	Farmsteads	Fences	Crop and pasture
Sun River	32, 600	$578, 200	$324, 400	$302, 000
Marias River				
Teton River	44, 600	743, 800	115, 900	1, 136, 800
Birch Creek	16, 670	562, 000	146, 800	481, 000
Two Medicine River	8, 660	1, 109, 000	60, 700	153, 900
Cut Bank Creek	8, 680	424, 000	41, 000	84, 800
Main stem and tributaries	8, 590	79, 000	10, 000	171, 500
Miscellaneous areas [1]	600	6, 500	600	2, 800
Total	120, 400	3, 502, 500	699, 400	2, 332, 800

Stream	Land	Irrigation works	Other [2]	Total
Sun River	$1, 222, 900	$1, 223, 800	$456, 400	$4, 107, 700
Marias River				
Teton River	780, 100	7, 000	171, 700	2, 955, 300
Birch Creek	156, 900	1, 145, 000	17, 200	2, 508, 900
Two Medicine River	91, 400	1, 300, 000	59, 000	2, 774, 000
Cut Bank Creek	44, 200	9, 000	11, 500	614, 500
Main stem and tributaries	85, 800	20, 000	1, 000	367, 300
Miscellaneous areas [1]	100	100	399, 200	409, 300
Total	2, 381, 400	3, 704, 900	1, 116, 000	13, 737, 000

[1] Includes Missouri River main stem and minor tributaries, St Mary River, Milk River, and Glacier National Park

[2] Includes damage to U S Forest Service facilities and costs of stream channel clearing and stabilization

URBAN DAMAGE

The largest city flooded was Great Falls where damage was estimated at $4 4 million, of which nearly $3.2 million was for residences and more than $1 million was for streets and utilities. Overflow from the Sun and Missouri Rivers flooded the southwestern part of the city, requiring evacuation of about 3,000 persons

Choteau was almost completely flooded when the Teton River overflowed into Spring Creek, which courses through the town Hurried evacuation of the entire population of nearly 2,000 persons was necessary, and damage to homes, businesses, and municipal property exceeded $1 million Damage to 14 other communities totaled about $1 million Urban flood damage estimates are given in table 9.

TABLE 9 —*Urban flood damages east of the Continental Divide*

[Compiled by U S Army Corps of Engineers]

Stream basin and city or town	1960 Population	Residential	Commercial	Utilities	Municipal	Other	Total
Sun River							
Augusta	450	$30, 400	$32, 400		$2, 800	$1, 000	$66, 600
Sun River	100	68, 100	60, 500		10, 000	9, 000	147, 600
Vaughn	265	201, 400		$40, 000		11, 000	252, 400
Manchester	(1)	46, 600		200	500	200	47, 500
Great Falls	55, 357	3, 161, 200	199, 700	456, 000	546, 000	47, 000	4, 409, 900
Marias River							
East Glacier	350	13, 700		65, 000	2, 200	5, 000	85, 900
Dupuyer	125	5, 600	1, 200		1, 000	500	8, 300
Browning	2, 011	14, 800	400			7, 000	22, 200
Shelby	4, 017	66, 900	5, 400	21, 600	11, 900	900	106, 700
Choteau	1, 966	558, 600	339, 300	42, 000	90, 500	7, 800	1, 038, 200
Loma	110				1, 600		1, 600
Missouri River (main stem)							
Fort Benton	1, 837			113, 200			113, 200
Others							
Raynesford	(1)	1, 500	500				2, 000
Belt	757				1, 000		1, 000
Lewistown	7, 408	11, 200	3, 100	500	500	200	15, 500
St Mary	(1)	3, 700	95, 800	2, 500	30, 000	500	132, 500
Total		$4, 183, 700	$738, 300	$741, 000	$698, 000	$90, 100	$6, 451, 100

[1] Less than 100

TRANSPORTATION DAMAGE

The damage to transportation facilities (table 10) was more than $10 million, of which the county road system sustained nearly $1 million and railroads about $300,000 Losses to the Federal aid primary and secondary systems, exclusive of Glacier National Park and Forest Service roads in the area, account for nearly $2 6 million Approximately 60 road bridge crossings were affected, as well as several culvert crossings and many miles of roadway Damage ranged from loss of approaches and abutments to complete destruction or loss of crossings. In the Lewis and Clark National Forest, 20 percent of the 112 miles

of forest roads was destroyed and an additional 50 percent was so heavily damaged as to make reconstruction necessary Of the 15 bridges on forest roads, 5 were completely destroyed, 1 was damaged beyond repair, and 9 required extensive repair, replacement of approaches, or realinement of the channel The Pretty Prairie airfield in the Sun River basin, was damaged beyond repair The Gates Park airfield, also in the Sun River basin, was severely damaged More than a third of the 977 miles of forest trail was completely destroyed and damage of 10 to 50 percent occurred to the rest. All major packhorse trail bridges were destroyed. The loss to public transportation facilities was estimated at $5 3 million in the Lewis and Clark National Forest.

The National Park Service estimated the damage to roads and trails at nearly $1.5 million for that part of Glacier National Park lying east of the Continental Divide

TABLE 10.—*Transportation flood damage east of the Continental Divide*

[Based on damage estimates compiled by the U S Army Corps of Engineers and U S Forest Service]

Stream basin	County roads and bridges	State and federal highways, bridges and airfields [1]	Railroads	Total
Sun River	$99, 500	$3, 129, 300	$74, 000	$3, 302, 800
Marias River				
Teton River	368, 100	1, 820, 300	69, 100	2, 257, 500
Birch Creek	45, 200	1, 256, 300	----------	1, 301, 500
Two Medicine River	13, 200	918, 200	----------	931, 400
Cut Bank Creek	43, 800	199, 000	----------	242, 800
Main stem and tributaries	105, 500	66, 500	132, 000	304, 000
Miscellaneous Areas [2]	205, 300	1, 962, 800	18, 300	2, 186, 400
Total	$880, 600	$9, 352, 400	$293, 400	$10, 526, 400

[1] Includes damage estimates to roads, trails, and airfields in the Lewis and Clark National Forest
[2] Includes Missouri River main stem and minor tributaries, St Mary River, Milk River and Glacier National Park

DAMAGE WEST OF CONTINENTAL DIVIDE

Flood damage west of the Continental Divide was estimated at $24 5 million, of which $17 6 million was for transportation facilities The second highest category of damage, as reported by the Corps of Engineers, includes that to buildings, contents and improvements, and so forth, for a total of $3 8 million Damage to land, crops, livestock fences, and farm equipment was estimated at nearly $1 8 million The remaining four categories of damage total $1 3 million The

damage estimate compiled by the Corps of Engineers is summarized in table 11 The breakdown by stream basins, or reaches, points up the preponderance of damage in the sparsely settled Middle Fork Flathead River drainage basin and the more populous area along the Flathead River from the Middle Fork Flathead River downstream to Flathead Lake.

Damage to transportation facilities accounted for about $12 6 million, or nearly 95 percent of the total damage, in the Middle Fork Flathead River drainage basin where U.S Highway 2 and the Great Northern Railway tracks were in the narrow valleys Earth slippage and the washout of bridges and trackage by tributary streams accounted for a large part of the railroad damage The timber industry of the Flathead Valley depends greatly upon the forest roads, and it is reported that the road damage caused a setback of about a month in that industry Nearly 180 miles of trails in the Flathead National Forest will require restoration, and several livestock and foot bridges that were destroyed will require replacement. Damage to trails and roads in Glacier National Park was severe

The category of buildings, contents and improvements, and automobiles and trucks covers rural and urban areas and does not distinguish between commercial and residential damage The fact that 50 homes near Columbia Falls and 350 homes near Kalispell were flooded indicates urban damage may represent a substantial part of the damage in this category for the area along the Flathead River below the Middle Fork Flathead River Facilities around Flathead Lake sustained some damage when the level of Flathead Lake exceeded the upper limit for controlled regulation of 2,893 0 feet elevation (Somers datum)

The chief agricultural area affected by the flood was along the Flathead River from Columbia Falls to Flathead Lake The rapid rise of flood waters contributed to a substantial livestock loss

Among the losses to utilities was damage to a natural-gas pipeline in the narrow valleys of Bear Creek and the Middle Fork Flathead River About 100 miles of forest telephone line needed repair or replacement

The upper reaches of the Blackfoot River and its tributaries and most of the streams in the Flathead River basin, both in and outside Glacier National Park and the Flathead National Forest, are good trout habitat The U S Forest Service estimated that 105 miles of main stream and about 240 miles of tributary streams of the Flathead River were scarred to the point of seriously affecting fish and wild-

TABLE 11 —*Summary of flood damage west of the Continental Divide by basins*

[Compiled by U S Army Corps of Engineers]

Stream basin	Land, crops, livestock, poultry, fences and farm equipment	Buildings, contents and improvements, and autos and trucks	Highways, roads and railroads, includes bridges, re-routed trains and traffic interruptions	Utilities, including power and communications
Upper Clark Fork	$118,500	$70,500	$536,000	$38,600
Flathead River above Middle Fork Flathead River	17,000	62,000	152,700	700
Middle Fork Flathead River excluding Bear Creek	77,300	232,600	8,293,900	135,700
Bear Creek	1,000	17,600	4,319,300	200,200
Other tributary streams in upper Flathead River basin	193,100	602,700	1,940,600	700
Flathead River below Middle Fork Flathead River	1,343,900	2,841,000	2,332,600	100,500
Total	$1,750,800	$3,826,400	$17,575,100	$476,400

Stream basin	Refugee care, Red Cross, and flood fighting	Employee and business losses	Flood protective works, irrigation systems, and pumping and pumping plants	Total
Upper Clark Fork	$28,700	----------	$103,200	$895,500
Flathead River above Middle Fork Flathead River	200	$7,000	----------	239,600
Middle Fork Flathead River excluding Bear Creek	9,800	7,200	----------	8,756,500
Bear Creek	1,600	----------	----------	4,539,700
Other tributary streams in upper Flathead River basin	1,900	500	1,200	2,740,700
Flathead River below Middle Fork Flathead River	231,000	140,000	314,000	7,303,000
Total	$273,200	$154,700	$418,400	$24,475,000

life habitat The loss of nesting areas for upland and migratory birds was also mentioned as serious in the Flathead National Forest No monetary value was placed on these items.

FLOOD-CREST STAGES

Flood-crest stages in the Missouri River basin are given for the Sun River and one of its major tributaries (table 12) and for the Teton River (table 13) in the area flooded during June 1964 In the upper Columbia River basin, flood-crest stages are given for the Flathead River upstream from Flathead Lake (table 14), the Middle Fork Flathead River and one of its tributaries (table 15), the Stillwater River and one of its major tributaries (table 16), and the Swan River (table 17) Most of the information presented in the tables was furnished by Corps of Engineers

TABLE 12.—*Flood-crest stages, Sun River basin, floods of June 1964*

[Data mostly furnished by U S Army Corps of Engineers]

Stream, location, and time	Miles above mouth of Sun River	Elevation (feet)
June 8		
Left bank Sun River, approximately 4 miles north of Augusta, old telephone pole about 700 ft west of State Highway 287 and 150 ft northwest of old concrete bridge pier sec 27, T 21N, R 6 W	71 5	3,973 52
Left bank Sun River, approximately 4 miles north of Augusta, 50 ft north and 40 ft east of State Highway 287 bridge abutment in sec 27, T 21 N, R 6 W	71 3	3,970 21
Left bank Elk Creek, approximately 0 5 mile upstream from State Highway 287 bridge in Augusta, 260 ft north of a steel truss road bridge in sec 17, T 20 N, R 6 W, at 2200 hours	73 4	4,089 98
Left bank Elk Creek, 0 4 mile south of Main St, Augusta, on State Highway 287 Northeast corner of timber bridge abutment in sec 17, T 20 N, R 6 W	72 4	4,076 06
Left bank Elk Creek, on north gate of west entrance to Augusta rodeo grounds in sec 17, T 20 N, R 6 W	71 5	4,068 28
Left bank Elk Creek, on northeast corner of outside toilet at residence about 400 ft south-southwest of American Legion building in Augusta in sec 17, T 20 N, R 6 W	71 4	4,064 70
Right bank Elk Creek, ¼ mile east of Augusta at Sofic Malataire residence Northwest corner of porch on television antenna pole in sec 17, T 20 N, R 6 W	71 0	4,056 80
June 9		
Right bank Sun River, approximately 450 ft northeast of mile post 36, Great Northern Railway, and 100 ft west of communication marker pole in sec 8, T 20 N, R 5 W	65 1	3,868 14
Right bank Sun River, 125 ft northwest of Riebling Station railroad siding sign in sec 8, T 20 N, R 4 W	58 1	3,755 78
Right bank Sun River, 40 ft south of upstream abutment of Great Northern Railway bridge at mile 27 3 in sec 12, T 20 N, R 4 W	52 9	3,716 44
Right bank Sun River, on south side of Simms grain elevator in sec 12, T 20 N, R 3 W at 0200 hours	44 4	3,561 69
Right bank Sun River, on power pole 8–56–R7 south of Great Northern Railway about 1 5 miles east of Simms in sec 8, T 20 N, R 2 W	42 3	3,534 18
Left bank Sun River, 200 ft north of county bridge 122 on road from Fort Shaw to Asheulot about 0 5 mile north of Fort Shaw, on gate post on west side of road in sec 2, T 20 N, R 2 W	38 1	3,473 75
Right bank Sun River, approximately 0 5 mile southwest of Sun River on northwest corner of grain elevator in sec 34, T 21 N, R 1 W	32 0	3,416 56
Left bank Sun River, 600 ft northeast of State Highway 20 bridge crossing at Sun River, on Montana Highway Commission sign in sec 34, T 21 N, R 1 W	31 5	3,410 85
Right bank Sun River, inside of Farmers Union oil station at Sun River in sec 34, T 21 N, R 1 W	31 4	3,414 56

TABLE 12.—*Flood-crest stages, Sun River basin, floods of June 1964*—Continued

[Data mostly furnished by U S Army Corps of Engineers]

Stream, location, and time	Miles above mouth of Sun River	Elevation (feet)
June 9—Continued		
Right bank Sun River, light pole at northwest corner of Union 76 service station at southwest end of State Highway 20 bridge over Sun River in sec 34, T 21 N, R 1 W	31 4	3,412 72
Left bank Sun River, 4 9 miles southwest of Texaco service station at Vaughn, 50 ft south of U S Highway 89, State Highway 20 in NE¼ sec 29, T 21 N, R 1 E	22 8	3,373 74
Left bank Sun River, 1 8 mile northeast of coin-operated laundry and 2 9 miles southwest of Vaughn on power pole in sec 28, T 21 N, R 1 E	20 4	3,355 18
Left bank Sun River, 300 ft east of Texaco service station at Vaughn in sec 34, T 21 N, R 1 E	18 1	3,349 19
Left bank Sun River, 25 ft east of road on corner of corral fence at Eidel Ranch in sec 23, T 21 N, R 2 E, 1800 hours	10 8	3,338 79
Left bank Sun River, in southwest corner of barn on Sam Lenz farm in sec 35, T 21 N, R 2 E	9 2	3,335 35
Right bank Sun River, above main door of barn on Ochsner farm in sec 2, T 20 N, R 2 E	9 1	3,334 13
Left bank Sun River, on corral post just east of livestock shed at Waldenberg residence, about 0 25 mile south of KFBB television station at Great Falls in sec 5, T 20 N, R 3 E	5 2	3,330 71
Left bank Sun River, northeast corner of small building at Great Falls Trap and Skeet Club	5 0	3,330 64
Left bank Sun River, 200 ft east of Central Ave bridge west of Great Falls, on upstream side of road	4 8	3,329 24
Left bank Sun River, corner of Central Ave West and 34th St, NW, Great Falls, on north side of large building	4 2	3,329 09
Left bank Sun River, 150 ft east of residence at 2719 Central Ave West, Great Falls	3 2	3,328 73
Left bank Sun River, top of window frame at 121 25th St, SW, Great Falls	3 1	3,327 83
Left bank Sun River, 1½ blocks west of 24th St, SW, and Sunset Rd intersection, Great Falls	2 8	3,328 12
Left bank Sun River, ½ block west of 24th St, SW, and Sunset Rd intersection, Great Falls	2 6	3,328 10
Left bank Sun River, power pole at 2217 Sunset Rd, Great Falls	2 2	3,327 82
Left bank Sun River, power pole at 2129 Sunset Rd, Great Falls	2 2	3,327 80
Left bank Sun River, power pole at 2105 Sunset Rd, Great Falls	2 2	3,327 41
Left bank Sun River, power pole at 2013 Sunset Rd, Great Falls	2 1	3,327 96
Left bank Sun River, power pole at 2010 Sunset Rd, Great Falls	2 1	3,327 61

TABLE 12.—*Flood-crest stages, Sun River basin, floods of June 1964*—Continued

[Data mostly furnished by U S Army Corps of Engineers]

Stream, location, and time	Miles above mouth of Sun River	Elevation (feet)
June 9–10		
Left bank Sun River, greenhouse at corner of 5th Ave and 14th St, SW, Great Falls	1 8	3,327 27
Left bank Sun River, north side of residence at 721 14th St, SW, Great Falls	1 7	3,326 71
Left bank Sun River, power pole at 825 14th St, SW, Great Falls	1 6	3,326 85
Left bank Sun River, residence at 917 14th St, SW, Great Falls	1 6	3,325 80
June 10		
Left bank Sun River, in garage at 1337 10th Ave, SW, Great Falls	1 3	3,326 30
Left bank Sun River, telephone pole at 1118 10th Ave, SW, Great Falls, at 0100 hours	1 2	3,324 11
Left bank Sun River, power pole at 1019 10th Ave, SW, Great Falls	1 2	3,324 17
Right bank Sun River, 200 ft east of Great Northern Railway and 200 ft south of river in Great Falls	1 1	3,322 94
Left bank Sun River, storage shed at 1010 10th Ave, SW, Great Falls	0 9	3,322 56
Left bank Sun River, large cottonwood tree at entrance to 928½ 10th Ave, SW, Great Falls	0 8	3,322 86
Left bank, Sun River, large cottonwood tree south of 208 10th Ave, SW, Great Falls	0 1	3,318 34

TABLE 13.—*Flood-crest stages, Teton River, floods of June 1964*

[Data mostly furnished by U S Army Corps of Engineers]

Location and time	Miles above mouth	Elevation (feet)
June 8		
Right bank, post of fuel-tank stand on Crawford Ranch in sec 33, T 25 N, R 6 W	169 4	4,229 61
Left bank, 20 ft southwest of camp fireplace about 4 8 miles north of Choteau on U S Highway 89 in sec 4, T 24 N, R 5 W	162 8	3,972 95
Left bank, foundation of Gus Depner residence about 2 9 miles north of Choteau in SW¼ sec 11, T 24 N, R 5 W	160 4	3,910 96
Left bank, telephone pole on west side of U S Highway 89, 1 5 miles north of Choteau in sec 14, T 24 N, R 5 W	159 1	3,860 71

TABLE 13.—*Flood-crest stages, Teton River, floods of June 1964*—Continued

[Data mostly furnished by U S Army Corps of Engineers]

Location and time	Miles above mouth	Elevation (feet)
June 9—Continued		
Left bank, ½ block west of corner of 3d Ave NW, and Weaver St in Choteau in sec 24, T 24 N, R 5 W	158 7	3,832 94
Left bank, northwest corner of barn at intersection of 7th Ave NW and Main St in Choteau in sec 24, T 24 N, R 5 W	158 7	3,832 85
Left bank, foundation of residence approximately ¼ mile west of Choteau school in sec 25, T 24 N, R 5 W	157 6	3,819 48
Left bank, northwest corner of Teton County shop building in Choteau in sec 25, T 24 N, R 5 W	157 3	3,812 24
Left bank, northwest corner of house foundation on southeast corner of 2d St SW, and 9th Ave SW, in Choteau	157 2	3,811 89
Left bank, large cottonwood tree at T H Hammond home about 1 0 mile south of Choteau in sec 30, T 24 N, R 4 W	156 2	3,795 22
Right bank, door of Quonset building at Ferris farmstead in sec 24, T 24 N, R 4 W, at 2000 hours	147 3	3,675 81
Right bank, 200 ft north of dwelling on power pole in sec 22, T 25 N, R 2 W	123 7	3,445 25
June 8–9		
Right bank, west side of road crossing in SE¼ sec 12, T 25 N, R 1 W	104 5	3,315 61
June 9		
Right bank, south foundation of Bill Maurer home in sec 22, T 25 N, R 3 E, at 1200 hours	75 2	3,132 95
Left bank, 400 ft northeast of Dent Bridge in sec 35, T 25 N, R 4 E	62 5	3,059 84
Right bank, steel pier of bridge about 5 miles north of Carter in NE¼ sec 9, T 24 N, R. 6 E, at 1800 hours	38 9	2,913 72
June 9–10		
Right bank, 0 2 mile west of red grain elevator on brace pole in center of sec 13, T 24 N, R 7 E	19 8	2,780 16
Left bank, guard rail on northwest corner of F A S 223 road bridge in S½ sec 9, T 24 N, R 8 E	15 9	2,738 61
June 10		
Right bank, 200 ft south of bridge on west side of road near center of sec 1, T 24 N, R 8 E	11 2	2,684 26
Right bank, power pole leading to farmstead in NW¼ sec 5, T 24 N, R 9 E	8 0	2,659 67

TABLE 14.—*Flood-crest stages, Flathead River, floods of June 1964*

[Based on data furnished by U S Army Corps of Engineers]

Location and time	Miles above Flathead Lake	Elevation (feet)
June 9		
Right bank, streamward face of rock outcrop 9 ft upstream from axis of proposed Glacier View Dam, 1 6 miles downstream from Camas Creek, and 12½ miles northwest of West Glacier	72 1	3, 338 27
Right bank, streamward side of 24-in fir tree, 1 5 ft above ground, 0 9 mile upstream from Big Creek, in SE¼SE¼ sec 15, T 33 N , R 20 W , and 11½ miles northwest of West Glacier	71 3	3, 331 81
Right bank, Flathead River and left bank Big Creek, on streamward face, downstream edge concrete bridge pier, 1 3 ft above ground, bridge at mouth of Big Creek, in SW¼SW¼ sec 22, T 33 N , R 20 W , and 11 miles northwest of West Glacier	70 4	3, 323 65
Right bank, 1½-in iron pipe, 0 2 foot above ground, 30 ft upstream from intersection of new and old North Fork roads, 0 3 mile downstream from Deep Creek, in SE¼ sec 34, T 33 N , R 20 W , and 9½ miles northwest of West Glacier	67 8	3, 282 86
Right bank, shoreward side of twin 8-in cottonwood tree, 15 ft downstream from road culvert, 4 3 miles downstream from Big Creek, in W½W½ sec 2, T 32 N , R 20 W , and 8 miles northwest of West Glacier	66 1	3, 265 34
Right bank, chiseled "X" on steep rock face, streamward from 24 in corrugated metal pipe on North Fork road, 3 8 miles upstream from Canyon Creek, in SE¼SW¼ sec 11, T 32 N , R 20 W , and 7½ miles northwest of West Glacier	64 5	3, 245 97
Right bank, shoreward side 15-in fir tree, 3 ft above ground, in vicinity of Foolhen Hill, in N½ sec 14, T 32 N , R 20 W , and 7 miles northwest of West Glacier	64 0	3, 229 82
Right bank, shoreward side of 12-in twin top fir tree, upstream from rapids, 1 6 miles upstream from Canyon Creek, in SE¼NW¼ sec 23, T 32 N , R 20 W , and 7 miles west of West Glacier	62 3	3, 212 33
Right bank, root on downstream side of 14-in fir tree, 0 1 mile upstream from Canyon Creek, in SW¼NE¼ sec 27, T 32 N , R 20 W , and 7 miles west of West Glacier	60 8	3, 187 29
Gaging station on right bank, 1½ miles downstream from Canyon Creek, near center of W½ sec 35, T 32, N , R 20 W , and 9 miles northeast of Columbia Falls, at 0900 hr	59 1	3, 164 19
Right bank, shoreward side of 18-in pine tree, 5 5 ft above ground, at point opposite high rock cliffs on the left bank, 1 7 miles downstream from Canyon Creek, in NE¼SW¼ sec 35, T 32 N , R 20 W , and 6½ miles west of West Glacier	59 0	3, 160 98
Right bank, at former gaging station site, upstream shoreward corner of wooden gage house, 30 in above ground, 1 1 miles upstream from Middle Fork, in NE¼NE¼ sec 12, T 31 N , R 20 W , and 8 miles northeast of Columbia Falls	56 4	3, 123 59
Left bank, shoreward side 18-in cottonwood tree, 4 5 ft above ground, at first curve in road from Blankenship bridge, 0 1 mile downstream from Middle Fork in E½ sec 7, T 31 N , R 19 W , and 3½ miles north of Corum	55 2	3, 115 08

TABLE 14.—*Flood-crest stages, Flathead River, floods of June 1964*—Continued

[Based on data furnished by U S Army Corps of Engineers]

Location and time	Miles above Flathead Lake	Elevation (feet)
June 9		
Left bank, downstream side of 30-in stump, 30 in above ground, at end of trail from buildings to river, 2 2 miles downstream from Middle Fork, in SE¼ sec 17 T 31 N, R 19 W, and 2 miles north of Corum	53 1	3,098 85
Left bank, upstream shoreward corner of log cabin, 30 in above ground, at end of access road from U S Highway 2, in NE¼ sec 19, T 31 N, R 19 W, and 1½ miles northwest of Corum	51 8	3,088 38
Left bank, 8 ft above ground on streamward side of steel leg of middle pier, second pier from left bank of Great Northern Railway bridge, in NE¼ sec 32, T 31 N, R 19 W, and ½ mile southwest of Corum	49 6	3,074 19
Left bank, center aluminum tag, south corner timber of wooden structure east of pump house, 0 5 mile downstream from Abbott Creek, near center S½ sec 5, T 30 N, R 19 W, and at Martin City	47 7	3,054 34
Left bank, shoreward side, 8-in fir tree, 20 ft streamward from edge U S Highway 2, 0 6 mile downstream from South Fork, in S½ sec 1, T 30 N, R 20 W, and 3 miles west of Martin City	45 2	3,036 63
Left bank, downstream side of 20-in larch tree, 3 ft above ground, 1 3 miles downstream from South Fork, in NE¼NE¼ sec 11, T 30 N, R 20 W, and 3 miles east of Columbia Falls	44 5	3,031 74
Right bank, downstream side of 15-in cottonwood tree, 3 ft above ground, 3 6 miles downstream from South Fork near line between secs 4 and 9, T 30 N, R 20 W, and 1 mile northeast of Columbia Falls	42 2	3,016 22
Left bank, northwest wingwall of wooden box culvert under State Highway 40, ¼ mile from intersection with U S Highway 2, near center of west edge sec 15, T 30 N, R 20 W, and 1½ miles southeast of Columbia Falls	41 1	3,010 88
Right bank, concrete bridge abutment, 0 2 ft below concrete joint, 1 0 ft upstream from downstream edge northwest corner, at new steel bridge on State Highway 40, in NW¼ sec 16, T 30 N, R 20 W, and 1 mile southeast of Columbia Falls	40 9	3,006 78
Gaging station on right bank, 200 ft downstream from county bridge, 5 8 miles downstream from South Fork in NW¼SE¼ sec 17, T 30 N, R 20 W, and ½ mile south of Columbia Falls, at 0500 hrs	40 05	3,003 22
Right bank, east side of 36-in cottonwood tree, 5 5 ft above ground, about 0 3 mile south of Great Northern Railway underpass, in SE¼ sec 24, T 30 N, R 21 W, and 2½ miles southwest of Columbia Falls	38 0	2,986 37
Left bank, center 8-in 45° elbow between hose and valve, 1 ft below valve center, on irrigation pump intake line, pump near residence on left bank, in NE¼ sec 31, T 30 N, R 20 W, and 4 miles southwest of Columbia Falls	35 9	2,974 33
Left bank, shoreward side multiple birch tree, 1 ft above ground, 10 ft downstream from fence line, in E½ sec 6, T 29 N, R 20 W, and 5 miles southwest of Columbia Falls	34 8	2,965 34

TABLE 14.—*Flood-crest stages, Flathead River, floods of June 1964*—Continued

[Based on data furnished by U S Army Corps of Engineers]

Location and time	Miles above Flathead Lake	Elevation (feet)
June 9		
Right bank, shoreward side of 20-in pine tree, 30 in above ground, 50 ft streamward from fence on top left bank of old highwater channel, 4 miles upstream from McWenneger Slough drain, on line SE¼ sec 14 and NE¼ sec 23, T 29 N, R 21 W, and 7 miles northeast of Kalispell	31 4	2,944 30
Right bank, power pole, 4 ft above ground, 50 ft southeast of bridge over slough, 1 4 miles upstream from McWenneger Slough drain, in NW¼ sec 35, T 29 N, R 21 W, and 5½ miles northeast of Kalispell	28 8	2,927 67
Right bank, flood plain, east face of power pole, northeast corner intersection LaSalle Rd and Spring Creek Dr, near center sec 33, T 29 N, R 21 W, and 3½ miles northeast of Kalispell	----------	2,920 13
Right bank, flood plain, on concrete curb, east edge of road across from Evergreen School, 200 ft south of intersection, near center of north edge sec 4, T 28 N, R 21 W, and 3 miles northeast of Kalispell	----------	2,918 59
Right bank, on left upstream abutment of bridge over second slough 0 2 miles west of Flathead River bridge on U S Highway 2, in NE¼ sec 3, T 28 N, R 21 W, and 4½ miles northeast of Kalispell	27 4	2,920 36
Right bank, 0 83 ft above point of survey stake on power pole on downstream side of U S Highway 2 between first and second sloughs, west of Flathead River bridge in NE¼ sec 3, T 28 N, R 21 W, and 4½ miles northeast of Kalispell	27 4	2,920 73
Right bank, upstream corner of bridge abutment, U S Highway 2, in NW¼ sec 2, T 28 N, R 21 W, and 4½ miles northeast of Kalispell	27 4	2,920 28
Right bank, downstream side of steel case bridge pier, steel bridge on old U S Highway 2, in NE¼NW¼ sec 10, T 28 N, R 21 W, and 3 miles northeast of Kalispell	26 3	2,915 31
Left bank, streamward side, downstream pole of "H" frame of cableway, in NE¼ sec 15, T 28 N, R 21 W, and 2½ miles east of Kalispell	24 4	2,906 92
Left bank, streamward side of 36-in cottonwood tree, 2 9 ft above ground, 0 1 ft below railroad spike, along road from dam across Bradley Channel, in NW¼ sec 15, T 28 N, R 21 E, and 2 miles east of Kalispell	24 3	2,906 77
Right bank, base of streamward side of power pole, 30 ft upstream and opposite driveway to farm house, 0 8 mile downstream from Stillwater River, in vicinity of former gage at Demersville, in NE¼ sec 28, T 28 N, R 21 W, and 2½ miles southeast of Kalispell	21 7	2,905 44
Right bank, streamward side of power pole, 4 8 ft above ground, 20 ft south of gravel road center line, 2 0 miles upstream from Ashley Creek, in vicinity of former gage at Jetty, in SW¼ sec 34, T 28 N, R 21 W, and 3½ miles southeast of Kalispell	18 8	2,904 13

TABLE 14.—*Flood-crest stages, Flathead River, floods of June 1964*—Continued

[Based on data furnished by U S Army Corps of Engineers]

Location and time	Miles above Flathead Lake	Elevation (feet)
June 9–10		
Right bank, at former gaging station at Damon's Ranch, ground level at 19th fence post upstream from northeast corner of cultivated field just west of farmstead, 3 1 miles downstream from Ashley Creek, in NW¼ sec 32, T 28 N, R 20 W, and 6½ miles southeast of Kalispell	13 7	2, 899 53
Right bank, at former gaging station at Therriault Ferry, 14 in above ground level shoreward side of largest twin cottonwood tree, 25 ft upstream from old ferry landing in W½ sec 4, T 27 N, R 20 W, and 8½ miles southeast of Kalispell	7 5	2, 897 36
Left bank, at former gaging station at Keller's Ranch near Holt, upstream side of power pole, 200 ft north of road, 500 ft east of concrete bridge, in NW¼ sec 23, T 27 N, R 20 W, and 2½ miles northwest of Bigfork	3 8	2, 894 14
Left bank, shoreward side upstream pole support of overhead beam, 1 8 ft above ground, on wood bridge at Holt, in SW¼ sec 23, T 27 N, R 20 W, and 2 miles northwest of Bigfork	3 0	2, 894 24

TABLE 15.—*Flood-crest stages, Middle Fork Flathead River basin, floods of June 1964*

[Based on data furnished by U S Army Corps of Engineers]

Stream, location, and time	Miles above mouth	Elevation (feet)
June 8		
Middle Fork Flathead River		
Right bank, 4-in fir tree, 1½ ft above ground, at mouth of Bear Creek, in W½ sec 31, T 29 N, R 15 W, and 4 miles southeast of Essex	44 5	3, 882 36
Gaging station on right bank 4 miles downstream from Bear Creek, in NE¼SW¼ sec 14, T 29 N, R 16 W, and 0 7 mile southeast of Essex, at 1830 hr	39 9	3, 748 8
Left bank, root on streamward side of 10-in fir tree at toe of slope 30 ft north of dirt access road to U S Highway 2, 0 1 mile downstream from Park Creek, in sec 2, T 29 N, R 16 W, and 2½ miles north of Essex	36 2	3, 677 18
Left bank, shoreward side of 6-in larch tree on edge of foot trail, 0 8 mile downstream from Paola Creek, in sec 21, T 30 N, R 16 W, and 5 miles northwest of Essex	32 15	3, 598 35
Left bank, 8-in rotten stump, 3 ft high, on top of bank, 0 2 mile downstream from Tunnel Creek, in sec 7, T 30 N, R 16 W, and 7½ miles northwest of Essex	27 9	3, 507 96

TABLE 15.—*Flood-crest stages, Middle Fork Flathead River basin, floods of June 1964*—Continued

[Based on data furnished by U S Army Corps of Engineers]

Stream, location, and time	Miles above mouth	Elevation (feet)
June		
Middle Fork Flathead River—Continued		
Left bank, upstream side of 8-in fir tree, 1 ft above the ground, 0 1 mile upstream from Coal Creek, in center of N½ sec 26, T 31 N , R 17 W , and 11 miles northwest of Essex	23 4	3, 443 30
Left bank, shoreward side of lone 30-in fir tree, 7 0 ft above ground, 35 ft streamward from edge of U S Highway 2, 0 6 mile upstream from Wahoo Creek, in SW¼ sec 21, T 31 N , R 17 W , and 12½ miles northwest of Essex	20 8	3, 387 65
Left bank, streamward side of 10-in cottonwood tree, 2½ ft above ground, 600 ft northwest of Great Northern Railway Red Eagle station, 1 1 miles upstream from Nyack Creek, in SW¼ sec 17, T 31 N , R 17 W , at Nyack, and 9 miles southeast of West Glacier	18 8	3, 353 17
Left bank, streamward side telegraph pole, 3 ft above ground, 1 1 miles upstream from Lincoln Creek, near center of E½NW¼ sec 35, T 32 N , R 18 W , and 5½ miles east of West Glacier	12 7	3, 303 56
Left bank, base of streamward side of 4-in pine tree, at top of Great Northern Railway cut, 0 1 mile upstream from Kootenai Creek, in NW¼ sec 33, T 32 N , R 18 W , and 3½ miles east of West Glacier	10 4	3, 286 44
Left bank, shoreward side of 12 in fir tree, 2 ft above ground, 60 ft upstream from center line of concrete arch bridge, near center of N½ sec 36, T 32 N , R 18 W , and ½ mile east of West Glacier	6 7	3, 187 38
Left bank, 2 5 ft below chiseled square on upstream streamward corner of concrete bridge girder footing, on Going to the Sun Highway in NE¼NE¼ sec 35, T 32 N , R 18 W , at West Glacier	5 95	3, 180 6
June 9		
Right bank, upstream side of 9-in pine tree, 0 4 ft above ground, 0 1 mile downstream from McDonald Creek, in NW¼SE¼ sec 27, T 32 N , R 19 W , and 1 mile west of West Glacier, at 0300 hr	4 5	3, 161 71
Left bank, shoreward side of 6-in pine tree, 2 ft above ground, in NW¼ sec 8, T 31 N , R 19 W , and 4½ miles southwest of West Glacier	0 15	3, 119 06
McDonald Creek		
Left bank, streamward side of 28-in cottonwood tree, between cabins 6 and 7 of Village Motor Inn at outlet of Lake McDonald, in NW¼NW¼ sec 23, T 32 N , R 18 W , and 2 miles north of West Glacier	2 2	3, 162 46

TABLE 16.—*Flood-crest stages, Stillwater River Basin, floods of June 1964*

[Based mostly on data furnished by U S Army Corps of Engineers]

Streams and location	Miles above mouth	Elevation (feet)
Stillwater River (mainstem)		
Right bank, 4 ft lower than spike at base of 24-in cottonwood tree on top of right bank, 4 7 miles upstream from Whitefish River, near center of sec 31, T 29 N , R 21 W , and 2½ miles north of Kalispell	7 4	2, 956 5
Right bank, 5 1 ft lower than spike in streamward side of 16-in fir tree 400 ft upstream from access road to utility building at municipal golf course, 2 7 miles upstream from Whitefish River, in E½ sec 6, T 28 N , R 21 W , and ½ mile north of Kalispell	5 4	2, 940 6
Whitefish River		
Gaging station on left bank in SE¼NW¼ sec 34, T 30 N , R 21 W , and 8 miles north of Kalispell	12 6	2, 973 20
Left bank, 4 2 ft lower than railroad spike in streamward side of 24-in pine tree 50 ft northeast of northeast corner of bridge in SE¼ sec 20 ,T 29 N , R 21 W , and 4 miles north of Kalispell	5 3	2, 922 3
Left bank, 4 4 ft above railroad spike, on downstream side of transformer pole, east of gravel road, 150 ft northeast of northeast corner of wooden bridge in SW¼ sec 4, T 28 N , R 21 W , and 2 miles north of Kalispell	0 1	2, 913 96

The records of flood stages may be a useful guide to the limitations on the occupancy of lands along these rivers They also furnish basic data on the velocity of flood crests and on valley or channel storage The profile sites are described in enough detail so that they can be relocated for comparison with crests of other floods Other information at each site in the tables includes the date (and the hour, when known) that the crest occurred; the distance above the mouth, in river miles; and the elevation, in feet above sea level

The lower reach of the Flathead River between the discontinued gaging station near Kalispell (mile 26.3) and Flathead Lake has been subjected to high flood-crest elevations in 1928, 1933, 1948, and 1964 Table 18 is a summary of these elevations at discontinued gaging station sites converted to sea level datum of 1929, supplemental adjustment of 1947 Elevations of Flathead Lake referred to elsewhere in this report are to Somers datum

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TABLE 17.—*Flood-crest stages, Swan River, floods of June 1964*

[Based mostly on data furnished by U S Army Corps of Engineers]

Location and time	Miles above mouth	Elevation (feet)
June 9–10		
Right bank, on center piling of 3 piling, on upstream side of bridge abutment, 1 mile upstream from Porcupine Creek, in SW¼ sec 35, T 25 N, R 18 W, and 3½ miles south of Swan Lake	28 95	3,081 29
Right bank, shoreward side of 56-in cottonwood tree, 1½ ft above ground, 165 ft north of boat launching area at Swan Lake Camp Ground, near north edge sec 14, T 26 N, R 19 W, and ½ mile northwest of Swan Lake	23 0	3,071 9
June 10		
Gaging station on left bank, at outlet of Swan Lake, 1000 ft downstream from Johnson Creek, in SE¼SW¼ sec 11, T 26 N, R 19 W, and 5 miles southeast of Bigfork, at 1200 hours	14 6	3,069 6
Right bank, downstream end of concrete abutment, 4 25 ft below aluminum tag, bridge 1 mile upstream from Bigfork Dam, in SE¼ sec 32, T 27 N, R 19 W, and 2 miles east of Bigfork	2 7	3,012 18
Left bank, shoreward side of 6-in birch tree, 1 0 ft above ground, on streamward side of drive in Big Fork State Park, in NE¼ sec 36, T 27 N, R 20 W, ½ mile southwest of Bigfork	0 1	2,893 87

TABLE 18.—*Flood-crest elevations, in feet, on the Flathead River between Kalispell and Flathead Lake*

[Elevations referenced to datum of 1929, supplemental adjustment of 1947]

Name of gaging station	Miles above mouth	Year of flood			
		1928	1933	1948	1964
Flathead River					
Near Kalispell	26 3	2,912 96	2,912 28	2,913 0	2,915 31
At Demersville	21 7	2,903 3	2,903 82	2,903 1	2,905 44
At Damon Ranch	13 7	2,898 5	2,899 85	----------	2,899 53
At Therriault Ferry	7 5	----------	2,897 37	2,896 7	2,897 36
At Keller Ranch	3 8	2,896 4	2,896 0	[1] 2,895 8	2,894 14
Flathead Lake at Somers	0	2,894 92	2,895 26	2,895 01	2,893 27

[1] At site 3 0 miles above mouth

Profiles of flood-crest stages in the Missouri River basin along the Sun and Teton Rivers are shown in figures 39 and 40 The profile of the Sun River extends from State Highway 287, north of Augusta, downstream to the mouth. The Teton River profile extends from a point about 11 miles upstream from Choteau to the mouth.

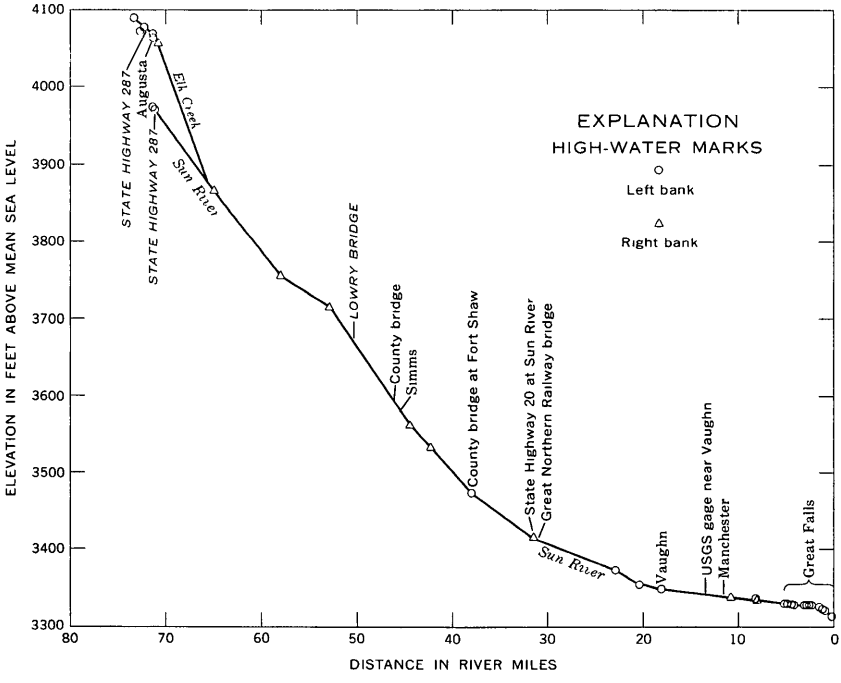

FIGURE 39 —Profile of flood-crest elevations on the Sun River and Elk Creek upstream from the mouth of the Sun River

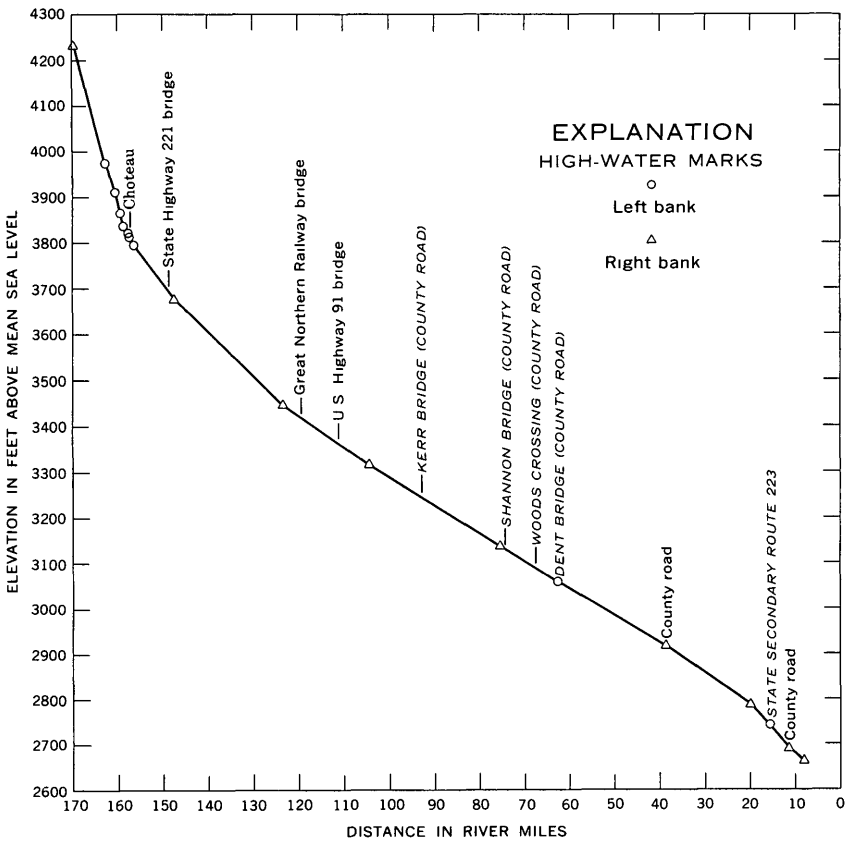

FIGURE 40.—Profile of flood-crest elevations on the Teton River upstream from the mouth

Flood-crest profiles in the upper Columbia River basin are shown in figures 41 to 44 for the Flathead River upstream from Flathead Lake, the Middle Fork Flathead River, the Stillwater River and one of its major tributaries, and the Swan River. Figure 45 is an enlargement of a part of the profile in figure 41, showing the reach of the Flathead River from Columbia Falls to within 3 miles of its mouth at Flathead Lake. Also shown are the flood-stage elevations for 1948 and 1933.

The profiles shown were based primarily on data furnished by the Corps of Engineers.

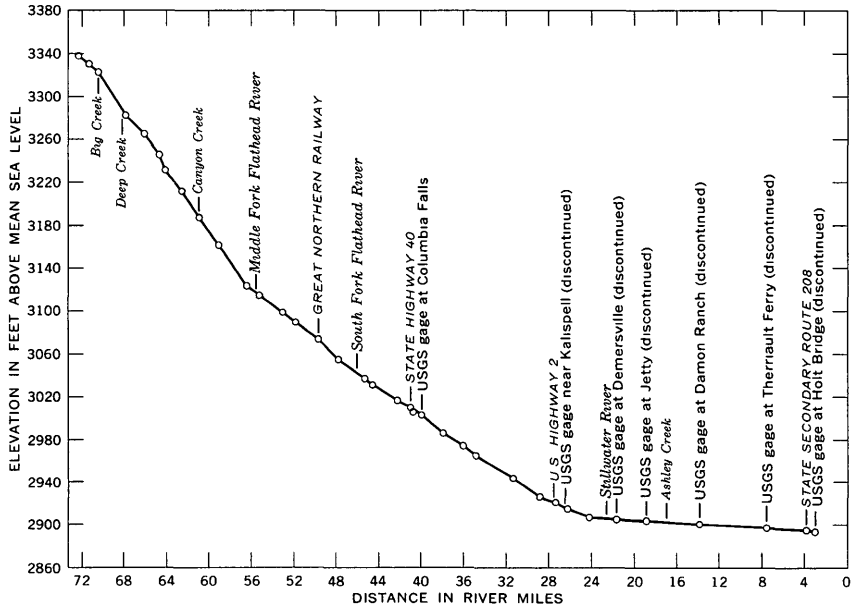

FIGURE 41 —Profile of flood-crest elevations on the Flathead River upstream from Flathead Lake

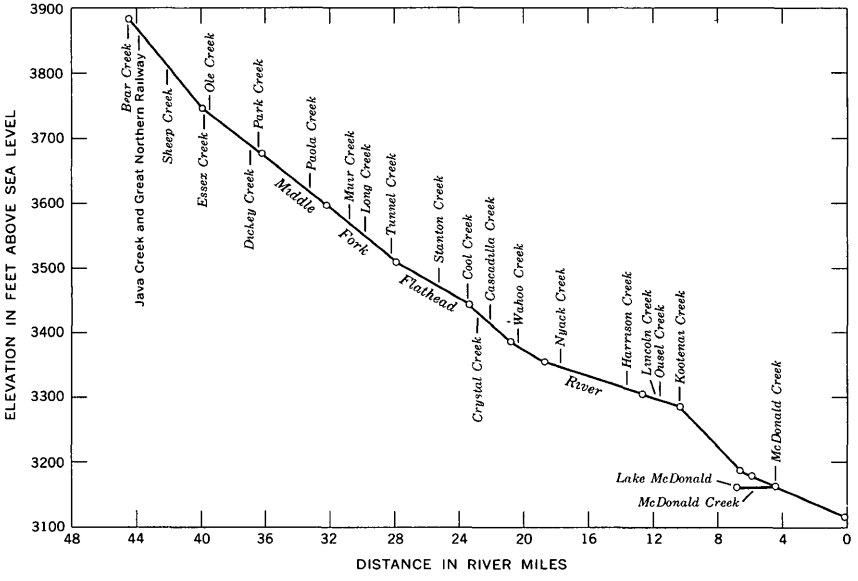

FIGURE 42 —Profile of flood-crest elevations on the Middle Fork Flathead River and McDonald Creek upstream from the mouth of the Middle Fork Flathead River

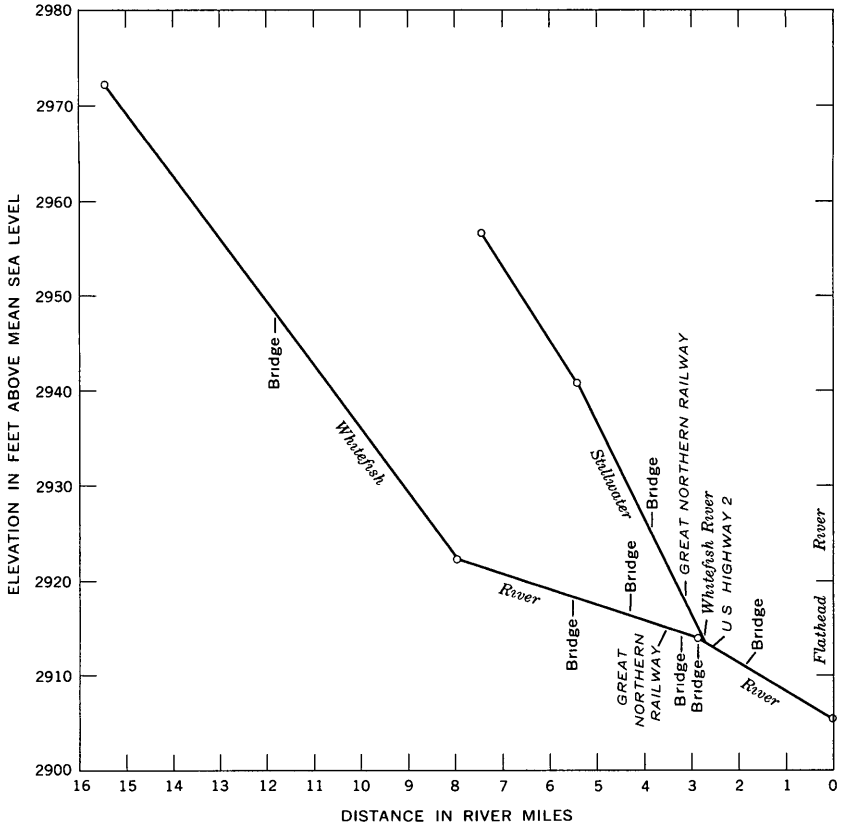

FIGURE 43.—Profile of flood-crest elevations on the Stillwater and Whitefish Rivers upstream from the mouth of the Stillwater River

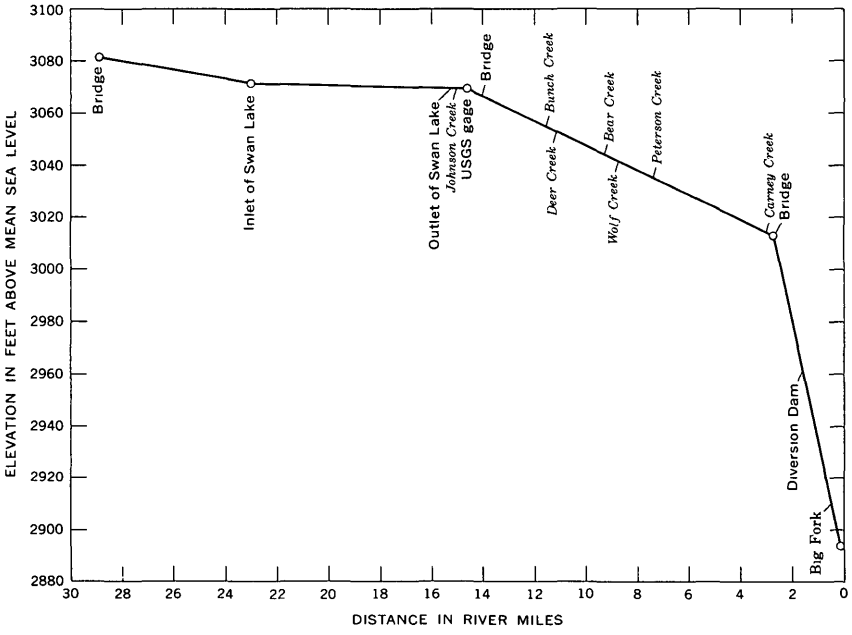

FIGURE 44.—Profile of flood-crest elevations on the Swan River upstream from the mouth

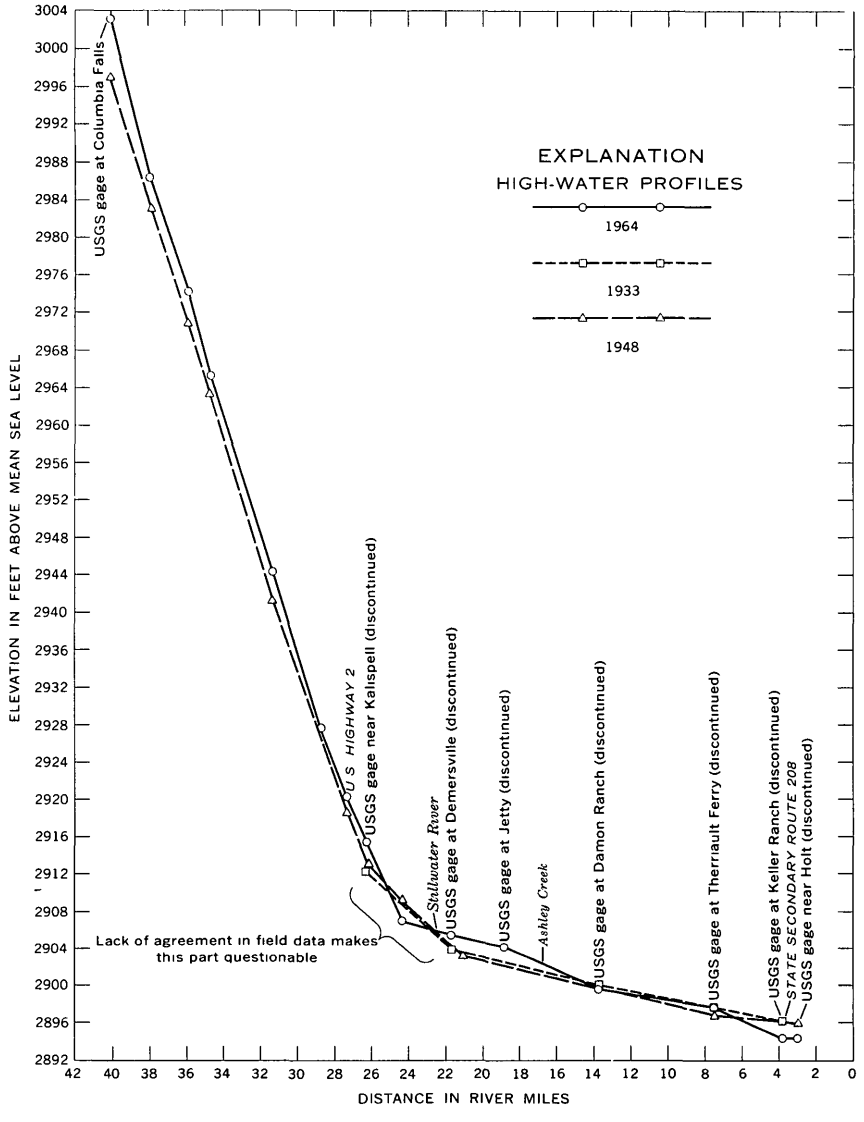

FIGURE 45.—Profile of flood-crest elevations on the Flathead River from 40.05 to 3.0 miles upstream from the mouth at Flathead Lake

STORAGE REGULATION

Lake Sherburne stored all inflow during the critical flood period; thus it reduced the peak on Swiftcurrent Creek by about 10,000 cfs and resulted in some beneficial effects on the flow of the St. Mary River. About 25,000 acre-ft of floodwater were stored during the period June 7–10.

Canyon Ferry Reservoir on the Missouri River, near Helena, reduced the peak flow of the Missouri River from about 24,000 cfs to about 5,000 cfs at that point for a period of nearly 3 days. This reduction had a favorable effect at Great Falls where the combined record flow of the Sun River and high stage on the Missouri River caused great damage. The Corps of Engineers estimated this reduction prevented about $60,000 damage. Hauser, Holter, Black Eagle, Rainbow, Cochrane, Ryan, and Morony Dams on the Missouri River above and below Great Falls had little effect on discharge regulation.

The Bureau of Reclamation estimated that Gibson Dam on the Sun River reduced the peak flow of the Sun River near Great Falls and the Missouri River downstream from the Sun River by about 4,000 cfs. The net reduction of the Missouri River flow below the Sun River by Gibson Dam and Canyon Ferry Dam was estimated to have been about 23,000 cfs.

The failure of Swift Dam on Birch Creek, at about 1000 hours on June 8, released about 30,000 acre-feet of stored water in a short time and greatly increased the natural peak flow of that stream. The discharge diminished as it moved downstream. Failure of Lower Two Medicine Lake Dam, although less abrupt than that of Swift Dam, resulted in unnaturally high flow for a considerable distance downstream from the dam. However, the maximum discharge of Two Medicine River at the gaging station southeast of Browning occurred prior to the arrival of water released by the dam failure. Storage by the dam, prior to failure, was probably favorable to peak-flow reduction along much of Two Medicine River.

Tiber Reservoir on the Marias River near Chester, with a drainage area of 4,923 square miles that includes Birch Creek and Two Medicine River where dams failed, had a peak inflow of about 200,000 cfs. Daily outflow from the reservoir was increased from 1,150 cfs on June 8 to about 10,000 cfs on June 11. Nearly 285,000 acre-ft of water was stored during the 3-day period of June 9–11. The regulation and storage by Tiber Dam and Reservoir averted flooding of a number of ranches and the town of Loma and prevented an estimated $600,000 damage along the lower Marias River and the Missouri River upstream from Fort Peck Reservoir.

Fresno Reservoir on the Milk River, 13 miles west of Havre, stored about 15,000 acre-feet during the flood period while downstream releases for irrigation continued. As the natural peak flow was not unusually high, the regulation benefit was probably minor.

Fort Peck Reservoir on the Missouri River, upstream from the Milk River, is one reservoir of a system of large reservoirs on the main stem

of the Missouri River operated by the Corps of Engineers Damage prevented by these main-stem reservoirs and local Federal flood-control projects were estimated to be nearly $63 million Bureau of Reclamation reservoirs were credited, by the Corps of Engineers, with an additional downstream benefit estimated at about $11 million

Hungry Horse Dam on the South Fork Flathead River reduced outflow from about 3,000 cfs at the beginning of the flood to 500 cfs Peak inflow to the reservoir was computed at about 78,000 cfs. A stage reduction on the Flathead River of 4 feet at both Columbia Falls and Kalispell was attributed to reservoir storage (estimate by the Corps of Engineers) The corresponding prevention of damage was estimated at $10 million

RECORDS OF PREVIOUS FLOODS

Information on floods prior to the turn of the century is very scarce for the area east of the Continental Divide The Waterton, Belly, and St Mary Rivers of the Hudson Bay drainage basin had high flows in 1902, 1908, and 1953 The 1953 flood is discussed in detail by the Department of Northern Affairs and National Resources (1953), Ottawa, Canada. Noteworthy floods in the Missouri River basin, upstream from Fort Peck Reservoir, occurred in 1908, 1916, 1927, 1948, and 1953 A report of the 1953 flood and a general review of some previous floods have been published by the U.S Geological Survey (1957)

Information obtained from residents and weather records indicate that the June 1908 and June 1953 floods in the Waterton, Belly and St Mary River basins were caused by exceptionally intense rainfall The maximum stages in 1908 on the Belly River near Mountain View, Alberta, and Waterton River near Waterton Park, Alberta, were slightly higher than in 1964.

The peak discharges of 1964 in the St. Mary River drainage basin upstream from Babb may have exceeded those of 1908 The peak discharge of the St. Mary River at the international boundary was 21,000 cfs in 1964 and about 40,000 cfs in 1908

The floods in June 1908 in the Missouri River basin above Fort Peck Reservoir were considered record floods in the memory of residents, and still stand as the record floods in much of the area The longest continuous record of streamflow in the basin started in 1891 on the Missouri River at Fort Benton The June 1908 peak of about 140,000 cfs is nearly double the next highest peak of 78,700 cfs in June 1953 The 1964 peak of 77,400 cfs ranks third, and the fourth highest known peak occurred in June 1892 Storage in Canyon Ferry Reservoir reduced both the 1953 and 1964 peaks

The June 1916 peak on the Sun River at the diversion dam northwest of Augusta was 32,300 cfs compared with the June 1908 peak of 20,000 cfs and the June 1964 peak of 59,700 cfs Storage in Gibson Reservoir reduced the 1964 peak by about 4,000 cfs On Elk Creek at Augusta, the June 1908 peak was the highest recorded during the years 1904–24, when streamflow records were being collected. Although records were not obtained during the June 1953 flood, local residents indicate the 1953 flood was higher than the 1908 flood and the 1964 peak exceeded the 1953 peak The June 1964 peak stage at the Sun River near Vaughn gaging station exceeded the June 1908 peak by about 3 feet

The peak discharge of 241,000 cfs on the Marias River near Shelby greatly exceeds any discharge since 1902, when intermittent record began. The peak discharge of 1908 may have been slightly higher than the 40,000 cfs recorded for 1948. Records at the discontinued station on the Marias River near Brinkman list the 1908 peak discharge at about 70,000 cfs and the 1948 peak at 50,000 cfs Intermediate inflow between these sites was believed to have been much less in 1948 than in 1908 The 1948 flood in the Marias River basin has been discussed by Dightman (1950).

The peak stage of the Missouri River at Virgelle was about 2 feet higher in 1908 than in 1953 The 1953 peak discharge was 122,000 cfs as compared with 105,000 cfs in 1964.

The Milk River basin underwent flooding in 1899, 1906, 1908, 1948, 1952, and 1953, serious flooding occurred in the central and lower parts of the basin. There was no serious flooding in this reach in June 1964 Very little is known of floods in the upper Milk River basin prior to 1905, except that the Milk River at Havre had a peak in 1899 of about 20,000 cfs, the highest known prior to completion of Fresno Dam in 1939 The peak of the Milk River in 1964 evidently exceeded the peak of 1908 and subsequent years in the Del Bonita area

West of the Continental Divide severe general floods are known to have occurred in 1894, 1899, and 1948. Lesser or more localized floods occurred in 1913, 1916, 1928, and 1954. The floods of May-June 1948 and May 1954 are discussed by the U S Geological Survey (1949, 1959)

The Clark Fork upstream from Missoula had its highest peak flow in 1908, according to information of local residents The Clark Fork peak discharge of about 48,000 cfs in 1908 at the Milltown Dam, just downstream from the mouth of the Blackfoot River, was the highest known The peak discharge of 1894 is not known but was probably the second highest, followed in diminishing order by the 1899, 1964, and 1948 peaks

The Blackfoot River near Bonner was probably higher in 1894 and 1908 than in 1964 The 1964 peak is the highest recorded discharge during the periods 1899–1904 and 1940–64 However, the upper Blackfoot River near Lincoln was higher in 1899, 1908, and 1953 than in 1964, according to information of local residents

The 1948 peak discharge for the Clark Fork below Missoula was 52,800 cfs and is the highest since record began in 1929 The 1964 peak is the second highest Higher flows are assumed to have occurred in 1894, 1899, and 1908 The summation of the peak discharges for Clark Fork at Missoula and Bitterroot River near Missoula for June 20, 1899, indicates a peak discharge for Clark Fork below Missoula of at least 70,000 cfs

At St Regis the Clark Fork peak discharge in 1948 is the highest since gaging station records began in 1911 This peak is followed in order of diminishing magnitude by the peaks of 1913, 1956, and 1964 As is generally assumed within this basin, peak discharges in 1894, 1899, and 1908 probably exceeded the 1948 peak

In the Flathead River basin, quantitative information is meager for floods prior to 1910 The 1894 flood of 142,000 cfs on the Flathead River at Columbia Falls was the highest known until the discharge of 176,000 cfs in 1964 The 1964 peak discharge would have been about 245,000 cfs if the South Fork Flathead River had not been regulated by Hungry Horse Dam The maximum known elevation of Flathead Lake (about 2,900 ft, Somers datum) occurred in 1894 The maximum elevation of 2,894 27 feet in 1964 was exceeded six times between 1909 and 1964 The Corps of Engineers estimate that the storage in Hungry Horse Reservoir reduced the potential maximum elevation of Flathead Lake in 1964 by 2 5 feet

FLOOD FREQUENCY

The evaluation of the flood potential of a stream is of primary interest to persons concerned with location and design of structures subject to possible flooding The probable return frequency (recurrence interval) can be determined by analysis of flood records for gaging stations Regional flood characteristics are developed from statistical study of flood experience on a number of streams The reliability of calculated return frequencies may be expected to vary with the areal coverage and number of years of flood records on which they are based A fair degree of confidence is indicated for recurrence intervals as great as 50 years, extension of curves beyond that period is not recommended A flood having a recurrence interval of 50 years will be equaled or exceeded once in 50 years, on an average, in other words, it has a 2-percent chance of occurring in any year

Comparison of the peak discharge at a gaging station for a given flood with the probable 50-year flood as determined by flood-frequency relations provides an approximate measure of the severity of the flood The floods of June 1964 were outstanding, particularly on streams that drained the mountain slopes on both sides of the Continental Divide

In the Hudson Bay drainage basin, most streams had peak discharges that were more than twice the discharge of the probable 50-year flood The peak of Street Creek at international boundary was 10 3 times the probable 50-year flood This may have been exceeded on some streams where peak discharges were not determined

Peak discharges in the Missouri River basin were also outstanding in the upper drainage areas of the Sun, Teton, Marias, and Milk Rivers The ratios of the peak discharge to the probable 50-year flood ranged from about 3 in the upper Sun River area to more than 10 in the Teton River drainage Peak discharges of 5 to 10 times the probable 50-year flood were common on Two Medicine Creek (called Two Medicine River downstream from lower Two Medicine Lake), North and South Fork Birch Creek, Badger Creek, Dupuyer Creek, and South Fork Milk River The highest determined ratio was 11 5 for Teton River near Farmington

West of the Continental Divide, ratios of the June 1964 peak discharge to the probable 50-year flood were generally less than 2 in the Clark Fork drainage except in the upper Blackfoot River area. In the upper Flathead River basin, the peak discharges determined ranged from 2 to 4 times the probable 50-year flood except in the Middle Fork Flathead River basin where the ratios approached 9

Table 19 lists the calculated flood-recurrence intervals or ratios to the probable 50-year flood for gaged sites susceptible to analysis through reports of the U S Geological Survey on the magnitude and frequency of floods The reports for the upper Columbia River basin and for the Missouri River basin have been prepared by the U S Geological Survey (1964, 1966) The report for the Hudson Bay basin will be published after completion of studies

The variation of flood characteristics east of the Continental Divide led to the regional areal separations shown in figure 46 The peak discharges for the June 1964 flood have been plotted against drainage area in each appropriate region and area as shown in figures 47 to 55 Recurrence-interval lines for the 10-year flood and the 50-year flood are shown to aid comparison Extension of the recurrence-interval lines in these figures is not advised

In general, flood-frequency relations are based upon natural streamflow conditions However, the Missouri River peak flows have been affected by a relatively constant degree of regulation during most of

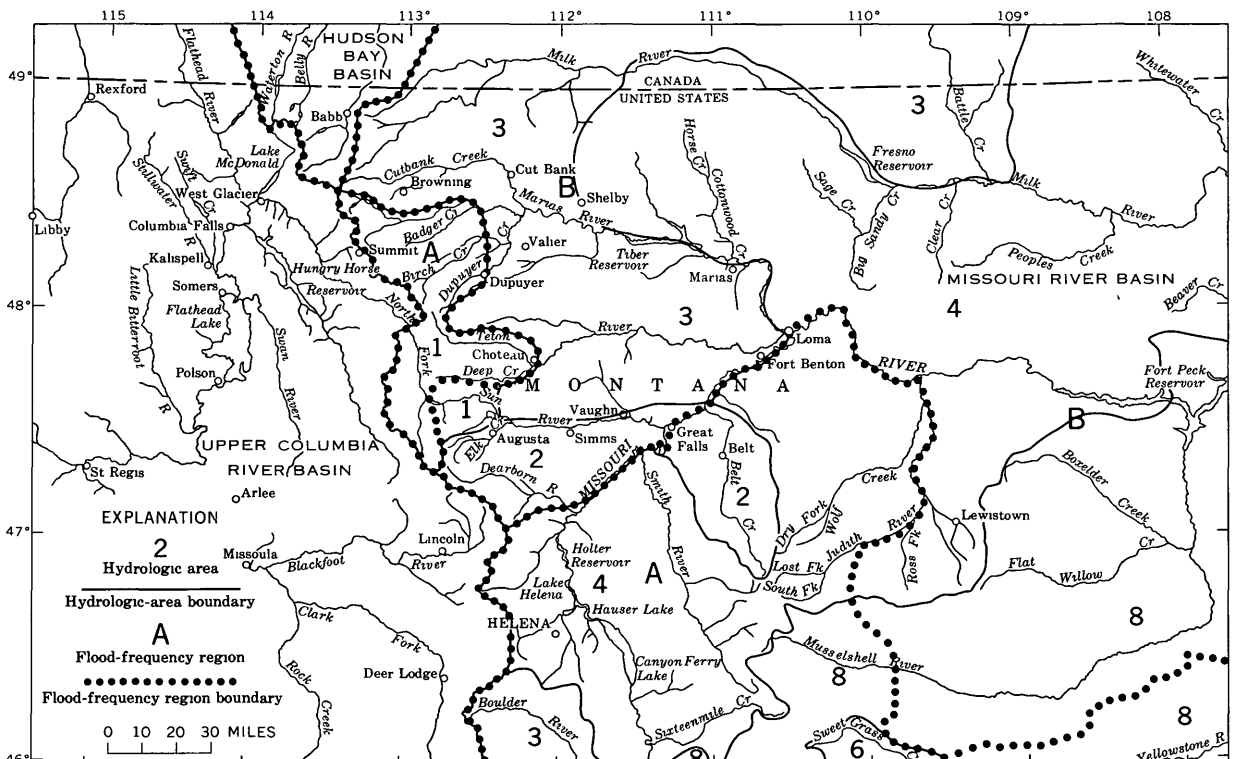

FIGURE 46.—Flood-frequency regions and hydrologic areas

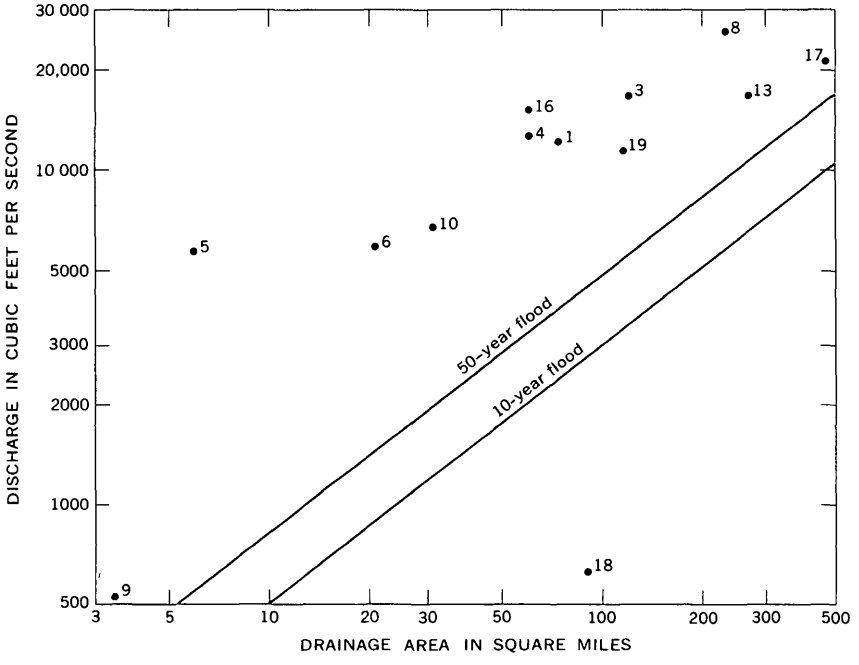

FIGURE 47.—Relation of 1964 peak discharge to 10- and 50-year floods in Hudson Bay basin Numbers conform with those in table 19 and on figure 2

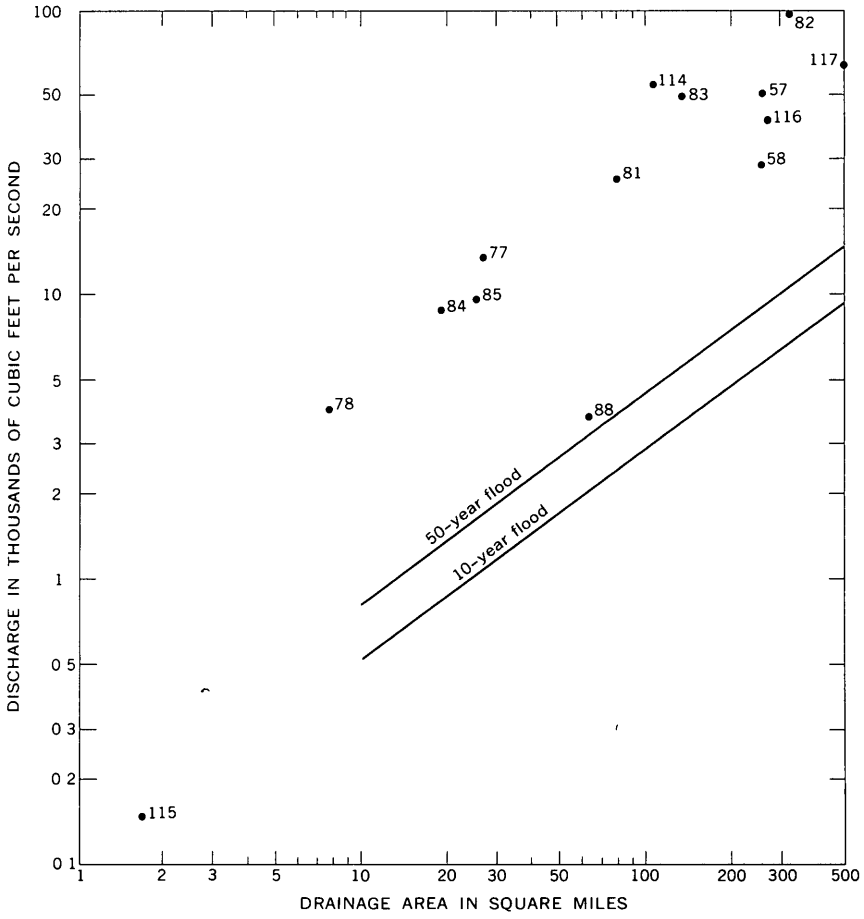

FIGURE 48.—Relation of 1964 peak discharge to 10- and 50-year floods in region A, area 1. Numbers conform with those in table 19 and on figure 2.

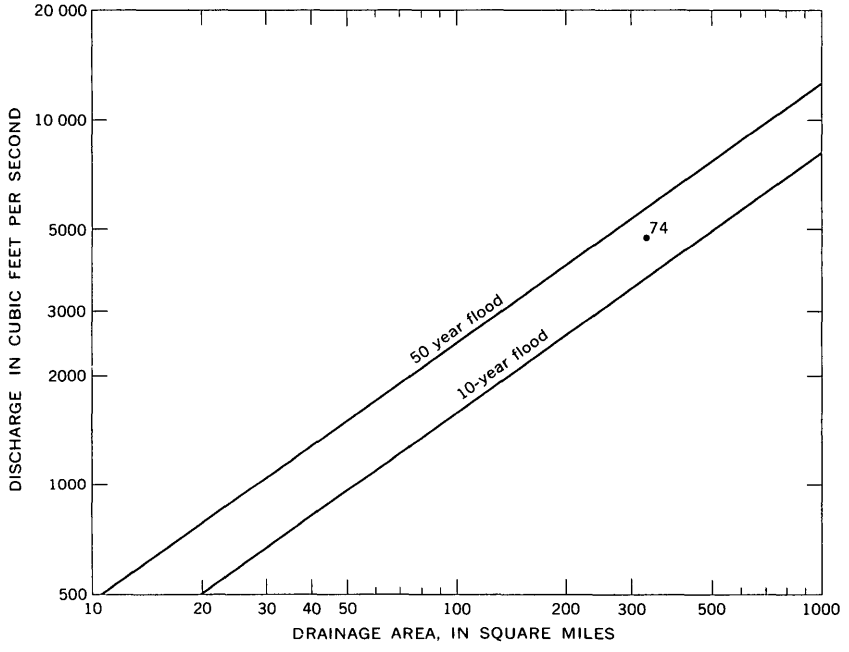

FIGURE 49.—Relation of 1964 peak discharge to 10- and 50-year floods in region A, area 2. Number conforms with that in table 19 and on figure 2.

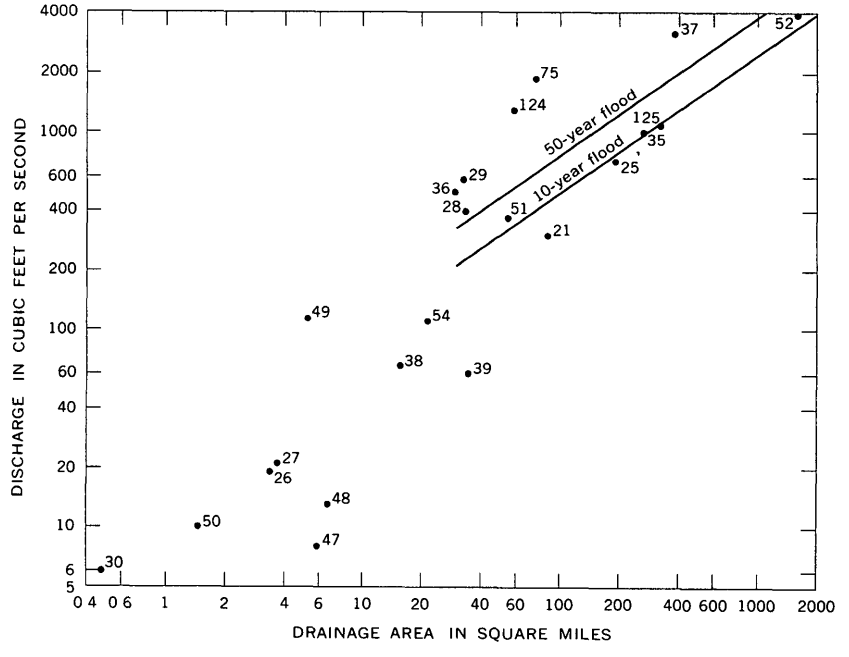

FIGURE 50.—Relation of 1964 peak discharge to 10- and 50-year floods in region A, area 4. Numbers conform with those in table 19 and on figure 2.

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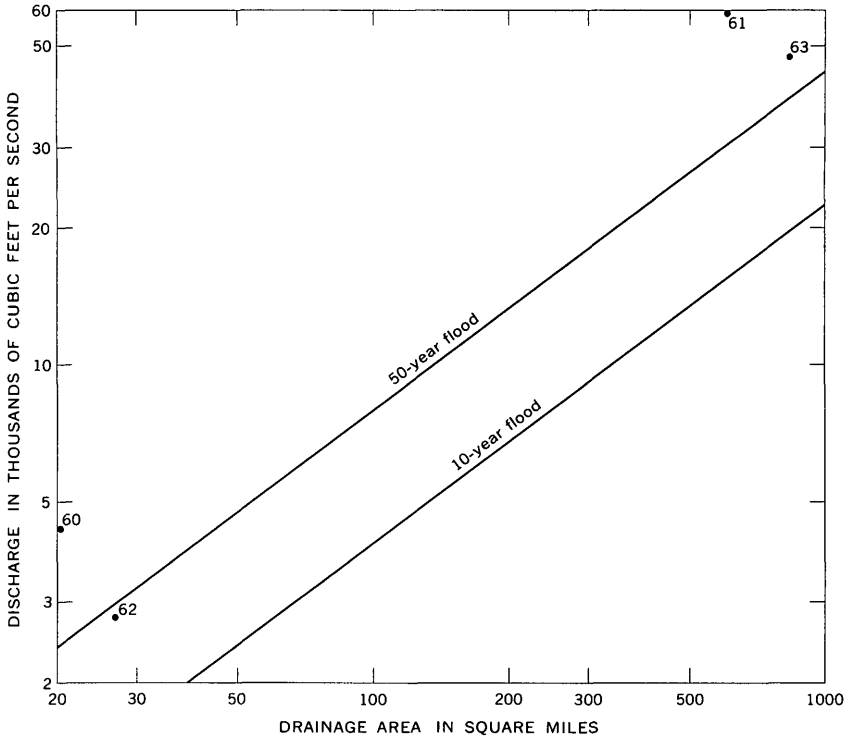


FIGURE 51.—Relation of 1964 peak discharge to 10- and 50-year floods in region B, area 1. Numbers conform with those in table 19 and on figure 2.

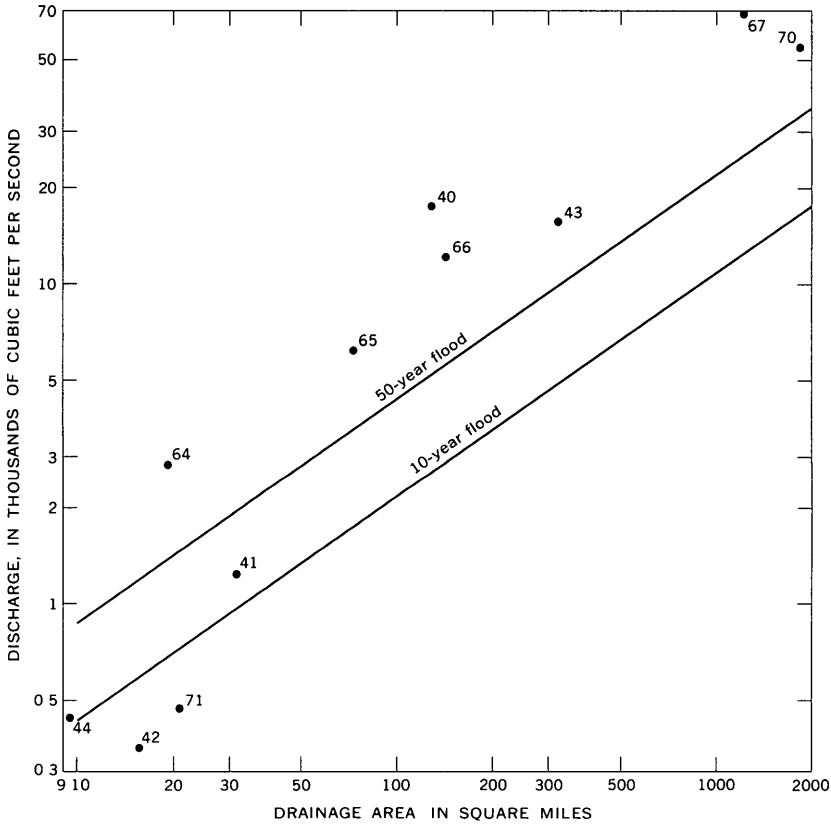


FIGURE 52.—Relation of 1964 peak discharge to 10- and 50-year floods in region B, area 2. Numbers conform with those in table 19 and on figure 2.

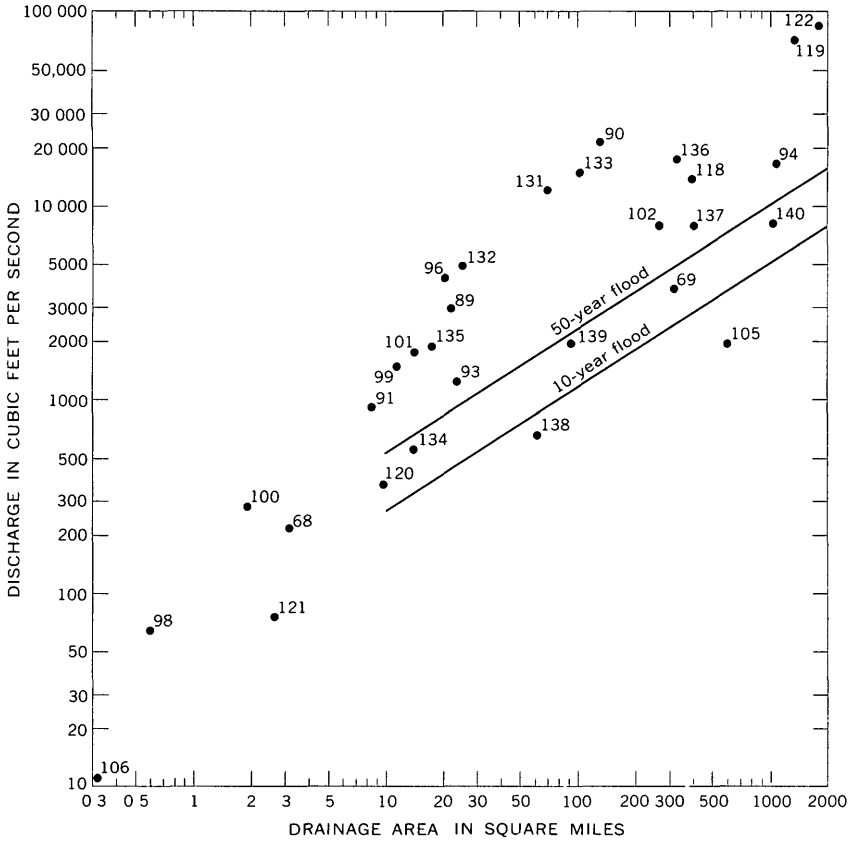


FIGURE 53.—Relation of 1964 peak discharge to 10- and 50-year floods in region B, area 3. Numbers conform with those in table 19 and on figure 2

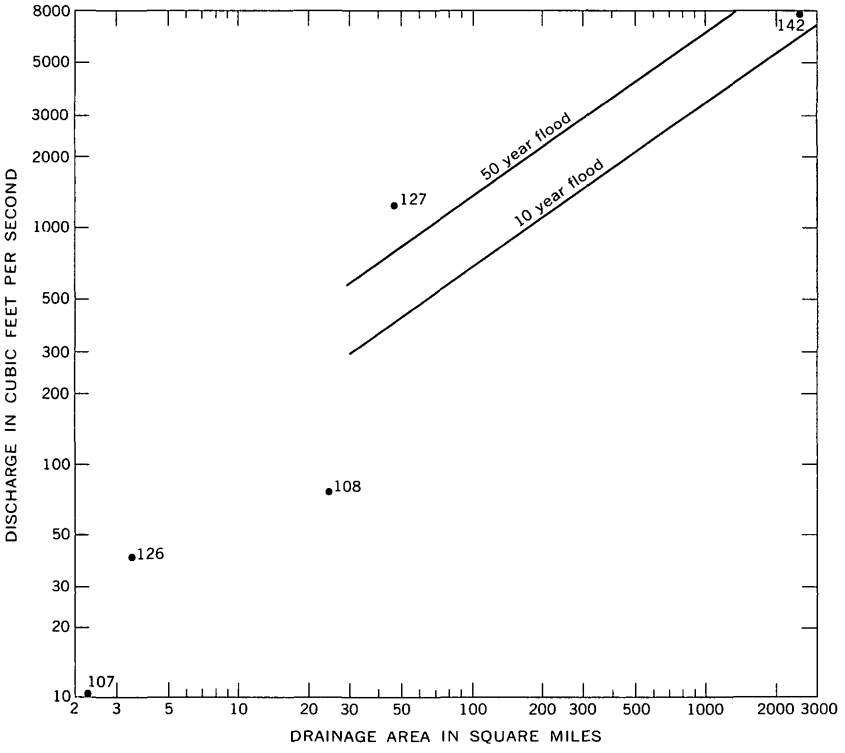


FIGURE 54.—Relation of 1964 peak discharge to 10- and 50-year floods in region B, area 4. Numbers conform with those in table 19 and on figure 2.

the period for which records have been collected. Figure 56 shows the peak discharges of June 1964 and the 10-year and 50-year flood lines for gaging stations on the Missouri River main stem between the Gallatin River and Fort Peck Reservoir.

The flood-frequency formulas for the area west of the Continental Divide (U.S. Geological Survey, 1964) were developed from the parameters of drainage area, average annual runoff, areas of lakes and ponds, and a numerical geographic factor. Examples of derived recurrence intervals for discharges at selected gaging-station sites are given in figure 57.

The relations of peak discharge to drainage area provide easy comparison of the unit discharge of the 1964 flood peaks (figs. 58 and 59). The same information for four points along the Teton River is given in figure 60 to illustrate the downstream reduction in unit discharge and to provide a means of estimating the unit discharge at any intermediate point.

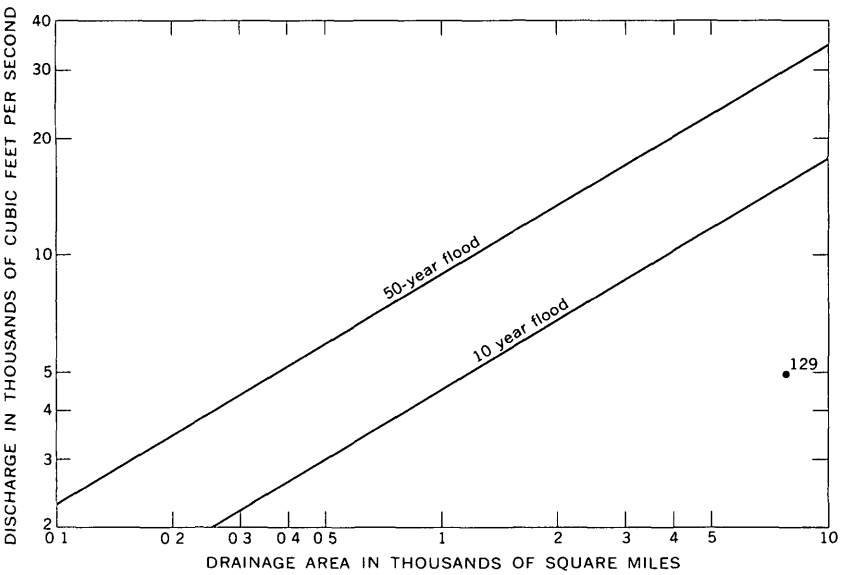


FIGURE 55.—Relation of 1964 peak discharge to 10- and 50-year floods in region B, area 8. Number conforms with that in table 19 and on figure 2.

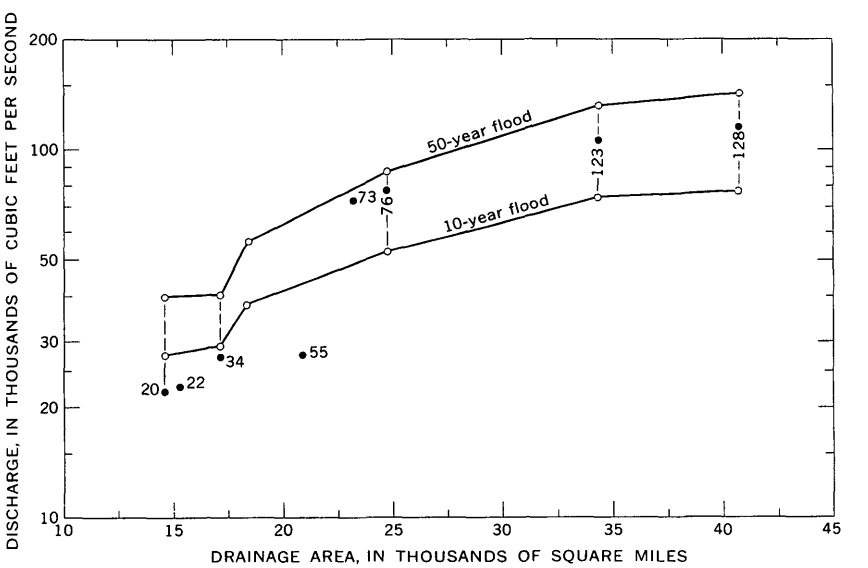


FIGURE 56.—Relation of 1964 peak discharge to 10- and 50-year floods on Missouri River main stem. Numbers conform with those in table 19 and on figure 2.

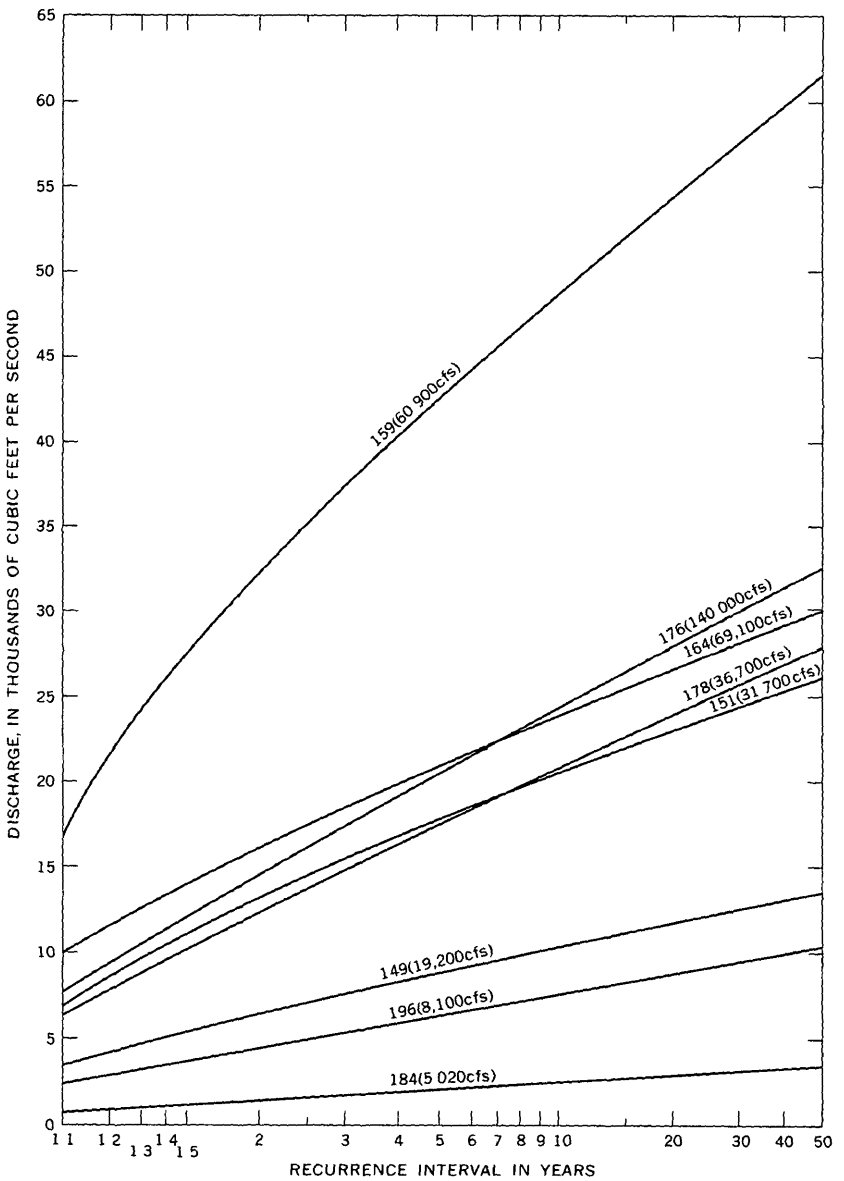


FIGURE 57.—Flood-frequency curves for selected stations in upper Columbia River basin. Numbers conform with those in table 19 and on figure 2. Numbers in parentheses are June 1964 peak discharges.

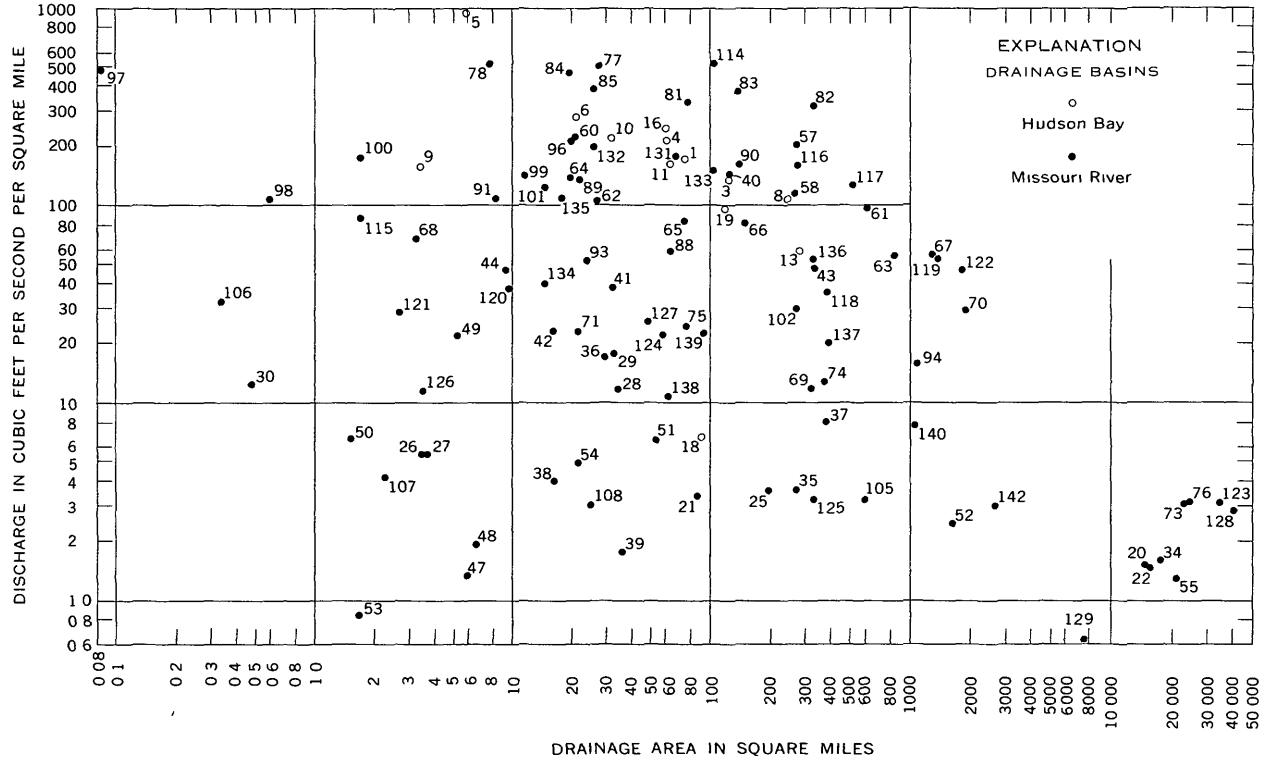


FIGURE 58.—Relation of unit discharge to drainage area in Hudson Bay and Missouri River basins. Numbers conform with those in table 19 and on figure 2

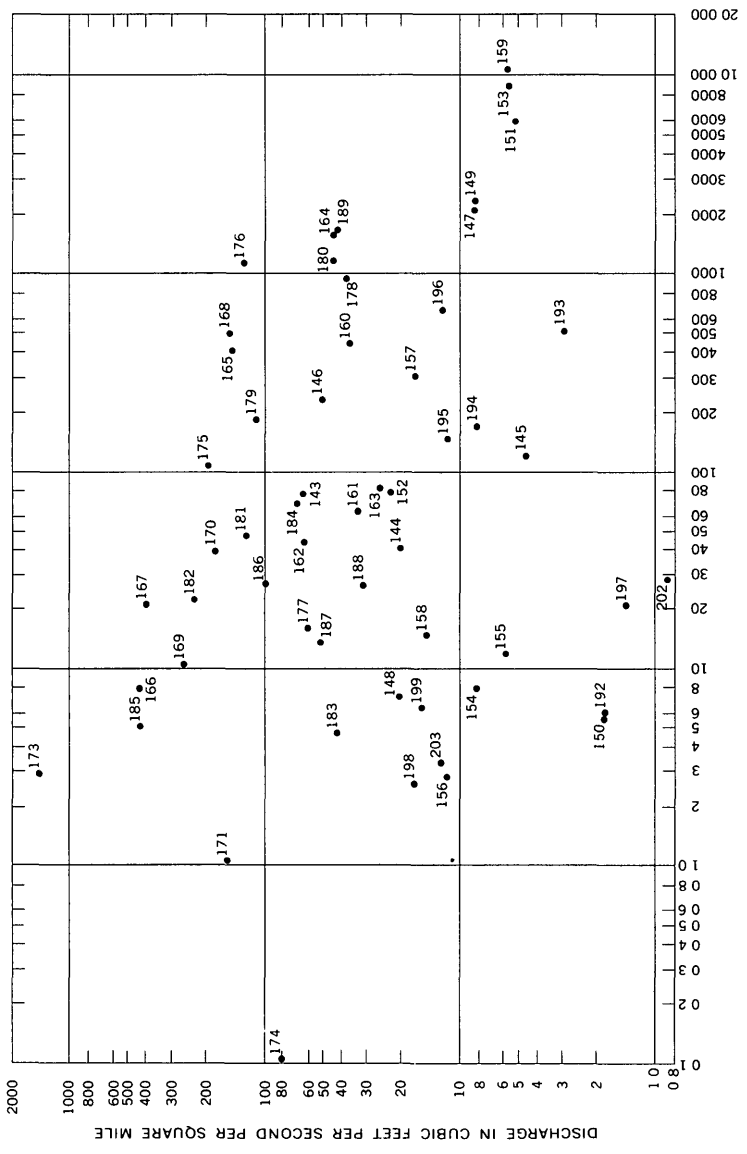


FIGURE 59.—Relation of unit discharge to drainage area in upper Columbia River basin. Numbers conform with those in table 19 and on figure 2

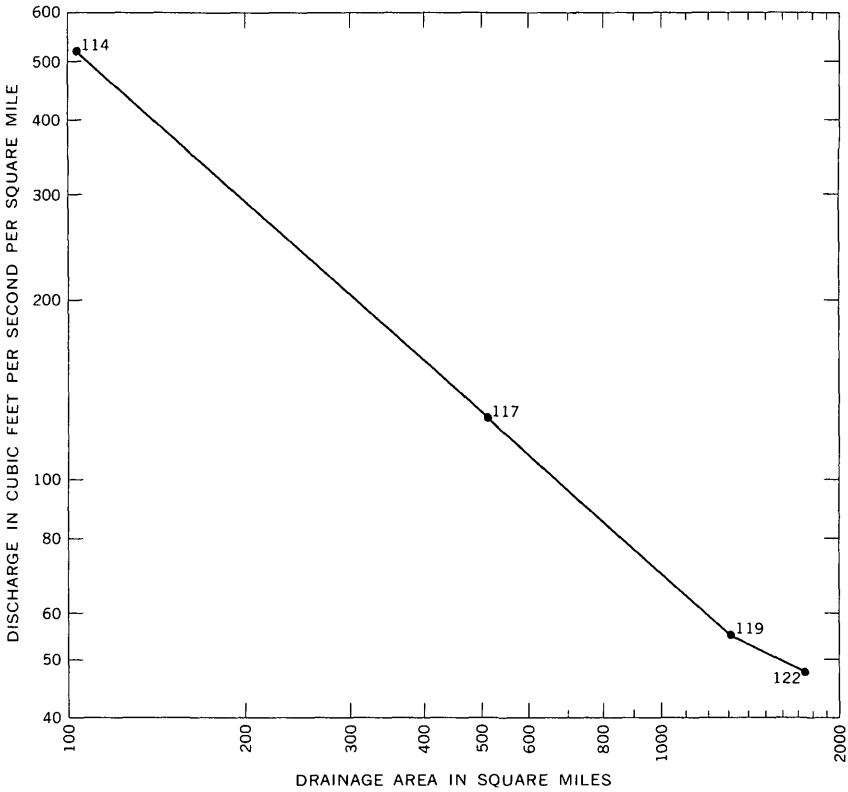


FIGURE 60.—Relation of unit discharge to drainage area, Teton River. Numbers conform with those in table 19 and on figure 2

EROSION AND DEPOSITION CAUSED BY FLOODS OF JUNE 1964 IN NORTHWESTERN MONTANA

By RICHARD F HADLEY

INTRODUCTION

This section of the report is concerned with the physical changes produced by the flood on stream channels and on landforms such as mountain slopes. Many of the changes in the landscape after such catastrophic floods as those of June 1964 in northwestern Montana are apparent to observers, but most changes cannot be verified quantitatively. Opportunities for comparison of natural features before and after the flood, by surveys or photographs, are limited Therefore, the data presented here are a combination of quantitative measurements and qualitative observations of geomorphic changes produced by an outstanding flood

The author wishes to express his thanks to Frank Stermitz, District Engineer, Helena, Mont , and personnel of the Surface Water Branch, U S. Geological Survey, for assistance in the collection of field data and photographs

FIELDWORK

A reconnaissance of the area was made during the period September 1–10, 1964 During this brief trip, field observations and surveys were made in several large river valleys and in valleys of smaller tributaries in the area affected by the flood Channel cross sections were surveyed at U.S Geological Survey gaging stations where channel dimensions were known for the period before the flood. At other sites, where exact preflood measurements were not available, an estimate of channel dimensions was made from photographs and topographic maps

GENERAL FEATURES OF THE FLOOD AREA

LOCATION

The greatest damage caused by the flood was concentrated in an area bounded by the Dearborn River on the south, Interstate Highway 15 on the east between Helena and Great Falls, Middle Fork Flathead River on the north, and Flathead River on the west This roughly rectangular-shaped area includes about 12,000 square miles, and the Continental Divide trends northwest through it

TOPOGRAPHY

The topography is diverse Altitudes reach 8,500–9,000 feet in the rugged peaks along the Continental Divide, in the Flathead Range, and in the mountains of Glacier National Park west of the Divide.

On the east side of the Divide, the northern Great Plains and foothills abut the mountains, and the general altitude of the area ranges from 3,300 feet at Great Falls to almost 5,000 feet in the foothills and to more than 8,500 feet in the mountains 10 miles away

GEOLOGY

The Rocky Mountains which bisect the flood area and form the Continental Divide are composed of sedimentary, metamorphic, and igneous rocks ranging from Precambrian to Quaternary in age These rocks are folded and faulted into complex structural patterns. The sedimentary rocks are chiefly limestone, sandstone, and shale. The metamorphic rocks are predominantly quarzite, and the igneous rocks are diorite and gabbro On the Great Plains east of the Rockies, the rocks are chiefly Tertiary and Cretaceous sandstone and shale Some areas are mantled with Pleistocene glacial drift and morainal deposits

PHYSIOGRAPHY

The mountain valleys are generally narrow and steep, their shapes being controlled to a large degree by geologic structure The valley side slopes are heavily forested, and the surficial mantle is thin and rocky The stream channels are incised in the bottom of V-shaped troughs and most have very narrow flood plains One reason for the heavy damage to roads and railroads is the lack of room on the mountain valley floors for rights-of-way. Most roadbeds are high fills which tend to impinge on the riverbanks Immediately east of the mountains most river valleys and the flood plains widen markedly, and the slope of the rivers and upland areas is much flatter There is, therefore, a significant difference in the kind of flood damage in the two physiographic types

EROSIONAL EFFECTS OF THE FLOOD

UPLAND AREAS

The steep upland slopes in the mountainous areas have a thin soil mantle which was probably saturated or near saturation because of the above-average snowpack Therefore, when rainfall of such quantities and intensities as occurred on June 7–8 fell on the steep, relatively unstable slopes, the erosion on mountain slopes was extraordinary Gullying in small mountain rills and movement of debris on steep valley slopes were pronounced in the drainage area of Middle Fork Flathead River between Summit and West Glacier, Mont

For example, in sec 36, T 32 N, R 18 W, on Moccasin Creek, a tributary of the Middle Fork Flathead River where the slope of the

valley floor is 20 percent and the valley side slopes exceed 50 percent, an estimated 3.8- to 4-foot thickness of rock and alluvium was removed from the central part of the valley in a trench 32 feet wide. Boulders with maximum diameters of 3¾ feet were scattered along the channel banks. On the upland slopes covered with ponderosa pine, trees up to 1 foot in diameter had been uprooted and moved down the slopes (figs. 61, 62). Less than 100 yards below the section shown in figure 62, U.S. Highway 2 was closed by a debris cone that was transported from the Moccasin Creek drainage basin of about 2 square miles. In the area between Summit and Hungry Horse Dam, Mont., the flood discharge was extremely high, and erosion was severe from all headwater stream and mountain slopes.

On the east side of the Continental Divide, upland erosion was also severe and comparisons of aerial photographs taken before and after the flood reveal that upland slopes near the junction of the West Fork and South Fork Sun River were intricately gullied. The antecedent moisture in the soil mantle was probably responsible, in large part, for the high rate of discharge and upland erosion in the mountain-

FIGURE 61.—Moccasin Creek near West Glacier, Mont. showing debris moved down steep mountain slopes by flood.

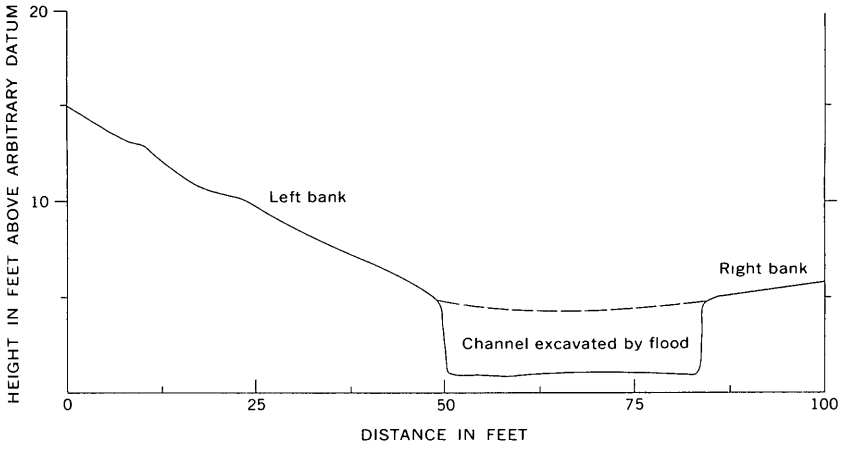


FIGURE 62.—Channel cross section on Moccasin Creek near West Glacier, Mont.

ous areas. On the High Plains east of the mountains, there was little gullying on the grassed upland slopes and most erosion was confined to the channels and valley floors.

CHANNEL EROSION

Data for determining channel erosion were obtained primarily at U.S. Geological Survey gaging stations. Figures 62, 63, 68, and 72 show six channel cross sections before and after the flood. Although only a small sampling of rivers affected by the flood is included, it is representative of both mountain and plains streams. The range in drainage area is from 8 to 1,380 square miles. Surveys of these cross sections and observations at other locations indicate that most channels were considerably deepened and widened by the flood although the changes may be temporary.

DETAILED DESCRIPTION OF CHANNEL CHANGES

SKYLAND CREEK NEAR ESSEX, MONT.

The drainage basin of Skyland Creek is very representative of the small, forested headwater basins west of the Continental Divide that received the brunt of the flood. The drainage area at the Skyland Creek gaging station is 8.09 square miles, and the maximum known peak discharge prior to the 1964 flood was 284 cfs. The flood of 1964 produced a peak discharge of 3,580 cfs, and velocities must have been extremely high judging by the amount and size of debris that was

moved into the valley. The channel was completely filled by uprooted trees up to 8 inches in diameter and by boulders as much as 2 feet in longest dimension. The stream now occupies a channel to the left of the gage house and slightly higher than the old channel (figs. 63, 64).

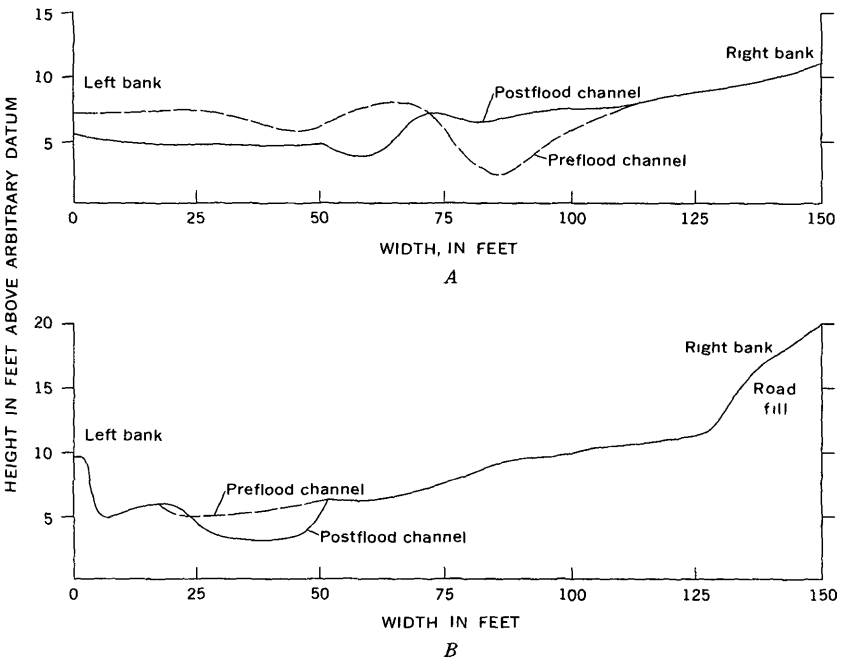
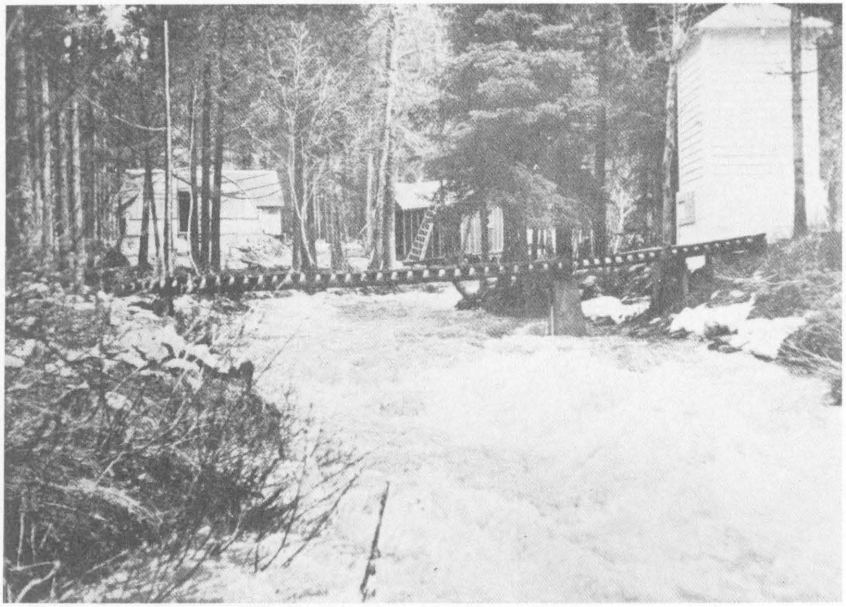


FIGURE 63.—Channel cross sections on Skyland Creek near Essex, Mont., (*A*) and on Bear Creek near Essex (*B*)



A, View looking upstream, May 22, 1948.

B, View on September 5, 1964, showing debris that has completely obliterated the channel. Gage house was not moved by the flood.

FIGURE 64.—GAGING STATION ON SKYLAND CREEK NEAR ESSEX, MONT.

BEAR CREEK NEAR ESSEX, MONT

The Bear Creek cross section is downstream from the Skyland Creek gaging station The drainage area is 20 7 square miles The gaging station is in a narrow valley bounded by a steep bedrock valley wall on the left bank and an earth-fill road embankment on the right bank The previously known maximum discharge was 696 cfs, and the peak discharge on the 1964 flood was 8,380 cfs The channel does not appear to have been severely eroded by the high peak discharge Heavy growth of trees and shrubs on the flood plain was relatively undamaged, and there is little evidence of deposition on the low terrace along the right bank; however, approximately 3 feet of channel scour was accompanied by minor widening (figs 63, 64, 65, 66)

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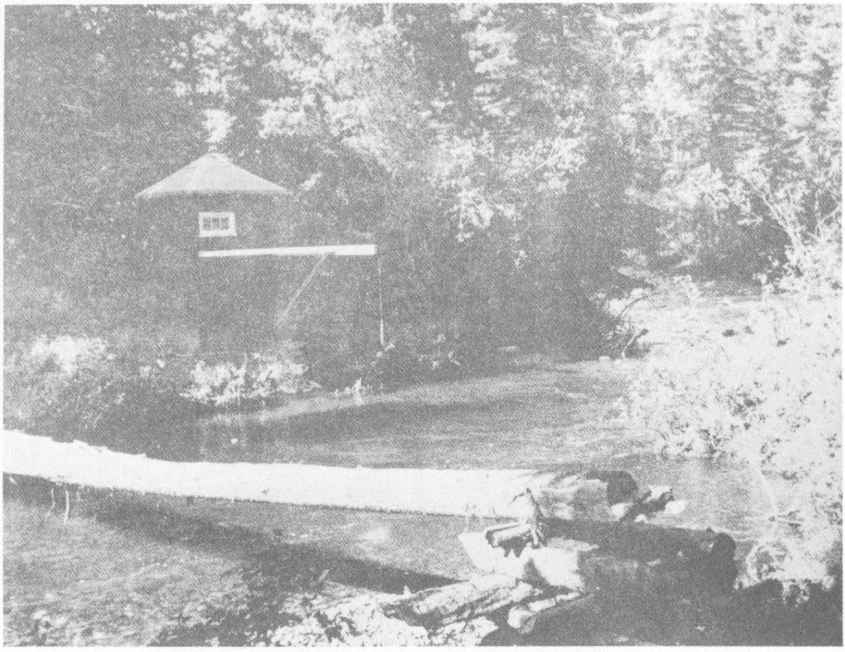


FIGURE 65.—Gaging station on Bear Creek near Essex, Mont., looking upstream, June 26, 1948.

FIGURE 66.—View of Bear Creek near the gaging-station site on September 5, 1964, showing erosion along channel sides.

MIDDLE FORK FLATHEAD RIVER AT ESSEX, MONT.

On the Middle Fork Flathead River at Essex, below the mouth at Bear Creek, the gaging station and a highway bridge were destroyed by the flood. Datum that could have been used to survey the eroded channel was not recovered, but qualitative observations of channel erosion and deposition were made near the gaging station site. The drainage area at this site is 510 square miles, and the maximum discharge during the flood was 75,300 cfs. For about a quarter of a mile upstream from the bridge site and U.S. Highway 2 crossing, the channel had been widened about 135 feet and a house was left hanging over the edge of an 8-foot high raw cutbank. On the right bank and downstream from the highway crossing, fine sand and silt had been deposited in a Forest Service campground to a depth of 5 to 6 feet (fig. 67). Estimates of the depth of deposition were aided by the near burial by sediment of fireplaces in the campground. The fine sediment may have been derived from erosion of the left bank immediately upstream.

FIGURE 67.—View of flood plain of Middle Fork Flathead River at Essex, Mont., showing deposition of fine-grained material in Forest Service campground.

TWO MEDICINE RIVER NEAR EAST GLACIER, MONT

On the east side of the Continental Divide, the channel erosion was equally as severe as on the west side and in some places was more spectacular because of the failure of dams The gaging station site on Two Medicine River near East Glacier is a quarter of a mile downstream from Lower Two Medicine Lake Dam and reservoir on a drainage area of 51 1 square miles Comparison of channel erosion with rainfall amounts and intensities or runoff is not meaningful because the greater part of the erosion and deposition in the valley is due to the failure of the dam and the subsequent extremely high peak discharge Nevertheless, the channel changes are noteworthy as an example of the erosional forces of the flood The peak discharge at the gaging station was 63,500 cfs Prior to the 1964 flood the maximum known discharge was 1,390 cfs in 1918 The channel at the gaging site was not deepened much by the flood presumably because of the rock control. However, the width of the channel was increased nearly fourfold (fig 68) Much of the vegetation along the banks was removed by the flood (fig 69) and cobbles up to 12 inches in longest dimension were deposited on the flood plain (fig 70)

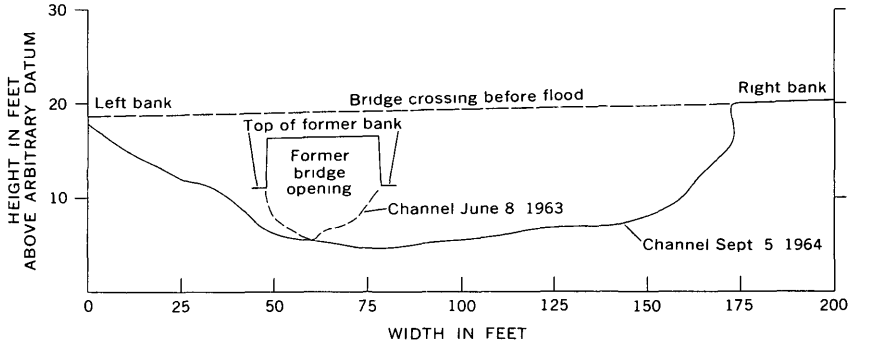
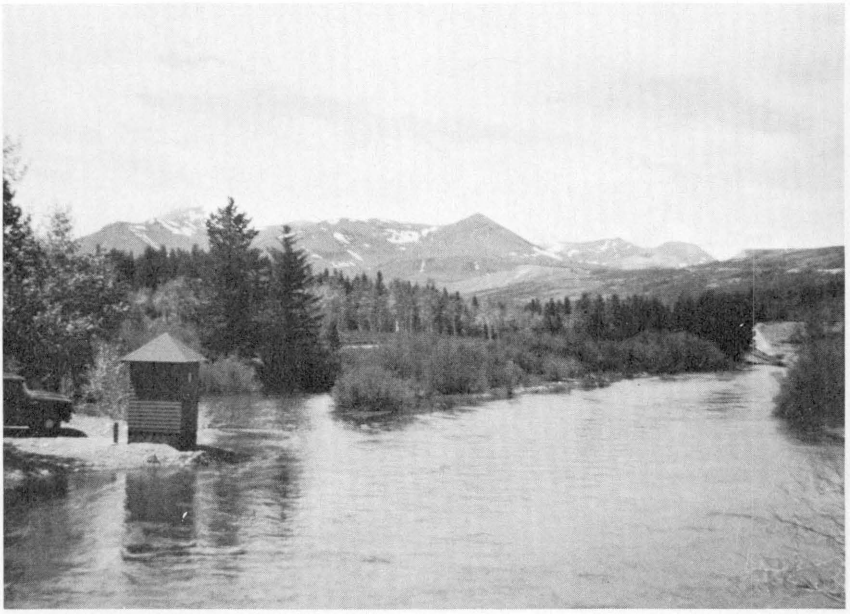
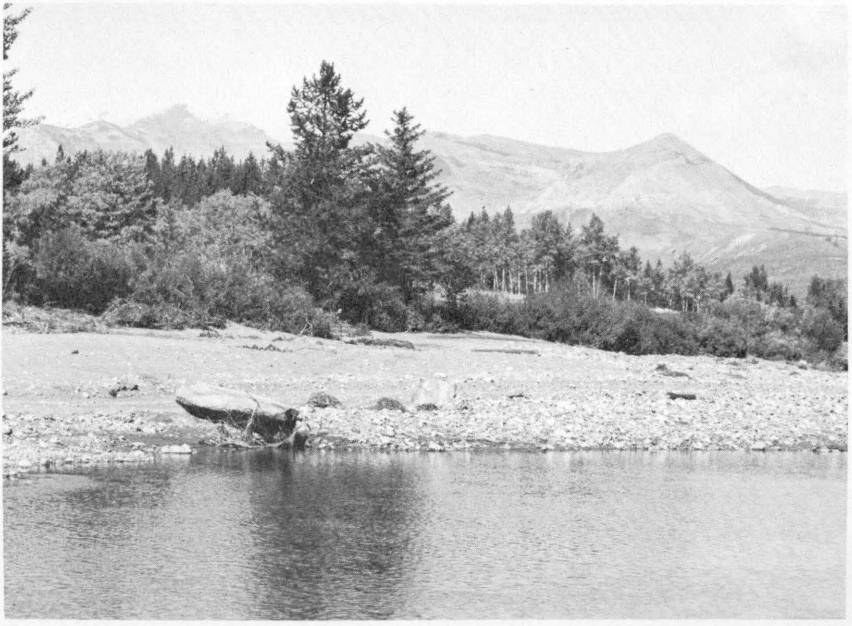


FIGURE 68—Channel cross section on Two Medicine River near East Glacier, Mont



A, View on June 8, 1963.



B, View on September 5, 1964. Two tall conifers in middle background appear on *A* to the right gage house. Coarse debris was deposited by the flood of June 1964.

FIGURE 69.—GAGING STATION ON TWO MEDICINE RIVER NEAR EAST GLACIER, MONT.

FIGURE 70.—Cobbles that were transported onto flood plain of Two Medicine River near East Glacier, Mont., by the flood.

NORTH FORK SUN RIVER NEAR AUGUSTA, MONT.

The North Fork Sun River heads on the Continental Divide at an altitude of about 8,500 feet and drains an area of 258 square miles of heavily forested, rugged mountain country The gaging station is in a narrow, steep-sided valley. The channel floor is covered by coarse gravel and boulders. The maximum discharge during the flood was 51,100 cfs As shown in figure 71 the channel was widened and deepened several feet at the gaging station cableway The maximum channel deepening was 5 5 feet, and the channel was widened about 25 feet. Although the flood stage rose higher than the bank on the left side, there is no indication of scour or fill on the low terrace

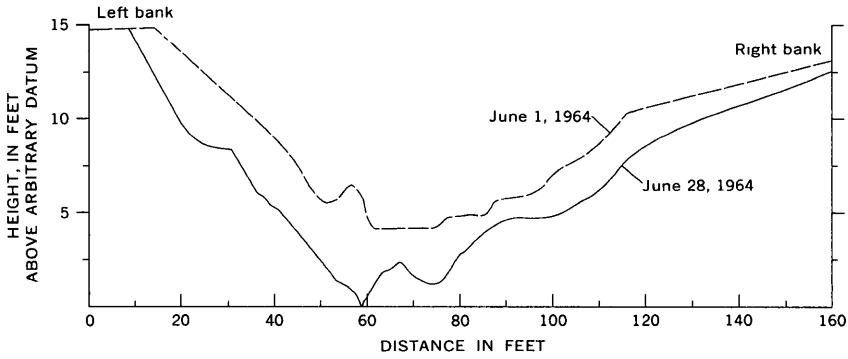


FIGURE 71 —Channel cross section on North Fork Sun River near Augusta, Mont

TETON RIVER NEAR DUTTON, MONT.

On the plains east of the Rocky Mountains, the Teton River is representative of the rivers affected by the flood At the gaging station near Dutton, Mont, the 1964 peak discharge was 71,300 cfs as compared with the previously known maximum discharge of 1,310 cfs The drainage area at the surveyed cross section is 1,308 square miles The valley is wide and flat with few obstructions to flow In spite of the large flood there was very little scour in the channel, and the widening was undoubtedly due to scour around the bridge abutments before the bridge was washed out (fig 72) In a study of erosion caused by floods of 1955 in Connecticut, Wolman and Eiler (1958) found that where channel width was small compared to valley width, scour was generally slight This condition seems to be true for the Teton River near Dutton where the channel is less than 15 percent of the valley width The flood plain showed no evidence of scour, even though it was completely inundated in the reach examined

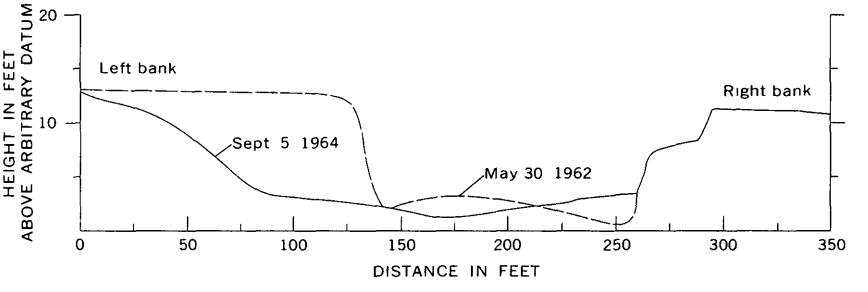


FIGURE 72 —Channel cross section on the Teton River near Dutton, Mont

DEPOSITION CAUSED BY FAILURE OF SWIFT DAM ON BIRCH CREEK

The floods in the valley of Birch Creek were extremely severe because of the failure of Swift Dam and the discharge of the contents of Swift Reservoir into the valley The maximum capacity of the reservoir was approximately 30,000 acre-ft, and evidence suggests that the dam failed suddenly The peak discharge of 881,000 cfs from an area of 105 square miles was determined by indirect measurements near Dupuyer, Mont, which is 17 miles downstream The force of

the flood was remarkably demonstrated on the valley floor of Birch Creek in the half-mile reach directly below the dam. Several large blocks of rockfill material from the dam were moved a quarter to half a mile along the valley floor without being broken up. The stratification in the fill material was still visible in these large blocks in September 1964 (fig. 73). The largest block observed contained approximately 475 cubic yards of material and several others exceeded 100 cubic yards. The angular rock fragments in the fill material from the dam contrast sharply with the rounded cobbles and gravel of the flood plain on which they came to rest. Farther downstream on Birch Creek north of Valier, the channel was widened approximately 70 feet near the bridge crossing, and scour of the channel bed into bedrock probably exceeded 5 feet.

FIGURE 73.—Block of earthfill material from Swift Dam on Birch Creek that was carried intact from the damsite downstream about one-half mile by the flood. Stratification of earth fill is still discernible. Note the contrast in the blocky material from the dam and the rounded cobbles on the flood plain.

DETERMINATION OF FLOOD DISCHARGES

The operation of a stream gaging station consists principally of the measurement of stage and discharge and the definition of the stage-discharge relation from which discharge can be calculated for a given stage The development of a stage-discharge relation is based upon current-meter measurements throughout the range of stage experienced, or through a sufficient part of the range so that the discharge corresponding to the maximum stage can be obtained by a reasonable extension of the stage-discharge relation, or rating curve Short extensions of a rating curve are usually made by logarithmic plotting, from velocity-area studies, or by the use of other hydraulic or hydrologic principles.

Because of the record-breaking magnitude of the June 1964 floods, it was impossible to obtain current-meter measurements at or near peak stage at many of the gaging stations In some places, measuring facilities were destroyed, in others, access roads and bridges were flooded or washed out; and in some of the small streams, the durations of the flood peaks were too short to permit measurement.

For many of the gaging stations at which no high-water current-meter measurements were made and for ungaged sites where peak discharge data were desired, peak discharges were obtained by slope-area measurements, contracted-opening measurements, or other types of indirect discharge measurements These indirect measurements are based on channel geometry and high-water profiles obtained by field survey and are computed by established hydraulic principles They are indirect only in the sense that the data are collected subsequent to the passage of the peak discharge A general description of the indirect measurement methods used by the Geological Survey is given by Johnson (1936), Dalrymple and others (1937), and Corbett and others (1943) More detailed information concerning the latest techniques is available in recent reports by Kindsvater and others (1953), Bodhaine (1963), and Tracy (1957)

SUMMARY OF FLOOD STAGES AND DISCHARGES

Maximum stages and discharges at 204 gaging stations, crest-stage stations, miscellaneous sites, and reservoir stations are summarized in table 19 The reference numbers in the table correspond to those on the location map (fig. 2) and aid in locating the sites at which peak discharges were determined

The derivation of the maxima data is explained in the station descriptions for each site The peak discharges in table 19 are those ac-

tually determined; that is, no adjustments for storage, regulation, or diversion have been made For reservoir stations the maximum stage and contents are given, and for some, the computed peak inflow is given

Explanation of data in the 13 columns in table 19 follows

Number.—The number by which each station is identified at references in this report. The numerical order follows the Geological Survey's standard downstream order of listing stations

Permanent station number—The number used in the Geological Survey's water-supply papers of surface-water supply in the United States and the annual reports of surface water records of Montana Blank spaces in the column indicate that a station is at a miscellaneous site or is a station operated by Canada, and no number has been assigned to it. The number for each station includes the part (Geological Survey's geographical division of principal river basins) number Station 1–19 are in Part 5 (Hudson Bay basin), stations 20–142 are in Part 6–A (Missouri River basin above Sioux City, Iowa), and stations 143–204 are in Part 12 (Pacific slope basins in Washington and upper Columbia River basin).

Stream and place of determination.—The permanent name adopted for the site to which the listed data apply, each name is unique

Drainage area—The gross drainage area, in square miles, above the station site as determined by the topography

The last nine columns of the table give data for all known floods at the site

Period.—The period of known floods prior to June 1964 This period does not necessarily correspond to that in which continuous records of discharge were obtained, but for many records it extends back to an earlier date

Year—The calendar year, in the period of known floods before June 1964, of the maximum stage or discharge

Date.—The date of the maximum stage or discharge during the floods of June 1964

Gage height and discharge—Data in each pair of columns are associated with the year or date in the preceding column The 1964 peak discharges, in cubic feet per second per square mile, have been given for sites not significantly affected by regulations or diversions

Recurrence interval—The average interval of time in which the peak discharge of June 1964 can be expected to be equaled or exceeded once Where the recurrence interval is greater than 50 years, the ratio of the peak discharge to the discharge of the 50-year flood is shown

EXPLANATION OF STATION DATA

The main purpose of a flood report is presentation of stage and discharge data on streams These data are presented in the following section in sufficient detail so that the hydrographs of the flood peaks may be accurately constructed The hydrologist who needs more detailed data may find them in the Helena district office of the Geological Survey

The data consist of a description of the station or site, a table showing the daily discharge at gaging stations for May–June 1964, and tables of stages and discharges at indicated times for many of the gaging stations

The station description gives information relative to the location of the gage, size of the drainage basin above the gage, nature of the gage-height record obtained during the period covered by this report, datum of gage, definition of the stage-discharge relation, maximum stage and discharge during the June 1964 floods and previous maximum during the period of record, maxima data for floods outside the period of record, effect of regulation and diversion, and other pertinent general information

The table of daily mean discharge gives data for the 2-month period, May–June 1964, to cover not only the period of major flooding but a sufficient length of time to show discharges during antecedent and recession periods. The monthly figures of the table show the monthly mean discharge, in cubic feet per second, the volume of monthly runoff, in acre-feet, and the volume of monthly runoff, in inches, at selected stations. Monthly figures for a few stations downstream from a reservoir have been adjusted for change in contents of the reservoir

The table of stages and discharges at indicated times gives sufficient data so that hydrographs of stage and discharge can be drawn. The period of time covered is from prior to the start of the major rise to an arbitrary cutoff point on the recession and is not the same for all stations.

The stages and associated discharges given should not be used in preparation of a stage-discharge relation (rating curve) for use outside the flood period For many stations the relation used to compute the discharge was shifted from the basic rating for various reasons, such as backwater from debris blockage or other changes in control conditions.

Table 19 --Summary of flood stages and discharges

No	Permanent station number	Stream and place of determination	Drainage area (sq mi)	Maximum previously known				Maximum June 1964				
				Period	Year	Gage height (feet)	Discharge (cfs)	Day	Gage height (feet)	Discharge		
										Cfs	Cfs per sq mi	Recurrence interval (years)
		Saskatchewan River basin										
1	5-100	Belly River at international boundary	74 8	1947-64	1953	6 66	2,450	8	10 16	12,000	160	a 3 10
2	5-107	Mountain View Irrigation District Canal, near Mountain View, Alberta	-	1935-64	1961	-	b 155	8	-	b 162	-	-
3	5-110	Belly River near Mountain View, Alberta	121	1908	1908	12	(c)	-	-	-	-	-
				1911-64	1953	6 64	4,500	8	11 40	16,400	136	a 2 93
4	5-115	Waterton River near international boundary	61 0	1947-64	1954	6 51	2,710	8	11 55	12,400	203	a 3 77
5	5-120	Street Creek at international boundary	6 0	1947-55	1953	4 5	437	8	13 6	5,740	957	a 10 3
6	5-125	Boundary Creek at international boundary	21 0	1947-64	1950	5 34	-	8	-	5,930	282	a 4 01
					1953	-	904	-	-	-	-	-
7	-	Waterton Lake at Waterton Park, Alberta d/	146	1950-64	1953	4,199 5	-	9	4,206 76	-	-	-
8	5-130	Waterton River near Waterton Park, Alberta	238	1908-64	1908	e9 5	24,000	9	9 22	25,700	108	a 2 72
9	5-140	Grinnell Creek near Many Glacier	3 47	1949-64	1950	3 45	242	8	4 88	536	154	a 1 43
10	5-145	Swiftcurrent Creek at Many Glacier	31 4	1912-64	1937	f 6 89	2,250	8	f 10 00	6,700	213	a 3 38
11	5-155	Lake Sherburne at Sherburne	63 7	1915-64	1961	4,788 1	g 66,370	11	4,780 88	g 54,320	-	-
								8	-	h 10,000	157	a 2 95
12	5-160	Swiftcurrent Creek at Sherburne	64 3	1912-64	1916	e 7 85	i 2,280	11	8 37	i 2,360	-	-
13	5-175	St Mary River near Babb	278	1902, 1911-25, 1951-64	1902	e 6 50	9,300	8	12 96	i 16,500	59 4	a 1 56
14	5-185	St Mary Canal at St Mary Crossing, near Babb	-	1918-64	1936	-	b 767	7	-	b 706	-	-
15	5-190	St Mary Canal at Hudson Bay Divide, near Browning	-	1917-64	1937	-	b 758	8	-	b 816	-	-
16	5-200	Kennedy Creek near Babb	60 6	jk1905	-	-	-	8	-	15,000	248	a 4 56
17	5-205	St Mary River at international boundary	469	1902-64	1908	e 12 75	40,000	8	12 06	i 21,000	-	-
18	-	Rolph Creek near Kimball, Alberta d/	90 6	1911-16, 1935-64	1953	7 21	1,290	8	4 80	630	6 95	1
19	-	Lee Creek at Cardston, Alberta d/	117	1909-14, 1920-64	1951	10 49	7,820	8	12 59	11,400	97 4	a 2 10
		Missouri River main stem										
20	6-545	Missouri River at Toston	14,669	1890, 1910-16, 1941-64	1948	11 77	32,000	12	10 00	22,000	1 50	5
		Deep Creek basin										
21	6-566	Deep Creek below North Fork Deep Creek, near Townsend	87 7	1959-64	1964	2 33	329	8	2 21	296	3 38	4

		Missouri River main stem										
22	6-570	Missouri River near Townsend	15,343	1892-1916, 1948-64	1894 1963	3,811 7 f 3,813	38,400 -	13 -	3,809 6 -	22,900 -	1 49 -	5 -
23	6-585	Canyon Ferry Reservoir near Helena	15,904	1953-64	(k)	3,800 00	g2,043,000	23	3,800 00	g2,043,000	-	-
		Spokane Creek basin										
24	6-587	Mitchell Gulch near East Helena	8 09	1959-64	1963	1 41	107	-	-	0	-	-
		Prickly Pear Creek basin										
25	6-615	Prickly Pear Creek near Clancy	192	1909-16, 1921-33, 1945-64	1927	-	900	9	6 01	700	3 65	8
26	6-617	Jackson Creek near East Helena	3 44	1961-64	1962	2 49	16	8	2 64	19	5 52	-
27	6-618	Crystal Creek near East Helena	3 77	1961-64	1964	1 52	16	8	1 64	21	5 57	-
28	6-619	McClellan Creek at city diversion dam, near East Helena	33 2	1960-64	1962	1 48	175	8	2 59	390	11 7	a 1 12
29	6-625	Tenmile Creek near Rimini	32 7	1914-64	1917	e 4 98	781	9	3 77	563	17 2	a 1 63
30	6-627	Little Porcupine Creek tributary near Helena	48	1959-64	1964	74	38	8	1 17	59	12 3	-
31	6-645	Lake Helena near Helena m/ .	610	1945-64	(k)	3,635 60	g 11,790	1	3,634 90	g 10,240	-	-
		Missouri River main stem										
32	6-650	Hauser Lake near Helena m/	16,876	1945-64	(k)	3,635 60	g 53,630	1	3,634 90	g 51,050	-	-
33	6-660	Holter Lake near Wolf Creek	17,149	1936-64	1951	3,564 25	g 83,110	26	3,563 75	g 80,730	-	-
34	6-665	Missouri River below Holter Dam, near Wolf Creek	17,149	1945-64	1948	11 70	i 34,800	19	10 04	i 27,100	1 58	8
		Little Prickly Pear Creek basin										
35	6-711	Little Prickly Pear Creek at Sieben Ranch, near Wolf Creek	270	1962-64	1964	-	b 600	9	5 78	972	3 60	10
36	6-712	Lyons Creek near Wolf Creek	29 4	1959-64	1962	1 57	158	8	3 80	490	16 7	a 1 57
37	6-713	Little Prickly Pear Creek at Wolf Creek	381	1962-64	1964	5 13	1,120	9	7 65	3,110	8 16	a 1 64
		Dog Creek basin										
38	6-714	Dog Creek near Craig	15 9	1959-64	1961	4 40	1,160	8	1 97	65	4 09	-
		Wegner Creek basin										
39	6-716	Wegner Creek at Craig	35 0	1959-64	1961	2 54	408	8	0 54	60	1 71	1
		Dearborn River basin										
40	6-730	Dearborn River near Clemons	m 130	1921-23, 1929-53	1953	6 20	3,200	9	9 15	n 17,400	134	a 3 39
41	-	South Fork Dearborn River near Craig	32 0	-	-	-	-	8	-	1,230	38 4	16
42	-	Auchard Creek near Craig	15 7	-	-	-	-	8	-	353	22 5	4
43	6-735	Dearborn River near Craig	325	1945-64	1953	9 58	7,960	9	13 5	n 15,400	47 4	a 1 59
		Hardy Creek basin										
44	-	Hardy Creek near Cascade	9 46	-	-	-	-	8	-	p 440	46 5	-

See footnotes at end of table

Table 19 --Summary of flood stages and discharges--Continued

No	Permanent station number	Stream and place of determination	Drainage area (sq mi)	Maximum previously known				Maximum June 1964				
				Period	Year	Gage height (feet)	Discharge (cfs)	Day	Gage height (feet)	Discharge		
										Cfs	Cfs per sq mi	Recurrence interval (years)
		Missouri River main stem										
45	6-740	Missouri River at Cascade	18,493	1902-15, 1950-64	1908	e 3,354 2	54,250	26	m 3,348 61	-	-	-
		Smith River basin										
46	6-750	Smith River Reservoir near White Sulphur Springs	72 3	1938-50, 1959-64	1950	5,488 6	g 11,600	(k)	5,488 45	g 11,450	-	-
47	6-756	Five Mile Creek near White Sulphur Springs	6 00	1960-64	1963	2 06	20	8	1 16	8	1 33	-
48	6-760	Newland Creek near White Sulphur Springs	6 74	1946-53, 1960-64	1953	3 50	56	8	2 59	13	1 93	-
49	6-767	Sheep Creek near Neihart	5 30	1960-64	1964	1 67	78	8	2 12	113	21 3	-
50	6-768	Nugget Creek near Neihart	1 48	1959-64	1964	1 07	15	8	77	10	6 76	-
51	6-770	Sheep Creek near White Sulphur Springs	54 4	1941-64	1953	e 5 80	460	9	4 93	362	6 65	15
52	6-775	Smith River near Eden	1,594	1951-64	1953	10 46	12,300	10	5 48	3,860	2 42	17
					1963	f 12 50	-	-	-	-	-	-
53	6-777	Smith River tributary near Eden	1 63	1960-64	1962	72	45	8	24	14	86	-
54	6-778	Goodman Coulee near Eden	21 8	1959-64	1964	4 02	150	8	3 58	110	5 05	-
		Missouri River main stem										
55	6-782	Missouri River near Ulm	20,941	1953	1953	17	35,000	22	14 44	i 27,500	1 31	3
				1957-64	1959	11 26	19,100	-	-	-	-	-
					1959	f 12 20	-	-	-	-	-	-
56	-	Missouri River above Sun River, at Great Falls	21,175	1930-64	1953	3,317 84	-	10	3,318 2	-	-	-
		Sun River basin										
57	6-785	North Fork Sun River near Augusta	258	1911-12, 1945-64	1948	7 03	4,840	8	15 82	51,100	198	a 5 57
58	6-790	South Fork Sun River near Augusta	252	1911-12	1911	4 6	2,740	8	-	28,800	114	a 3 19
59	6-795	Gibson Reservoir near Augusta	575	1930-64	1940	4,725 5	g 107,100	8	4,732 23	g 116,400	-	-
								8	-	h 60,000	104	-
60	6-796	Beaver Creek at Gibson Dam, near Augusta	20 3	1959-64	1962	2 45	496	8	-	4,360	215	a 1 77
61	6-800	Sun River near Augusta	609	1889-90, 1904-64	1916	11 4	32,300	9	15 7	i 59,700	98 0	a 1 96
62	-	South Fork Willow Creek near Augusta	26 9	-	-	-	-	8	-	2,790	104	41
63	-	Sun River at State Highway 287, near Augusta	827	-	-	-	-	9	-	i 46,700	56 5	a 1 23
64	6-835	Ford Creek near Augusta	19 4	1906-12	1909	5 5	1,230	8	-	2,700	139	a 1 99

65	6-840	Smith Creek below Ford Creek, near Augusta	74 0	1945-52	1948	5 7	1,830	8	13 4	6,140	83 0	a 1 96
66	-	Elk Creek near Augusta	145	-	-	-	-	8	-	12,000	82 8	a 2 16
67	-	Sun River at Simms	m 1,224	1941-64	1953	i 3,557 1	-	9	3,561 6	i 69,800	57 0	a 2 84
68	6-879	Muddy Creek tributary near Power	3 15	1963-64	1964	2 26	284	8	2 13	220	69 8	-
69	6-885	Muddy Creek at Vaughn	314	1908	1908	24	(c)	9	12 24	3,720	11 8	25
				1925-26, 1934-64	1953	17 7	7,600	-	-	-	-	-
70	6-890	Sun River near Vaughn	1,854	1908	1908	20 4	(c)	-	-	-	-	-
				1934-64	1953	16 38	i 17,900	9	23 4	i 53,500	28 9	a 1 61
71	6-893	Sun River tributary near Great Falls	21 1	1956-64	1964	3 94	215	8	5 46	470	22 3	4
72	-	Sun River at Great Falls	1,937	1908	1908	3,328	-	10	13,324 6	-	-	-
		Missouri River main stem										
73	6-903	Missouri River near Great Falls	23,292	1953, 1956-64	1953	-	66,600	10	-	q 72,000	3 09	40
		Belt Creek basin										
74	6-905	Belt Creek near Monarch	368	1951-64	1953	10 12	r 11,000	9	s 7 91	4,710	12 8	18
		Highwood Creek basin										
75	-	Highwood Creek near Highwood	75 2	1953	1953	-	9,210	8	-	1,830	24 3	a 2 99
		Missouri River main stem										
76	6-908	Missouri River at Fort Benton	24,749	1890-1964	1908	18 5	140,000	10	13 44	i 77,400	3 13	36
		Marias River basin										
77	-	Two Medicine Creek above Trick Falls, near East Glacier	26 8	-	-	-	-	8	-	13,600	507	a 7 95
78	-	Dry Fork Two Medicine Creek near East Glacier	7 66	-	-	-	-	8	-	3,940	514	-
79	6-909	Lower Two Medicine Lake near East Glacier	50 2	1938-64	1944	4,875 67	g 14,800	8	4,883 3	g 20,930	-	-
80	6-910	Two Medicine River near East Glacier	51 1	1912, 1918-24, 1962-64	1918	e 7 85	i 1,390	8	-	t 63,500	-	-
81	-	South Fork Two Medicine River near East Glacier	78 2	-	-	-	-	8	-	25,600	327	a 6 75
82	6-920	Two Medicine River near Browning	317	1907-24, 1951-64	1907	e 8 6	p 7,950	8	s 14 0	100,000	315	a 9 35
83	6-925	Badger Creek near Browning	133	1951-64	1953	6 28	4,220	8	10 37	49,700	374	a 8 78
84	-	North Fork Birch Creek near Dupuyer	19 0	-	-	-	-	8	-	8,890	468	a 6 68
85	-	South Fork Birch Creek near Dupuyer	25 3	-	-	-	-	8	-	9,770	386	a 5 92
86	6-940	Swift Reservoir near Dupuyer	75 3	1916	1916	4,959 94	g 36,070	8	4,956 30	g 34,300	-	-
				1936-64	1953	4,948 38	g 30,620	-	-	-	-	-
87	6-950	Birch Creek near Dupuyer	105	1909-37	1916	10 0	p 17,000	8	-	t 881,000	-	-
88	-	Blacktail Creek near Dupuyer	62 7	1948	1948	-	4,680	8	-	3,730	59 5	a 1 16
89	-	Cartwright Coulee near Valier	21 8	1948	1948	-	2,890	8	-	m 2,950	135	a 3 35
90	6-980	Dupuyer Creek near Valier	m 129	1912-37 1948	1934 1948	7 40 -	3,330 7,370	8 -	- -	21,600 -	167 -	a 7 91 -

See footnotes at end of table

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Table 19 --Summary of flood stages and discharges--Continued

No	Permanent station number	Stream and place of determination	Drainage area (sq mi)	Maximum previously known				Maximum June 1964				
				Period	Year	Gage height (feet)	Discharge (cfs)	Day	Gage height (feet)	Discharge		
										Cfs	Cfs per sq mi	Recurrence interval (years)
		Marias River basin--Continued										
91	-	Laughlin Coulee near Valier	8 4	1948	1948	-	820	8	-	912	109	-
92	-	Two Medicine River below Birch Creek, near Ethridge	1,288	-	-	-	-	9	-	t 204,000	-	-
93	-	Willow Creek at Browning	23 6	-	-	-	-	8	-	1,230	52 1	a 1 34
94	6-990	Cut Bank Creek at Cut Bank	1,065	1905-20, 1922-24, 1951-64	1908	e 11 04	10,400	9	s 14 2	16,600	15 6	a 1 55
95	6-995	Marias River near Shelby	m3,242	1902-7, 1911-64	1948	17 75	40,000	9	23 64	t 241,000	-	-
96	6-997	Middle Fork Dry Fork Marias River near Dupuyer	20 2	1960-64	1964	s 4 57	401	8	s 6 56	4,240	210	a 5 08
97	-	Lake Frances tributary near Valier	083	1948	1948	-	20	8	-	39	470	-
98	6-1002	Heines Coulee tributary near Valier	60	1960-64	1960	1 20	9	8	s 10 57	64	107	-
99	-	Lone Man Coulee above Miller Coulee, near Valier	11 3	1948	1948	-	1,820	8	-	1,460	129	a 2 52
100	-	Miller Coulee near Valier	1 91	1948	1948	-	197	8	-	282	148	-
101	6-1003	Lone Man Coulee near Valier	14 1	1960-64	1964	m 72	180	8	m 2 38	m 1,740	123	a 2 60
102	-	Dry Fork Marias River at Ledger	m 263	1948	1948	-	13,000	8	-	7,870	29 9	a 1 79
103	6-1013	Tiber Reservoir near Chester	m4,923	1955-64	1959	2,986 47	g 834,800	13	3,001 91	g1,116,000	-	-
								9	-	ht 200,000	40 6	-
104	6-1015	Marias River near Chester	m4,927	1921, 1945-47, 1955-64, 1948	1947 1948	(c) 16	(c) (c)	16 -	10 63 -	10,400 -	- -	- -
105		Pondera Coulee near Chester	598	-	-	-	-	8	-	1,950	3 26	3
106	6-1016	Marias River tributary No 3 near Chester	32	1962-64	1962	3 18	29	8	1 37	11	34 4	-
107	6-1017	Cottonwood Creek tributary near Chester	2 28	1963-64	1963	4 08	99	8	98	10	4 39	-
108	6-1018	Cottonwood Creek tributary No 2 near Chester	24 6	1963-64	-	-	0	8	2 35	75	3 05	-
109	6-1019	Dead Indian Coulee near Fort Benton	2 73	1963-64	1964	2 19	13	8	64	2	-	-
110	6-1020 5	Marias River near Loma	m6,995	1908	1908	(u)	70,000	16	8 72	i 10,800	-	-
				1959-64	1961	4 62	3,050	-	-	-	-	-
111	6-1021	Dry Fork Coulee tributary near Loma	84	1959-64	1959	4 02	71	-	-	0	-	-
112	6-1022	Marias River tributary at Loma	1 62	1956-64	1962	2 11	20	-	-	0	-	-
113	6-1023	Marias River tributary No 2 at Loma	25	1956-64	1956	2 97	20	-	-	0	-	-
114	6-1025	Tenton River near Farmington	105	1947-54	1948	5 32	2,780	8	-	54,600	520	all 5
					1950	f 7 34	-	-	-	-	-	-
115	6-1058	Bruce Coulee tributary near Choteau	1 70	1963-64	1963	65	18	8	1 76	148	87 1	-
116	6-1060	Deep Creek near Choteau	m 269	1911-24	1916	10 5	3 700	8	-	41,800	155	a 4 40
117	-	Teton River below Deep Creek, near Choteau	510	-	-	-	-	8	-	64,300	126	a 4 20

118	-	Muddy Creek near Collins	385		-	-	--	-	8	-	13,900	36 1	a 2 50
119	6-1080	Teton River near Dutton	1,308		1954-64	1958	5 96	1,310	9	19 8	71,300	54 5	a 5 80
						1959	e 8 68	-	-	-	-	-	-
120	6-1082	Kinley Coulee near Dutton	9	67	1963-64	1964	3 74	139	21	8 0	364	37 6	20
121	6-1083	Kinley Coulee tributary near Dutton	2	65	1963-64	1964	2 28	49	8	2 98	76	28 7	-
122	-	Teton River near Carter	1,762		-	-	-	-	9	-	84,300	47 8	a 5 73
		Missouri River main stem											
123	6-1095	Missouri River at Virgelle	34,379		1908	1908	25 4	(c)	10	21 27	i 105,000	3 05	25
					1935-64	1953	p 23 4	i 122,000	-	-	-	-	-
		Judith River basin											
124	6-1098	South Fork Judith River near Utica	58	7	1958-64	1962	4 90	277	8	s 7 4	v 1,290	22 0	a 2 48
125	6-1100	Judith River near Utica	328		1919-64	1927	5 70	1,120	9	5 77	1,070	3 26	9
126	6-1117	Casino Creek tributary near Lewistown	3	53	1960-64	1964	3 67	44	8	3 27	40	11 3	-
127	6-1121	Cottonwood Creek near Moore	47	9	1957-64	1962	6 77	683	9	7 68	1,220	25 5	a 1 54
		Missouri River main stem											
128	6-1150	Missouri River at powerplant ferry, near Zortman	40,763		1934-64	1947	f 30 16	-	11	19 74	i 114,700	2 81	30
						1953	22 20	i 137,000	-	-	-	-	-
		Musselshell River basin											
129	6-1305	Musselshell River at Mosby	7,846		1929-32, 1934-64	1944	e 14 43	i 18,000	21	10 00	i 4,920	0 63	2
		Missouri River main stem											
130	6-13-15	Fort Peck Reservoir at Fort Peck	57,500		1937-64	1948	2,244 80	w 18,170	30	2,231 5	w 15,220	-	-
		Milk River basin											
131	6-1322	South Fork Milk River near Babb.	68	6	1961-64	1963	f 5 33	500	8	6 61	12,000	175	a 6 49
132	6-1322 5	Livermore Creek near Babb	25	0	1962-64	1962	3 43	152	8	-	4,880	195	a 5 08
133	-	South Fork Milk River below Livermore Creek, near Babb	101		-	-	-	-	8	-	14,900	148	a 6 34
134	6-1323	Middle Fork Milk River near Babb	14	0	1962-64	1962	2 62	107	8	2 96	558	39 9	30
135	6-1324	Dry Fork Milk River near Babb	17	4	1962-64	1962	3 96	394	8	5 20	1,880	108	a 2 44
136	6-1327	Milk River near Del Bonita	325		1905-30, 1962-64	1908	e 15 4	13,000	8	9 0	17,300	53 2	a 3 47
137	6-1330	Milk River at western crossing of the international boundary	397		1931-64	1948	e 6 83	4,750	9	9 77	7,930	20 0	a 1 40
138	6-1335	North Fork Milk River above St Mary Canal, near Browning	61	8	1911-64	1953	7 55	2,120	8	4 91	653	10 6	6
139	6-1340	North Milk River near international boundary	91	8	1909-64	1948	e 6 47	2,950	8	7 98	1,940	21 1	36
140	6-1345	Milk River at Milk River	1,036		1909-64	1927	11 41	8,730	9	10 40	8,110	7 83	26
141	6-1348	Van Cleeve Coulee tributary near Sunburst	10	8	1963-64	1964	2 08	35	-	-	0	-	-
142	6-1350	Milk River at eastern crossing of international boundary	2,588		1909-64	1952	9 34	9,530	11	6 71	7,770	3 00	16
						1952	f 13 65	-	-	-	-	-	-

See footnotes at end of table

Table 19 --Summary of flood stages and discharges--Continued

No	Permanent station number	Stream and place of determination	Drainage area (sq mi)	Maximum previously known				Maximum June 1964				
				Period	Year	Gage height (feet)	Discharge (cfs)	Day	Gage height (feet)	Discharge		
										Cfs	Cfs per sq mi	Recurrence interval (years)
		Pend Oreille River basin										
143	-	Landers Fork above Copper Creek, near Lincoln	78 0	-	-	-	-	9	-	5,120	65 6	a 4 73
144	-	Copper Creek near Lincoln	40 8	-	-	-	-	8	-	803	19 7	a 1 75
145	12-3355	Nevada Creek above reservoir, near Finn	116	1939-64	1953	e 6 00	1,800	9	4 22	524	4 52	5
					1953	e f 7 40	-	-	-	-	-	-
146	12-3380	North Fork Blackfoot River near Ovando	228	1921-23	1922	7 58	2,900	8	-	11,800	51 8	a 3 43
				1948	1948	9 0	4,380	-	-	-	-	-
147	12-3398	Blackfoot River near Potomac	2,046	1957-64	1959	8 54	10,900	10	11 33	17,500	8 55	a 1 40
148	12-3399	West Twin Creek near Bonner	7 47	1959-64	1961	91	128	8	1 10	150	20 1	-
149	12-3400	Blackfoot River near Bonner	2,290	1899-1901, 1903-5, 1940-64	1953	e 11 65	18,300	10	10 89	19,200	8 38	a 1 35
150	12-3402	Marshall Creek near Missoula	5 47	1959-64	1964	1 05	50	8	28	10	1 83	-
151	12-3405	Clark Fork above Missoula	5,999	1908	1908	(c)	48,000	10	13 35	31,700	5 28	a 1 22
				1929-64	1948	13 07	31,500	-	-	-	-	-
152	12-3410	Rattlesnake Creek at Missoula	79 7	1899,	1899	e 6 25	2,050	8	10 15	1,830	23 0	a 1 99
				1958-64, 1948	1948	-	u 2,400	-	-	-	-	-
153	12-3530	Clark Fork below Missoula	9,003	1929-64	1948	12 08	52,800	10	11 45	50,100	5 56	a 1 03
154	12-3534	Nigger Gulch near Alberton	8 02	1959-64	1964	82	50	9	1 01	67	8 35	-
155	12-3538	Thompson Creek near Superior	12 2	1961-64	1962	82	85	8	40	72	5 90	-
156	12-3538 5	East Fork Timber Creek near Haugan	2 72	1961-64	1962	-	45	8	71	32	11 8	-
					1964	87	-	-	-	-	-	-
157	12-3540	St Regis River near St Regis	303	1910-17, 1958-64	1917	e 8 65	7,740	8	6 16	5,120	16 9	4
				1933	1933	14 5	(c)	-	-	-	-	-
				1954	1954	9 4	11,000	-	-	-	-	-
158	12-3541	North Fork Little Joe Creek near St Regis	14 7	1960-64	1961	1 88	185	8	1 91	212	14 4	-
159	12-3545	Clark Fork at St Regis	10,709	1910-64	1948	19 96	68,900	10	18 54	60,900	5 69	47
160	12-3550	Flathead River at Flathead, British Columbia	450	1929-64	1948	9 1	14,600	8	s 8 6	16,300	36 2	a 1 20
161	-	Trail Creek near Polebridge	64 6	-	-	-	-	8	-	2,100	32 5	4
162	-	Bowman Creek near Polebridge	44 0	-	-	-	-	8	-	2,780	63 2	a 2 14
163	-	Big Creek at Big Creek ranger station, near West Glacier	84 2	-	-	-	-	8	-	2,130	25 3	6
164	12-3555	Flathead River near Columbia Falls	1,548	1910-17, 1929-64	1954	e 12 25	31,500	9	18 60	69,100	44 6	a 2 06
165	12-3557	Middle Fork Flathead River near Essex	408	1957-61	1959	11 32	10,500	8	-	57,900	142	a 3 34
166	12-3560	Skyland Creek near Essex	8 09	1946-52, 1954, 1959-64	1948	2 15	284	8	9 55	3,580	443	-

167	12-3565	Bear Creek near Essex	20 7	1946-52	1948	3 01	696	8	7 2	8,380	405	a 8 67
168	12-3570	Middle Fork Flathead River at Essex	510	1939-54, 1956-64	1954	12 7	18,000	8	26 7	75,300	148	3 94
169	-	Essex Creek at Essex	10 5	-	-	-	-	8	-	2,760	263	-
170	-	Park Creek at Essex	39 4	-	-	-	-	8	-	7,180	182	a4 40
171	-	Wahoo Creek near West Glacier	1 05	-	-	-	-	8	-	161	153	-
172	12-3573	Moccasin Creek near West Glacier	1 97	1959-64	1960	-	120	8	-	(x)	-	-
					1961	1 43	-	-	-	-	-	-
173	-	Ousel Creek near West Glacier.	2 92	-	-	-	-	8	-	4,160	1,420	-
174	12-3574	Middle Fork Flathead River tributary at West Glacier	10	1960-64	1960	27	3	8	32	8	80 0	-
175	-	McDonald Creek above Lake McDonald, near West Glacier	109	-	-	-	-	8	-	21,200	194	a4 61
176	12-3585	Middle Fork Flathead River near West Glacier	1,128	1939-64	1954	13 01	34,500	9	36 46	140,000	124	a4 23
177	-	Bruce Creek near Hungry Horse	16 0	-	-	-	-	8	-	988	61 8	-
178	12-3590	South Fork Flathead River at Spotted Bear ranger station, near Hungry Horse	958	1948-57, 1959-64	1948	14 00	22,000	8	s 19 5	36,700	38 3	a1 25
179	12-3595	Spotted Bear River near Hungry Horse	184	1948-56	1954	7 40	5,480	8	s 14 47	20,200	110	a 2 20
180	12-3598	South Fork Flathead River above Twin Creek, near Hungry Horse	1,160	-	-	-	-	8	20 87	50,900	43 9	a 1 54
181	12-3600	Twin Creek near Hungry Horse	47 6	1948-56	1954	8 33	2,790	8	s 13 1	5,830	122	a 2 54
182	12-3605	Lower Twin Creek near Hungry Horse	22 2	1948-56	1948	5 25	1,200	8	-	5,110	230	a 3 70
183	12-3606	Soldier Creek near Hungry Horse	4 77	-	-	-	-	8	5 7	206	43 2	-
184	12-3610	Sullivan Creek near Hungry Horse	71 3	1948-56, 1959-64	1954	5 29	2,750	8	s 8 3	5,020	70 4	a1 46
185	-	Logan Creek near Hungry Horse	5 18	-	-	-	-	8	-	2,310	446	-
186	12-3615	Graves Creek near Hungry Horse	27 0	1948-56	1950	e 5 70	1,520	8	s 7 0	2,710	100	a1 63
187	12-3618 8	Wounded Buck Creek near Hungry Horse	13 6	-	-	-	-	8	10 8	706	51 9	-
188	12-3619 6	Emery Creek near Hungry Horse	26 4	-	-	-	-	8	3 39	832	31 5	2
189	12-3620	Hungry Horse Reservoir near Hungry Horse	1,654	1951-64	1955	3,561 40	w 3,461	30	3,560 58	w 3,429	-	-
								8	-	h 78,000	42 9	a1 39
190	12-3625	South Fork Flathead River near Columbia Falls	1,663	1910-16, 1923-64	1916	e 16 6	46,200	25, 26	13 34	i 18,000	-	-
191	12-3630	Flathead River at Columbia Falls	4,464	1894	1894	22 7	142,000	9	25 58	i 176,000	-	-
				1922-23, 1928-64	1948	19 08	102,000	-	-	-	-	-
192	12-3639	Rock Creek near Olney	6 18	1961-64	1964	1 29	25	8	81	11	1 78	-
193	12-3650	Stillwater River near Whitefish	524	1930-50	1948	20 90	4,330	9	10 98	1,480	2 82	1
194	12-3660	Whitefish River near Kalispell	170	1928-50	1948	-	1,290	9	3 68	1,400	8 24	26
					1950	4 45	-	-	-	-	-	-
195	-	Swan River at Stroms Store, near Condon	146	1948	1948	-	1,350	8	-	1,670	11 4	3
196	12-3700	Swan River near Bigfork	671	1922-64	1948	7 12	8,400	10	6 98	8,100	12 1	14
197	12-3705	Dayton Creek near Proctor	20 9	1959-64	1961	3 00	93	8	1 06	29	1 39	1
198	12-3709	Teepee Creek near Polson	2 55	1960-64	1961	90	22	8	2 15	44	17 3	-
199	12-3711	Hell Roaring Creek near Polson	6 41	1917-32, 1948, 1960-64	1917	e 2 4	104	8	1 73	98	15 3	-
200	12-3715	Flathead Lake at Somers	7,086	1894	1894	2,900	-	12	2,894 27	w 1,952	-	-
				1909-64	1933	2,896 26	w 2,208	10	-	h 128,000	-	-

Table 19 --Summary of flood stages and discharges--Continued

No	Permanent station number	Stream and place of determination	Drainage area (sq mi)	Maximum previously known				Maximum June 1964				
				Period	Year	Gage height (feet)	Discharge (cfs)	Day	Gage height (feet)	Discharge		
										Cfs	Cfs per sq mi	Recurrence interval (years)
		Pend Oreille River basin--Continued										
201	12-3720	Flathead River near Polson	7,096	1894	1894	21	110,000	12	17 99	1 66,800	-	-
				1907-64	1928	e 17 2	82,800	-	-	-	-	-
202	12-3743	Mill Creek near Niarada	28 0	1959-64	1961	1 42	140	8	62	24	86	1
203	12-3757	South Fork Garden Creek near Hot Springs	3 29	1959-64	1964	1 02	45	8	93	40	12 2	-
204	12-3890	Clark Fork near Plains	19,958	1910-64	1948	19 17	134,000	11	17 48	1 128,000	-	-

a Ratio of peak discharge to 50-year flood
b Daily mean discharge
c Unknown
d Canadian gaging station
e At different site or datum, see station description
f Affected by backwater, see station description
g Contents, in acre-feet
h Computed rate of peak inflow
i Affected or regulated by reservoirs
j Record incomplete, see station description
k More than once, see station description
m See station description
n Exceeds and is highest since flood of June 1908
p Flood of June 1908 was higher, see station description
q Highest since June 1908
r Flood of June 1908 was several feet lower
s From outside floodmark, see station description
t Affected by dam failure
u Greatest known, at site upstream, see station description
v Highest since 1927
w Contents, in thousands of acre-feet
x Debris movement in extremely steep channel may have affected floodmarks surveyed, indicated discharge in excess of 10,000 cfs

STATION DATA

SASKATCHEWAN RIVER BASIN

(1) 5-100 Belly River at international boundary

(International gaging station)

Location --Lat 48°59'50", long 113°40'50", in NW¼ sec 2, T 37 N , R 16 W (unsurveyed), on right bank 200 ft upstream from international boundary, 11 miles southeast of Waterton Park, Alberta, and 15 miles northwest of Babb, Mont

Drainage area --74 8 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 4,500 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 1,000 cfs and extended above by logarithmic plotting, and on basis of records for station near Mountain View, Alberta

Maxima --June 1964 Discharge, about 12,000 cfs 1900 hours June 8 (gage height, 10 16 ft)
1947 to May 1964 Discharge 2,450 cfs June 4, 1953 (gage height, 6 66 ft)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	-	685	11	-	2,080	21	1,210	888
2	-	758	12	400	1,810	22	1,040	856
3	-	934	13	466	1,740	23	771	868
4	-	1,200	14	483	1,690	24	612	1,000
5	-	1,350	15	466	1,500	25	510	1,110
6	-	1,410	16	457	1,310	26	461	1,080
7	-	1,570	17	527	1,180	27	457	1,020
8	-	8,200	18	691	1,100	28	510	998
9	-	7,830	19	830	1,010	29	604	842
10	-	3,520	20	1,050	946	30	645	715
						31	655	- - - - -
Monthly mean discharge, in cubic feet per second							-	1,707
Runoff, in inches							-	25 46
Runoff, in acre-feet							-	101,600

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	4 81	1,380	June 8	1200	9 31	9,410	June 9	1200	8 66	7,590
	0600	4 80	1,370		1500	9 92	11,200		1600	8 26	6,590
	0900	4 83	1,390		1800	10 12	11,900		2000	7 86	5,660
	1500	5 03	1,570		1900	10 16	12,000		2400	7 51	4,920
	1800	5 18	1,700		2000	10 15	12,000				
	2400	5 63	2,140		2200	10 10	11,800	10	1200	6 60	3,360
					2400	9 97	11,400		1800	6 23	2,860
8	0200	6 00	2,570						2400	5 95	2,510
	0400	6 62	3,390	9	0400	9 57	10,200				
	0600	7 29	4,490		0800	9 10	8,790				

(2) 5-107 Mountain View Irrigation District Canal near Mountain View, Alberta

(International gaging station)

Location --Lat 49°06'00", long 113°41'30", in NW¼ sec 4 , T 2, R 28 W , fourth meridian, in Alberta, on left bank 1½ miles downstream from headgate, 5 miles southwest of Mountain View, and 7 miles north of international boundary

Gage-height record --Water-stage recorder graph Datum of gage is 4,377 26 ft above mean sea level (Irrigation Surveys datum)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Daily discharge, 162 cfs June 8
1935 to May 1964 Daily discharge 155 cfs June 9, 1961

Mean discharge, in cubic feet per second, 1964, of Mountain View Irrigation District Canal near Mountain View, Alberta

Day	May	June	Day	May	June	Day	May	June
1	2 3	4 0	11	8 4	20 9	21	5 3	6 4
2	14 7	3 5	12	7 0	19 8	22	5 3	5 0
3	33 2	3 5	13	6 7	17 5	23	5 0	4 5
4	19 2	32 8	14	6 4	15 1	24	5 0	3 8
5	12 4	65 9	15	5 3	13 8	25	4 8	36 3
6	7 4	64 8	16	5 3	13 8	26	4 8	41 4
7	8 8	71 4	17	5 3	12 4	27	4 8	29 7
8	7 7	162	18	4 8	10 4	28	5 3	23 2
9	7 7	63 4	19	5 3	10 8	29	5 0	7 0
10	7 7	25 2	20	5 3	6 4	30	4 5	4 8
						31	4 5	- - - - -
Monthly mean discharge, in cubic feet per second							7 59	26 6
Runoff, in acre-feet							467	1,590

(3) 5-110 Belly River near Mountain View, Alberta

(International gaging station)

Location --Lat 49°06', long 113°42', in NE¼ sec 5, T 2, R 28 W , fourth meridian, in Alberta, on right bank 2 miles downstream from intake of Mountain View Irrigation District Canal, 5 miles southwest of Mountain View, and 7 miles north of international boundary

Drainage area --121 sq mi

Gage-height record --Water-stage recorder graph except 1400 hours June 8 to 0600 hours June 9, when graph was reconstructed on basis of high-water mark Datum of gage is 4,344 90 ft above mean sea level (Irrigation Surveys datum)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 16,400 cfs about 1900 hours June 8 (gage height, 11 40 ft from floodmark)
1911 to May 1964 Discharge, 4,500 cfs June 4, 1953 (gage height, 6 64 ft), from slope-area measurement
Flood in June 1908 reached a stage of about 12 ft

Remarks --Natural flow affected by diversion in Mountain View Irrigation District Canal since 1935

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	225	1,030	11	563	2,910	21	1,610	1,310
2	368	1,140	12	585	2,590	22	1,400	1,230
3	693	1,340	13	677	2,380	23	1,110	1,270
4	653	1,550	14	709	2,330	24	886	1,480
5	550	1,660	15	653	2,110	25	725	1,530
6	465	1,730	16	638	1,860	26	645	1,460
7	429	1,970	17	793	1,710	27	661	1,400
8	423	10,700	18	1,040	1,610	28	759	1,360
9	452	9,520	19	1,210	1,490	29	912	1,170
10	550	4,440	20	1,470	1,390	30	972	1,030
						31	989	- - - - -
Monthly mean discharge, in cubic feet per second							768	2,290
Runoff, in acre-feet							47,240	136,300

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	4 05	1,680	June 8	1200	10 12	13,300	June 9	1500	7 32	7,890
	0800	4 05	1,680		1400	10 60	14,400		1800	6 82	7,010
	1200	4 12	1,760		1700	11 10	15,700		2100	6 47	6,430
	1800	4 42	2,160		1900	11 40	16,400		2400	6 15	5,900
	2400	4 89	2,900		2200	10 89	15,200				
					2400	10 51	14,300	10	0600	5 54	4,930
8	0400	5 44	3,800						1200	5 16	4,350
	0700	6 71	6,000	9	0300	9 91	13,000		1800	4 82	3,840
	0900	7 89	8,190		0600	9 40	11,900		2400	4 49	3,340
	1000	8 49	9,490		0900	8 88	10,900				
	1100	9 38	11,500		1200	7 85	8,850				

(4) 5-115 Waterton River near international boundary

(International gaging station)

Location --Lat 48°57'20", long 113°54'00", in NW¼ sec 23, T 37 N , R 18 W (unsurveyed), on right bank 100 ft downstream from Olson Creek, 3 miles south of international boundary, and 7 miles south of Waterton Park, Alberta

Drainage area --61 0 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 4,200 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 1,900 cfs and by slope-area measurement at 12,400 cfs

Maxima --June 1964 Discharge, 12,400 cfs 1700 hours June 8 (gage height, 11 55 ft)
1947 to May 1964 Discharge, 2,710 cfs May 20, 1954 (gage height, 6 51 ft)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	-	1,020	11	-	1,660	21.	1,410	1,010
2	-	1,080	12	-	1,760	22	1,010	1,010
3	-	1,290	13	480	1,680	23	691	1,290
4	-	1,550	14	556	1,670	24	514	1,750
5	-	1,400	15	535	1,590	25	427	1,720
6	-	1,480	16	530	1,460	26	386	1,470
7	-	1,470	17	663	1,370	27	436	1,380
8	-	7,280	18	869	1,200	28	646	1,130
9	-	5,850	19	979	1,100	29	773	887
10	-	2,500	20	1,280	1,090	30	827	863
						31	905	- - - - -
Monthly mean discharge, in cubic feet per second							-	1,734
Runoff, in inches							-	31 71
Runoff, in acre-feet							-	103,200

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Dis-charge	Date	Hour	Gage height	Dis-charge	Date	Hour	Gage height	Dis-charge
June 7	0000	5 13	1,380	June 8	1400	11 09	10,800	June 9	0800	10 24	7,350
	1000	5 18	1,420		1600	11 34	11,700		1200	9 48	5,580
	1600	5 19	1,430		1700	11 55	12,400		1800	8 52	3,980
	2000	5 34	1,550		1900	11 05	10,100		2400	8 07	3,370
	2400	5 67	1,820		2100	10 63	8,540				
					2400	10 31	7,600	10	0600	7 70	2,880
8	0400	6 46	2,590						1200	7 36	2,430
	0800	8 69	5,510	9	0200	10 49	8,100		1800	7 07	2,070
	1200	10 57	9,350		0500	10 57	8,340		2400	6 89	1,870

(5) 5-120 Street Creek at international boundary

(International gaging station, discontinued 1955)

Location --Lat 48°59'20", long 113°52'40", in NE¼ sec 11, T 37 N , R 18 W (unsurveyed), on left bank half a mile upstream from mouth, three-quarters of a mile south of international boundary, and 5 miles south of Waterton Park, Alberta Gage destroyed by flood

Drainage area --6 0 sq mi, approximately

Gage-height record --Floodmarks at gage site Altitude of gage was 4,400 ft (from topographic map)

Discharge record --Peak discharge by slope-area measurement

Maxima --June 1964 Discharge, 5,740 cfs June 8 (gage height 13 6 ft, from flood profile)
1947-55 Discharge, 437 cfs June 3, 1953 (gage height 4 5 ft, from floodmarks)

(6) 5-125 Boundary Creek at international boundary

(International gaging station, discontinued June 1964)

Location --Lat 48°59'50", long 113°54'20", in NE¼ sec 3, T 37 N , R 18 W (unsurveyed), on right bank a quarter of a mile upstream from mouth, a quarter of a mile south of international boundary, and 4 miles south of Waterton Park, Alberta

Drainage area --21 0 sq mi

Gage-height record --Water-stage recorder graph to 1300 hours June 5 Station destroyed by flood on June 8 Altitude of gage is 4,300 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 450 cfs and by slope-area measurement at 5,930 cfs Discharge for June 6,7 estimated on basis of records for nearby stations

Maxima --June 1964 Discharge, 5,930 cfs June 8
1947 to May 1964 Discharge 904 cfs June 4, 1953 (gage height, 5 24 ft), gage height, 5 34 ft June 21 or 22, 1950, from floodmarks

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	-	293	11	-	-	21	363	-
2	-	333	12	-	-	22	232	-
3	-	411	13	164	-	23	178	-
4	-	450	14	162	-	24	149	-
5	-	434	15	140	-	25	132	-
6	-	475	16	140	-	26	129	-
7	-	525	17	191	-	27	155	-
8	-	-	18	237	-	28	188	-
9	-	-	19	284	-	29	209	-
10	-	-	20	349	-	30	224	-
						31	254	- - - - -

(7) Waterton Lake at Waterton Park, Alberta

(Canadian gaging station)

Location --Lat 49°03'15", long 113°54'20", in NE¼ sec 23, T 1, R 30 W , fourth meridian, in Alberta, on boat dock directly behind the National Park offices in the town of Waterton Park

Drainage area --146 sq mi (to Bosporus Narrows)

Gage-height record --Once-daily staff-gage readings at 0800 hours, except May 2, 3, 7-10, 16-18, 23, 24, 30, 31, June 6-16, 18-21, 27, 28, when lake stages were estimated on basis of outflow record at downstream gaging station

Maxima --June 1964 Elevation, 4,206 76 ft, from floodmark, 0200 hours June 9
1950 to May 1964 Elevation 4,199 5 ft June 3, 1953

Remarks --No regulation Records furnished by Department of Northern Affairs and National Resources, Canada

Elevation, in feet, 1964

Day	May	June	Day	May	June	Day	May	June
1	4,193 8	4,197 0	11	4,195 5	4,200 9	21	4,197 8	4,197 4
2	4,194 5	4,197 2	12	4,195 5	4,199 9	22	4,197 9	4,197 67
3	4,195 2	4,197 5	13	4,195 6	4,199 4	23	4,197 5	4,197 67
4	4,195 4	4,198 0	14	4,195 8	4,199 1	24	4,197 0	4,197 95
5	4,195 4	4,198 2	15	4,195 9	4,199 0	25	4,196 7	4,198 23
6	4,195 4	4,198 3	16	4,195 9	4,198 7	26	4,196 4	4,198 28
7	4,195 5	4,198 5	17	4,196 1	4,198 46	27	4,196 2	4,197 8
8	4,195 4	4,203 2	18	4,196 5	4,198 1	28	4,196 3	4,197 7
9	4,195 4	4,206 0	19	4,196 7	4,197 8	29	4,196 4	4,197 65
10	4,195 5	4,203 1	20	4,197 2	4,197 6	30	4,196 6	4,197 45
						31	4,196 8	- - - - -

(8) 5-130 Waterton River near Waterton Park, Alberta

(International gaging station)

Location --Lat 49°07', long 113°50', in NE¼ sec 8, T 2, R 29 W , fourth meridian, in Alberta, on right bank 300 ft downstream from highway bridge, a quarter of a mile upstream from Crooked Creek and 5 miles northeast of Waterton Park

Drainage area --238 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 4,154 19 ft above mean sea level (Irrigation Surveys datum)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 25,700 cfs 0400 hours June 9 (gage height, 9 22 ft) 1908 to May 1964 Discharge, 24,000 cfs June 6, 1908 (gage height, 9 5 ft, at site within 200 ft of present site and at datum then in use, from graph based on gage readings), from rating curve extended above 7,000 cfs by logarithmic plotting

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	331	2,340	11	1,140	8,220	21	3,240	2,790
2	495	2,620	12	1,170	6,230	22	3,170	2,660
3	965	2,940	13	1,280	5,450	23	2,830	2,660
4	1,140	3,370	14	1,390	5,030	24	2,340	2,940
5	1,130	3,690	15	1,420	4,710	25	1,980	3,240
6	1,130	3,870	16	1,420	4,320	26	1,710	3,280
7	1,080	4,130	17	1,570	3,940	27	1,600	3,210
8	1,040	13,700	18	1,850	3,540	28	1,640	3,080
9	1,030	22,700	19	2,160	3,210	29	1,820	2,680
10	1,080	13,400	20	2,680	2,970	30	1,980	2,430
						31	2,140	- - - - -
Monthly mean discharge, in cubic feet per second							1,610	4,980
Runoff, in inches							7 81	23 34
Runoff, in acre-feet							99,080	296,200

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	3 91	3,870	June 8	1300	8 08	19,900	June 10	0600	7 05	15,100
	0600	3 90	3,840		2100	8 66	22,800		1200	6 57	13,100
	1200	3 94	3,940		2400	9 00	24,500		1800	6 18	11,500
	1800	4 08	4,320						2400	5 83	10,100
	2400	4 32	5,000	9	0400	9 22	25,700				
					0600	9 20	25,600	11	0600	5 52	8,960
8	0600	5 00	7,150		1200	8 83	23,700		1200	5 28	8,110
	0900	5 68	9,550		1800	8 18	20,400		1800	5 05	7,320
	1200	6 53	12,900		2400	7 60	17,600		2400	4 92	6,890
	1500	7 39	16,700								

(9) 5-140 Grinnell Creek near Many Glacier, Mont

Location --Lat 48°46'20", long 113°41'50", in SE¼ sec 21, T 35 N , R 16 W (unsurveyed), on right bank 500 ft upstream from trail crossing, 1,000 ft downstream from Grinnell Lake, a quarter of a mile upstream from mouth, 3 miles southwest of Many Glacier, and 13½ miles southwest of Babb

Drainage area --3 47 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 5,000 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 115 cfs and by slope-area measurement at 536 cfs

Maxima --June 1964 Discharge, 536 cfs 1300 hours June 8 (gage height, 4 88 ft) 1949 to May 1964 Discharge, 242 cfs June 22, 1950 (gage height, 3 45 ft), from rating curve extended above 120 cfs by logarithmic plotting

Mean discharge, in cubic feet per second, 1964, of Grinnell Creek near Many Glacier, Mont

Day	May	June	Day	May	June	Day	May	June
1	17	74	11	24	162	21	79	90
2	24	80	12	24	192	22	59	86
3	24	103	13	28	157	23	37	98
4	22	117	14	27	121	24	26	115
5	18	115	15	24	108	25	22	107
6	16	113	16	27	95	26	21	93
7	14	119	17	39	96	27	27	83
8	12	342	18	47	90	28	42	71
9	15	334	19	55	85	29	65	64
10	26	196	20	72	94	30	61	66
						31	62	- - - - -
Monthly mean discharge, in cubic feet per second							34 1	122
Runoff, in inches							11 32	3,929
Runoff, in acre-feet							2,090	7,270

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	2 34	110	June 8	1100	4 20	395	June 9	0400	4 02	361
	1200	2 35	112		1200	4 65	486		0800	4 19	393
	1500	2 37	114		1300	4 88	536		1000	4 00	357
	1800	2 45	122		1400	4 50	455		1100	4 11	378
	2100	2 59	139		1500	4 40	435		1200	4 06	368
	2400	2 77	161		1800	4 25	405		1400	3 90	339
					2100	4 11	378		1800	3 73	308
8	0300	3 08	203		2400	3 92	343		2400	3 37	248
	0600	3 40	253								
	0900	3 79	319	9	0100	4 00	357	10	1200	2 97	188
	1000	4 00	357		0200	3 75	312		1800	2 86	173
									2400	2 81	166

(10) 5-145 Swiftcurrent Creek at Many Glacier, Mont

(International gaging station)

Location --Lat 48°48'10", long 113°39'20", in SE¼ sec 11, T 35 N , R 16 W (unsurveyed), on right bank 100 ft upstream from outlet of Swiftcurrent Lake at Many Glacier, Glacier National Park, and 11 miles southwest of Babb

Drainage area --31 4 sq mi

Gage-height record --Water-stage recorder graph, except 1200 hours to 2200 hours June 8, when graph based on high-water mark in gage house was used Altitude of gage is 4,860 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 1,000 cfs and by flow-over-dam measurement at 6,700 cfs

Maxima --June 1964 Discharge, 6,700 cfs 1600 hours June 8 (gage height, 10 00 ft, from high-water mark in well, backwater from bridge)
1912 to May 1964 Discharge, 2,250 cfs June 13, 1937 (gage height, 6 89 ft, backwater from bridge)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	126	514	11	230	682	21	753	440
2	173	571	12	218	720	22	548	426
3	181	686	13	280	766	23	377	458
4	166	808	14	290	728	24	270	567
5	150	779	15	252	633	25	221	586
6	131	783	16	252	567	26	206	517
7	114	820	17	349	525	27	233	458
8	112	4,130	18	495	484	28	336	412
9	140	2,480	19	548	447	29	514	356
10	221	970	20	678	444	30	499	326
						31	476	- - - - -
Monthly mean discharge, in cubic feet per second							308	769
Runoff, in inches							11 30	27 34
Runoff, in acre-feet							18,920	45,780

Gage height, in feet, and discharge, in cubic feet per second, at indicated time 1964, of Swiftcurrent Creek at Many Glacier, Mont

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	4 02	753	June 8	0400	5 80	1,550	June 9	0600	7 75	3,120
	0800	4 02	753		0600	6 60	1,960		1200	6 90	2,260
	1200	4 08	779		0800	7 52	2,880		1800	6 06	1,680
	1600	4 16	812		1200	9 09	4,990		2400	5 42	1,210
	2000	4 39	909		1400	9 74	6,200				
	2200	4 57	985		1600	10 00	6,700	10	0600	5 09	1,070
	2400	4 83	1,100		1800	9 84	6,390		1200	4 82	964
					2400	8 78	4,480		1800	4 54	854
8	0200	5 21	1,270						2400	4 33	774

(11) 5-155 Lake Sherburne at Sherburne, Mont

(International gaging station)

Location --Lat 48°49'50", long 113°31'10", in SE¼ sec 35, T 36 N , R 15 W , in gatehouse at Lake Sherburne on Swiftcurrent Creek, 4½ miles southwest of Babb

Drainage area --63 7 sq mi

Gage-height record --Water-stage recorder graph except May 1-20, 1700 hours June 11 to 0900 hours June 18 and 0900 hours June 19 to 2400 June 30 when graph was reconstructed on basis of outside gage readings Datum of gage is at mean sea level (levels by Bureau of Reclamation)

Discharge record --Inflow computed from change in contents adjusted for outflow

Maxima --June 1964 Contents, 54,320 acre-ft 0630 hours June 11 (elevation, 4,780 88 ft) Rate of inflow, 10,000 cfs 1500 hours June 8
1915 to May 1964 Contents, 66,370 acre-ft June 30, 1961 (elevation, 4,788 1 ft)

Remarks --Reservoir is formed on natural lake by earthfill dam completed in 1921 Prior to 1919, flashboards on a temporary dam provided limited storage Storage behind main dam began in 1919 Capacity, 66,200 acre-ft between elevations 4,726 ft (6 ft above lowest outlet gate sill) and 4,788 ft (spillway crest) Streambed above gages prevents withdrawal of storage to sill elevation Dead storage is negligible Water is used for irrigation on Milk River projects of the Bureau of Reclamation Figures given herein represent usable contents

Elevation, in feet, and contents, in acre-feet, at 2400 hours and daily computed inflow, in cubic feet per second, on indicated day 1964

Day	May			June		
	Elevation	Contents	Inflow	Elevation	Contents	Inflow
1	4,731 77	2,680	260	4,751 18	17,880	720
2	4,732 14	2,910	350	4,752 56	19,200	840
3	4,732 74	3,280	520	4,754 17	20,770	990
4	4,733 84	3,990	560	4,756 31	22,940	1,180
5	4,735 13	4,850	440	4,758 33	25,130	1,110
6	4,735 88	5,360	260	4,760 32	27,250	1,070
7	4,735 76	5,280	210	4,762 74	29,990	1,380
8	4,735 02	4,770	220	4,773 74	43,640	6,890
9	4,734 37	4,340	270	4,779 00	51,400	3,920
10	4,734 00	4,090	340	4,780 77	54,160	1,830
11	4,733 90	4,020	420	4,779 75	52,600	1,040
12	4,733 90	4,020	430	4,778 35	50,420	1,240
13	4,734 02	4,100	470	4,777 42	49,030	1,640
14	4,734 18	4,210	490	4,776 58	47,770	1,340
15	4,734 07	4,140	410	4,775 78	46,590	1,070
16	4,733 80	3,960	370	4,774 95	45,420	950
17	4,734 31	4,300	640	4,774 17	44,260	790
18	4,735 10	4,830	760	4,773 78	43,640	780
19	4,736 28	5,640	940	4,773 70	43,580	640
20	4,738 09	6,930	1,150	4,773 70	43,580	760
21	4,739 79	8,180	1,080	4,773 70	43,580	710
22	4,741 26	9,300	860	4,774 10	44,150	640
23	4,742 30	10,130	600	4,774 82	45,230	720
24	4,742 96	10,670	400	4,775 82	46,650	730
25	4,743 57	11,160	350	4,776 90	48,250	820
26	4,744 17	11,640	340	4,777 87	47,700	750
27	4,744 81	12,150	360	4,778 71	50,960	650
28	4,745 82	13,040	560	4,779 35	51,960	520
29	4,747 31	14,280	740	4,779 87	52,790	440
30	4,748 68	15,510	740	4,780 44	53,660	450
31	4,749 89	16,690	710	-	-	-
Change in contents	-	+14,200	-	-	+36,970	-

Computed inflow, in cubic feet per second, at indicated time, 1964, of Lake Sherburne at Sherburne, Mont

Date	Hour	Inflow	Date	Hour	Inflow	Date	Hour	Inflow
June 7	0000	1,080	June 8	1500	10,000	June 9	1800	2,760
	1200	1,180		1800	9,000		2400	2,290
	1800	1,470		2100	7,900			
	2400	2,410		2400	6,810	10	0600	2,010
							1200	1,790
8	0300	3,480	9	0300	5,800		1800	1,630
	0600	4,900		0600	4,900		2400	1,500
	0900	6,600		0900	4,100			
	1200	8,600		1200	3,580			

(12) 5-160 Swiftcurrent Creek at Sherburne, Mont

(International gaging station)

Location --Lat 48°50'00", long 113°30'50", in SW¼ sec 36, T 36 N , R 15 W , on left bank 1,000 ft downstream from outlet of Lake Sherburne Dam at Sherburne and 4½ miles southwest of Babb

Drainage area --64 3 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 4,720 81 ft above mean sea level (Bureau of Reclamation bench mark)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 2,360 cfs 1630 hours June 11 (gage height, 8 37 ft)
1912 to May 1964 Discharge, 2,280 cfs June 17, 1916 (gage height, 7 85 ft, at site within 1,000 ft of present site and at datum then in use)

Remarks --Flow regulated by Lake Sherburne (see station 11)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	163	123	11	450	1 820	21	447	713
2	240	172	12	426	2,340	22	300	351
3	327	202	13	429	2,340	23	188	180
4	201	81	14	438	1,970	24	131	17
5	3 6	2 5	15	447	1,660	25	102	16
6	2 9	2 3	16	457	1,540	26	105	17
7	254	5 4	17	466	1,380	27	107	16
8	469	77	18	491	1,060	28	110	16
9	488	29	19	529	700	29	115	16
10	475	448	20	497	761	30	118	16
						31	119	- - - - -
Monthly mean discharge, in cubic feet per second							293	602
Runoff, in acre-feet							18,040	35,840

(13) 5-175 St Mary River near Babb, Mont

Location --Lat 48°50'00", long 113°25'00", in SE¼ sec 34, T 36 N , R 14 W , on right bank half a mile upstream from outlet of Lower St Mary Lake and 2 miles southeast of Babb

Drainage area --278 sq mi

Gage-height record --Water-stage recorder graph, except 1800 hours June 8 to 1200 hours June 14 Peak stage from high-water mark in well Datum of gage is 4,468 13 ft above mean sea level, datum of 1929

Discharge record --Stage-discharge relation defined by current-meter measurements below 6,000 cfs and by slope-area measurement at 16,500 cfs

Maxima --June 1964 Discharge, 16,500 cfs about 1400 hours June 8 (gage height 12 96 ft, from high-water mark in well)
1902,1911-25, 1951 to May 1964 Discharge observed, 9,300 cfs July 4, 1902 (gage height, 6 50 ft, at site 3¾ miles downstream and at datum then in use)

Remarks --Entire flow of Swiftcurrent Creek below Lake Sherburne is diverted into Lower St Mary Lake above station Flow of Swiftcurrent Creek is regulated by Lake Sherburne (see station 11)

Mean discharge, in cubic feet per second, 1964, of St Mary River near Babb, Mont

Day	May	June	Day	May	June	Day	May	June
1	346	1,840	11	1,080	9,100	21	2,180	3,190
2	456	1,950	12	1,100	7,900	22	2,340	2,950
3	658	2,200	13	1,140	7,000	23	2,260	2,610
4	790	2,480	14	1,170	6,160	24	2,060	2,450
5	730	2,680	15	1,210	5,540	25	1,830	2,470
6	670	2,840	16	1,240	5,130	26	1,640	2,500
7	670	3,060	17	1,330	4,850	27	1,490	2,490
8	802	7,700	18	1,480	4,400	28	1,460	2,390
9	927	15,600	19	1,640	3,850	29	1,560	2,220
10	1,020	11,400	20	1,880	3,460	30	1,670	2,030
						31	1,740	- - - - -
Monthly mean discharge, in cubic feet per second							1,310	4,480
Runoff, in acre-feet							80,470	266,700

(14) 5-185 St Mary Canal at St Mary crossing, near Babb, Mont

(International gaging station)

Location --Lat 48°56'50", long 113°22'30", in SW¼ sec 19, T 37 N , R 13 W , on left bank 50 ft upstream from inlet of St Mary siphon, 7 miles northeast of Babb, and 9 miles downstream from intake

Gage-height record --Water-stage recorder graph Altitude of gage is 4,440 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Daily discharge, 706 cfs June 7
1918 to May 1964 Daily discharge, 767 cfs June 19, 28, 1936

Remarks --Canal diverts water from left bank of St Mary River near Babb and discharges into North Fork Milk River

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	133	683	11	616	34 1	21	643	481
2	181	685	12	616	19 2	22	654	451
3	290	690	13	618	15 4	23	668	461
4	346	696	14	618	12 3	24	668	517
5	503	700	15	618	10 2	25	662	519
6	499	700	16	620	3 2	26	662	471
7	523	706	17	624	1 4	27	675	432
8	598	624	18	624	1 4	28	675	392
9	610	103	19	629	95 5	29	679	343
10	616	47 3	20	635	499	30	679	316
						31	681	- - - - -
Monthly mean discharge, in cubic feet per second							576	357
Runoff, in acre-feet							35,430	21,240

(15) 5-190 St Mary Canal at Hudson Bay Divide, near Browning, Mont

(International gaging station)

Location --Lat 48°59', long 113°04', in sec 5, T 37 N , R 11 W , on right bank 3 miles upstream from canal outlet and 30 miles north of Browning on Blackfeet Indian Reservation

Gage-height record --Water-stage recorder graph Altitude of gage is 4,380 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Daily discharge, 816 cfs June 8
1917 to May 1964 Daily discharge, 758 cfs June 13, 1937

Remarks --Canal diverts water from left bank of St Mary River near Babb and discharges into North Fork Milk River

Mean discharge, in cubic feet per second, 1964, of St Mary Canal at Hudson Bay Divide, near Browning, Mont

Day	May	June	Day	May	June	Day	May	June
1	133	674	11	607	25 9	21	629	450
2	150	682	12	607	10 6	22	637	434
3	260	684	13	607	5 5	23	654	418
4	311	687	14	602	1 8	24	659	450
5	418	696	15	610	1 8	25	652	484
6	486	693	16	605	3 8	26	647	460
7	484	703	17	622	2 6	27	667	424
8	542	816	18	605	7	28	672	386
9	588	380	19	612	2	29	672	343
10	595	70 8	20	619	208	30	672	323
						31	674	- - - - -
Monthly mean discharge, in cubic feet per second							558	351
Runoff, in acre-feet							34,310	20,860

(16) 5-200 Kennedy Creek near Babb, Mont

(Gaging station, discontinued 1912)

Location --Lat 48°55'00", long 113°26'10", in SW¼ sec 34, T 37 N , R 14 W , 1¾ miles upstream from mouth and 4 miles north of Babb

Drainage area --60 6 sq mi

Maxima --June 1964 Discharge, about 15,000 cfs June 8, from slope-conveyance measurement

Remarks --Discharge measurements only in 1901,1903-4, 1906-7, 1911-12 Daily record in 1905, maximum not determined

(17) 5-205 St Mary River at international boundary

(International gaging station)

Location --Lat 49°00'10", long 113°18'50", in SW¼ sec 5, T 1, R 25 W , fourth meridian, in Alberta, on right bank a quarter of a mile north of international boundary, 2½ miles downstream from Boundary Creek, 7 miles southwest of Kimball, Alberta, and 11 miles northeast of Babb, Mont

Drainage area --469 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 4,120 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 21,000 cfs 1630 hours June 8 (gage height, 12 06 ft) 1902 to May 1964 Discharge, about 40,000 cfs June 5, 1908 (gage height, 12 75 ft, from floodmarks, at site within a quarter mile of present site and at datum then in use), from rating curve extended above 6,000 cfs by logarithmic plotting

Remarks --Diversions by St Mary Canal at St Mary crossing, near Babb (see station 14) Flow partly regulated by Lake Sherburne (see station 11)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	372	1,590	11	872	11,600	21	2,260	3,580
2	639	1,760	12	882	10,100	22	2,280	3,340
3	1,160	2,110	13	945	8,960	23	2,100	2,920
4	1,160	2,480	14	966	8,190	24	1,820	2,750
5	783	2,710	15	956	7,250	25	1,540	2,730
6	589	2,920	16	987	6,610	26	1,300	2,800
7	525	3,320	17	1,170	6,190	27	1,130	2,720
8	572	12,700	18	1,350	5,720	28	1,130	2,650
9	746	17,000	19	1,560	4,840	29	1,320	2,530
10	842	14,300	20	1,880	4,000	30	1,420	2,310
						31	1,490	- - - - -
Monthly mean discharge, in cubic feet per second							1,185	5,423
Runoff, in acre-feet							72,880	322,700

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964, of St Mary River at international boundary

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	6 31	2,980	June 8	0800	8 99	9,950	June 9	0600	11 09	17,000
	0600	6 32	3,000		1200	10 24	13,800		1200	11 16	17,300
	1200	6 38	3,140		1400	10 73	15,600		1800	11 31	17,800
	1800	6 56	3,540		1600	11 86	20,100		2400	10 96	16,600
	2400	6 87	4,260		1630	12 06	21,000				
					1800	11 48	18,400	10	0600	10 51	15,200
8	0200	7 10	4,810		2000	11 08	17,000		1200	10 22	14,300
	0400	7 52	5,920		2400	10 64	15,600		1800	9 89	13,300
	0600	8 16	7,590						2400	9 64	12,500

(18) Rolph Creek near Kimball, Alberta

(Canadian gaging station)

Location --Lat 49°07'30", long 113°08'30", in NW¼ sec 15, T 2, R 24 W , fourth meridian in Alberta, about 3 miles above mouth and 4½ miles northeast of Kimball

Drainage area --90 6 sq mi

Gage-height record --Twice-daily staff-gage readings, graph based on floodmark and observed readings June 8-10 Altitude of gage is 3,860 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 95 cfs and extended above by logarithmic plotting

Maxima --June 1964 Discharge, 630 cfs 1800 hours June 8 (gage height, 4 80 ft, from graph based on gage readings)
1911-16, 1935 to May 1964 Discharge, 1,290 cfs about 1800 hours June 3, 1953 (gage height, 7 21 ft, from high-water mark)

Remarks --Records furnished by Department of Northern Affairs and National Resources, Canada

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	17 8	7 1	11	44 0	143	21	7 1	42 5
2	31 2	5 9	12	33 8	132	22	5 9	36 4
3	185	5 0	13	24 3	97 1	23	5 0	30 9
4	230	4 2	14	18 5	77 2	24	5.0	26 9
5	262	3 7	15	23.8	74 9	25	5 0	25 3
6	167	2 8	16	19 0	66 4	26	5 0	24 3
7	162	3 5	17	12 8	120	27	5 3	23 8
8	113	265	18	9 5	76 0	28	5 6	20 9
9	85 6	183	19	9 5	57 4	29	6 2	19 9
10	61 3	136	20	8 1	65 3	30	5 3	20 4
						31	7 5	- - - - -
Monthly mean discharge, in cubic feet per second							51 0	59 9
Runoff, in inches							0 65	0 74
Runoff, in acre-feet							3,140	3,560

(19) Lee Creek at Cardston, Alberta

(Canadian gaging station)

Location --Lat 49°12'00", long 113°17'45", in NW¼ sec 10, T 3, R 25 W , fourth meridian, in Alberta, upstream from St Mary River Reservoir, 2 miles above mouth, and about 600 ft downstream from bridge on Highway 2 at Cardston

Drainage area --117 sq mi

Gage-height record --Water-stage recorder graph, except 1500 hours to 2000 hours June 8, when graph was reconstructed from high-water mark Altitude of gage is 3,710 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 8,700 cfs

Maxima --June 1964 Discharge, 11,400 cfs about 1700 hours June 8 (gage height, 12 59 ft, from high-water mark)
1909-14, 1920 to May 1964 Discharge, 7,820 cfs June 24, 1951 (gage height, 10 49 ft, from high-water mark)

Remarks --Records furnished by Department of Northern Affairs and National Resources, Canada

Mean discharge, in cubic feet per second, 1964, of Lee Creek at Cardston, Alberta

Day	May	June	Day	May	June	Day	May	June
1	130	254	11	339	1,180	21	430	298
2	302	258	12	330	1,020	22	330	250
3	767	276	13	375	850	23	272	226
4	741	285	14	348	760	24	254	212
5	536	276	15	321	692	25	236	192
6	375	303	16	312	692	26	228	176
7	415	341	17	385	750	27	245	165
8	334	5,340	18	445	602	28	285	156
9	339	2,750	19	420	514	29	326	142
10	385	1,560	20	450	371	30	280	142
						31	262	- - - - -
Monthly mean discharge, in cubic feet per second							361	701
Runoff, in inches							3 56	6 69
Runoff, in acre-feet							22,210	41,720

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	4 53	280	June 8	0200	5 34	663	June 8	2400	8 58	5,020
	0800	4 57	298		0600	6 20	1,530				
	1200	4 56	294		0900	7 48	3,370	9	0300	7 64	3,610
	1600	4 62	321		1200	9 00	5,650		0600	7 27	3,060
	1800	4 72	366		1700	12 59	11,400		1200	6 97	2,610
	2200	5 05	492		2000	11 25	9,160		1800	6 61	2,100
	2400	5 16	554		2200	9 96	7,100		2400	6 44	1,870

MISSOURI RIVER MAIN STEM

(20) 6-545 Missouri River at Toston, Mont

Location --Lat 46°08'45", long 111°25'15", in NW¼ sec 36, T 5 N , R 2 E , on left bank 2 miles southeast of Toston, 4½ miles upstream from Crow Creek, and 7 miles downstream from Sixteenmile Creek

Drainage area --14,669 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 3,920 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 22,000 cfs 2200 hours June 12 (gage height, 10 00 ft) 1890, 1910-16, 1941 to May 1964 Discharge, 32,000 cfs June 6, 1948 (gage height, 11 77 ft)

Remarks --Flow partly regulated by six reservoirs on tributaries (combined capacity, 567,200 acre-ft) Diversions for irrigation of about 535,000 acres

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	4,850	11,800	11	5,200	20,600	21	8,640	20,500
2	5,850	11,000	12	5,400	21,600	22	11,800	20,600
3	6,740	10,500	13	5,290	21,100	23	12,100	19,900
4	6,530	10,600	14	5,510	19,000	24	11,400	20,500
5	6,220	11,200	15	5,850	17,900	25	10,200	20,300
6	5,800	12,000	16	6,240	18,400	26	9,120	19,700
7	5,440	13,800	17	7,060	19,100	27	8,760	19,700
8	5,180	17,500	18	7,960	19,700	28	8,550	19,800
9	5,010	19,300	19	8,700	20,500	29	10,100	20,000
10	4,950	19,800	20	9,340	20,600	30	11,400	19,000
						31	11,800	- - - - -
Monthly mean discharge, in cubic feet per second							7,645	17,870
Runoff, in acre-feet							470,100	1,063,000

DEEP CREEK BASIN

(21) 6-566 Deep Creek below North Fork Deep Creek, near Townsend, Mont

(Crest-stage station)

Location --Lat 46°20', long 111°17', in SE¼ sec 25, T 7 N , R 3 E , at bridge on county road, 11 miles east of Townsend

Drainage area --87 7 sq mi

Gage-height record --Crest stages only Altitude of gage is 4,440 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 296 cfs June 8 (gage height, 2 21 ft)
1959 to May 1964 Discharge, 329 cfs May 18, 1964 (gage height, 2 33 ft)

MISSOURI RIVER MAIN STEM

(22) 6-570 Missouri River near Townsend, Mont

(Gaging station, discontinued 1904, U S Weather Bureau stage station 1902-16 and since 1957)

Location --Lat 46°20'10", long 111°31'55", in SW¼NW¼ sec 30, T 7 N , R 2 E , at highway bridge, 1 mile northwest of Townsend

Drainage area --15,343 sq mi

Gage-height record --Wire-weight gage read at 0730 hours Maximum from graph of gage readings, based on shape of graph at the Toston gage Datum of gage is at mean sea level, adjustment of 1929

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge 22,900 cfs 0100 hours June 13 (elevation, 3,809 6 ft, from graph of gage readings)
1892-1916, 1948 to May 1964 Discharge observed, 38,400 cfs June 3-5, 1894 (elevation, 3,811 7 ft), elevation, 3,813 0 ft about Feb 6, 1963, result of ice jam, but may have been higher in November 1959

Remarks --Daily stage record furnished by the U S Weather Bureau Flow partly regulated by six reservoirs on tributary streams (combined capacity, 567,200 acre-ft)

Elevation, in feet, at 0730 hours, of indicated day, 1964

Day	May	June	Day	May	June	Day	May	June
1	3,805 84	3,807 62	11	3,806 02	3,809 25	21	3,807 26	3 809 46
2	3,806 10	3,807 58	12	3,806 14	3,809 45	22	3,807 46	3,809 41
3	3,806 50	3,807 35	13	3,806 11	3,809 48	23	3,807 73	3,809 21
4	3,806 52	3,807 35	14	3,806 12	3,809 23	24	3,807 64	3,809 20
5	3,806 42	3,807 42	15	3,806 27	3,808 94	25	3,807 40	3,809 15
6	3,806 30	3,807 57	16	3,806 35	3,808 85	26	3,807 10	3,809 11
7	3,806 19	3,807 81	17	3,806 52	3,809 10	27	3,806 97	3,809 09
8	3,806 12	3,808 45	18	3,806 74	3,809 01	28	3,806 92	3,809 06
9	3,806 02	3,809 10	19	3,806 94	3,809 32	29	3,807 00	3,809 05
10	3,805 98	3,809 25	20	3,807 09	3,809 42	30	3,807 46	3,809 10
						31	3,807 57	- - - - -

(23) 6-585 Canyon Ferry Reservoir near Helena, Mont

Location --Lat 46°39'00", long 111°43'40", in SE¼SE¼ sec 4, T 10 N , R 1 W , in block 17 of Canyon Ferry Dam, 15 miles east of Helena

Drainage area --15,904 sq mi

Gage-height record --Water-stage recorder Datum of gage is at mean sea level (levels by Bureau of Reclamation)

Maxima --June 1964 Daily contents, 2,043,000 acre-ft June 23 (elevation, 3,800 00 ft)
1953 to May 1964 Daily contents, 2,043,000 acre-ft at times in July 1955, 1956, 1962 and June 23, 1964 (elevation, 3,800 00 ft)

Remarks --Reservoir is formed by concrete dam, construction began in 1949, completed in 1953 Storage began in March 1953 Usable capacity, 2,043,000 acre-ft at controlled spillway elevation (3,800 ft) Dead storage, 8,000 acre-ft below elevation 3,650 ft Minimum operating level, 3,728 ft for on-site power generation (usable contents, 428,000 acre-ft) Water is used for power production, flood control, irrigation, recreation, and supplemental water supply for city of Helena Elevations and capacity table furnished by Bureau of Reclamation Figures given herein represent usable contents

Elevation, in feet, and contents, in acre-feet, at 2400 hours of indicated day, 1964

Day	May		June		Day	May		June	
	Elevation	Contents	Elevation	Contents		Elevation	Contents	Elevation	Contents
1	3,791 02	1,740,000	3,794 35	1,852,000	16	3,792 64	1,795,000	3,799 84	2,038,000
2	3,791 15	1,744,000	3,794 39	1,854,000	17	3,792 69	1,796,000	3,799 97	2,042,000
3	3,791 59	1,759,000	3,794 39	1,854,000	18	3,792 74	1,798,000	3,799 95	2,041,000
4	3,791 95	1,771,000	3,794 43	1,855,000	19	3,792 74	1,798,000	3,799 95	2,041,000
5	3,792 21	1,780,000	3,794 50	1,857,000	20	3,792 75	1,798,000	3,799 95	2,041,000
6	3,792 49	1,790,000	3,794 55	1,859,000	21	3,792 77	1,799,000	3,799 95	2,041,000
7	3,792 63	1,794,000	3,794 75	1,866,000	22	3,792 88	1,803,000	3,799 98	2,042,000
8	3,792 57	1,792,000	3,795 23	1,882,000	23	3,793 22	1,814,000	3,800 00	2,043,000
9	3,792 53	1,791,000	3,796 20	1,915,000	24	3,793 55	1,825,000	3,799 98	2,042,000
10	3,792 44	1,788,000	3,797 18	1,948,000	25	3,793 75	1,832,000	3,799 96	2,042,000
11	3,792 44	1,788,000	3,798.14	1,980,000	26	3,793 89	1,837,000	3,799 85	2,038,000
12	3,792 45	1,788,000	3,798 69	1,999,000	27	3,793 96	1,839,000	3,799 72	2,033,000
13	3,792 45	1,788,000	3,799 06	2,011,000	28	3,794 00	1,841,000	3,799 63	2,030,000
14	3,792 50	1,790,000	3,799 36	2,021,000	29	3,794 11	1,844,000	3,799 63	2,030,000
15	3,792 57	1,792,000	3,799 67	2,032,000	30	3,794 20	1,847,000	3,799 73	2,034,000
					31	3,794 30	1,851,000	-	-
Change in contents						-	+110,000	-	+183,000

SPOKANE CREEK BASIN

(24) 6-587 Mitchell Gulch near East Helena, Mont

(Crest-stage station)

Location --Lat 46°34', long 111°49', in NW¼ sec 2, T 9 N , R 2 W , at culvert on U S Highway 12, 4 7 miles east of East Helena

Drainage area --8 09 sq mi

Gage-height record --Crest stage only Altitude of gage is 4,060 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 No flow
1959 to May 1964 Discharge, 107 cfs Feb 4, 1963 (gage height, 1 41 ft)

PRICKLY PEAR CREEK BASIN

(25) 6-615 Prickly Pear Creek near Clancy, Mont

Location --Lat 46°31'05", long 111°56'45", in NE¼SW¼ sec 23, T 9 N , R 3 W , on right bank 100 ft upstream from bridge on U S Highway 91, 3½ miles downstream from Lump Gulch Creek, 4 miles northeast of Clancy, and 7 miles southeast of Helena

Drainage area --192 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 4,067 1 ft above mean sea level, datum of 1929

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 700 cfs 1100 hours June 9 (gage height, 6 01 ft)
1909-16, 1921-33, 1945 to May 1964 Discharge, about 900 cfs about June 9, 1927 (estimated on basis of hydrographic comparison)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	89	173	11	87	310	21	213	249
2	104	171	12	86	271	22	201	260
3	79	177	13	97	247	23	169	225
4	70	178	14	108	243	24	156	213
5	80	175	15	112	260	25	158	205
6	81	180	16	127	267	26	144	207
7	76	239	17	153	316	27	138	209
8	73	373	18	172	247	28	157	187
9	74	540	19	178	288	29	250	172
10	82	376	20	196	288	30	217	166
						31	186	- - - - -
Monthly mean discharge, in cubic feet per second							133	247
Runoff, in inches							0 80	1 44
Runoff, in acre-feet							8,160	14,700

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	3 37	202	June 8	1000	4 86	426	June 9	1100	6 01	700
	0700	3 82	256		1200	4 88	430		1400	5 70	632
	0900	3 82	256		1400	4 85	424		1800	5 17	520
	1600	3 63	233		1800	4 60	377		2400	4 75	440
	2000	3 61	231		2100	4 51	362				
	2400	3 86	261		2400	4 59	375	10	1000	4 41	375
									1800	4 25	348
8	0400	4 22	314	9	0400	4 96	452		2400	4 17	335
	0600	4 54	367		0800	5 68	617				

(26) 6-617 Jackson Creek near East Helena, Mont

(Crest-stage station)

Location --Lat 46°28'20", long 111°51'10", in SE¼ sec 4, T 8 N , R 2 W , 300 ft upstream from mouth, 8½ miles southeast of East Helena

Drainage area --3 44 sq mi

Gage-height record --Crest stages only Altitude of gage is 4,990 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 19 cfs June 8 (gage height, 2 64 ft)
1961 to May 1964 Discharge, 16 cfs June 2, 1962 (gage height, 2 49 ft)

(27) 6-618 Crystal Creek near East Helena, Mont

(Crest-stage station)

Location --Lat 46°29'00", long 111°51'40", in NW¼ sec 4, T 8 N , R 2 W , a quarter of a mile upstream from mouth, 8 miles southeast of East Helena

Drainage area --3 77 sq mi

Gage-height record --Crest stages only Altitude of gage is 4,860 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 21 cfs June 8 (gage height, 1 64 ft)
1961 to May 1964 Discharge, 16 cfs May 28, 1964 (gage height, 1 52 ft)

(28) 6-619 McClellan Creek at city diversion dam, near East Helena, Mont

(Crest-stage station)

Location --Lat 46°32'00", long 111°52'40", in SE¼ sec 17, T 9 N , R 2 W , 300 ft upstream from diversion dam, 4½ miles southeast of East Helena

Drainage area --33 2 sq mi

Gage-height record --Crest stages only Altitude of gage is 4,200 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 100 cfs and by flow-over-dam measurement at 390 cfs

Maxima --June 1964 Discharge, 390 cfs June 8 (gage height, 2 59 ft)
1960 to May 1964 Discharge, 175 cfs June 2, 1962 (gage height, 1 48 ft)

(29) 6-625 Tenmile Creek near Rimini, Mont

Location --Lat 46°31'30", long 112°15'20", in SW¼NE¼ sec 20, T 9 N , R 5 W , on left bank at Moose Creek ranger station, 500 ft upstream from Moose Creek and 3 miles north of Rimini

Drainage area --32 7 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 4,850 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 450 cfs and by contracted-opening measurement at 556 cfs

Maxima --June 1964 Discharge, 563 cfs 0300 hours June 9 (gage height, 3 77 ft)
1914 to May 1964 Discharge 781 cfs May 27, 1917 (gage height, 4 98 ft, at site 40 ft downstream and at datum then in use)

Remarks --Flow partly regulated by two reservoirs on tributary streams (combined capacity, 2,340 acre-ft)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	21	141	11	35	203	21	202	160
2	21	145	12	41	173	22	172	160
3	18	153	13	53	154	23	149	137
4	17	149	14	68	150	24	130	123
5	15	138	15	86	144	25	123	110
6	15	134	16	123	142	26	114	106
7	15	152	17	168	140	27	117	95
8	17	310	18	164	121	28	145	86
9	23	412	19	157	162	29	206	75
10	34	263	20	202	162	30	157	67
						31	145	- - - - -
Monthly mean discharge, in cubic feet per second							95 3	156
Runoff, in acre-feet							5,860	9,260

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964, of Tenmile Creek near Rimini, Mont

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	2 44	145	June 8	0700	2 82	310	June 9	0100	3 73	546
	0600	2 44	145		0900	2 74	273		0300	3 77	563
	1400	2 39	127		1300	2 73	268		0600	3 59	486
	2000	2 49	164		1600	2 68	246		1000	3 43	418
	2300	2 60	210		1700	2 69	250		1030	3 32	375
	2400	2 75	278		2000	2 85	278		1100	3 37	394
					2100	3 05	324		1900	3 18	322
8	0300	2 99	395		2200	3 50	515		2000	3 20	329
	0330	3 14	319		2300	3 68	533		2400	3 15	310
	0600	3 02	264		2400	3 65	515				

(30) 6-627 Little Porcupine Creek tributary near Helena, Mont

(Crest-stage station)

Location --Lat 46°35', long 112°16', in SW¼ sec 29, T 10 N , R 5 W , at culvert on U S Highway 12, 11 miles west of Helena

Drainage area --0 48 sq mi

Gage-height record --Crest stages only Altitude of gage is 5,360 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 3 5 cfs and by flow-through-culvert measurement at 5 9 cfs

Maxima --June 1964 Discharge, 5 9 cfs June 8 (gage height, 1 17 ft)
1959 to May 1964 Discharge, 3 8 cfs May 17, 1964 (gage height, 0 74 ft)

(31) 6-645 Lake Helena near Helena, Mont

Location --Lat 46°46'00", long 111°54'10", in SE¼ sec 29, T 12 N , R 2 W , at Hauser Dam on Missouri River, 1¾ miles downstream from Prickly Pear Creek, and 13 miles northeast of Helena

Drainage area --610 sq mi, above dam and control works on Prickly Pear Creek

Gage-height record --Water-stage indicator at Hauser Dam read daily at 2400 hours Datum of gage is at mean sea level (levels by The Montana Power Co)

Maxima --June 1964 Contents observed, 10,240 acre-ft 2400 hours June 1 (elevation, 3,634 90 ft)
1945 to May 1964 Contents observed, 11,790 acre-ft Aug 2, 1960, Dec 10, 1962, July 19, 20, Sept 4, 1963 (elevation, 3,635 60 ft)

Remarks --Gage heights collected at Hauser Dam are effective on Lake Helena at control dam Prior to April 1945, contents of Lake Helena included with records of Hauser Lake Since that date, a dam and control works has separated the two lakes to allow independent regulation of Lake Helena if needed Usable capacity, 10,450 acre-ft at elevation, 3,635 00 ft No dead storage Water is used for recreation, wildlife, and power production through Hauser Dam Records furnished by The Montana Power Co Figures given herein represent usable contents

Elevation, in feet, and contents, in acre-feet, at 2400 hours on indicated day, 1964, of Lake Helena near Helena, Mont

Day	May		June		Day	May		June	
	Elevation	Contents	Elevation	Contents		Elevation	Contents	Elevation	Contents
1	3,634 90	10,240	3,634 90	10,240	16	3,635 40	11,340	3,634 00	8,450
2	3,635 20	10,890	3,634 20	8,830	17	3,635 40	11,340	3,633 90	8,270
3	3,634 80	10,030	3,633 70	7,900	18	3,634 90	10,240	3,634 20	8,830
4	3,634 50	9,420	3,634 20	8,830	19	3,634 60	9,620	3,633 60	7,720
5	3,634 70	9,820	3,634 30	9,020	20	3,634 00	8,450	3,633 20	7,030
6	3,634 30	9,020	3,634 40	9,220	21	3,634 00	8,450	3,633 20	7,030
7	3,634 70	9,820	3,634 50	9,420	22	3,634 20	8,830	3,633 20	7,030
8	3,635 00	10,450	3,634 50	9,420	23	3,633 80	8,080	3,633 40	7,370
9	3,635 00	10,450	3,634 50	9,420	24	3,633 60	7,720	3,633 90	8,270
10	3,635 10	10,670	3,633 90	8,270	25	3,633 70	7,900	3,634 00	8,450
11	3,635 00	10,450	3,633 30	7,200	26	3,634 30	9,020	3,634 00	8,450
12	3,634 80	10,030	3,634 10	8,640	27	3,634 50	9,420	3,634 00	8,450
13	3,634 50	9,420	3,634 10	8,640	28	3,634 00	8,450	3,634 10	8,640
14	3,634 60	9,620	3,634 00	8,450	29	3,633 90	8,270	3,633 30	7,200
15	3,635 20	10,890	3,634 00	8,450	30	3,635 30	11,110	3,633 40	7,370
					31	3,635 40	11,340	-	-
Change in contents						-	+450	-	-3,970

MISSOURI RIVER MAIN STEM

(32) 6-650 Hauser Lake near Helena, Mont

Location --Lat 46°46'00", long 111°54'10", in SE¼ sec 29, T 12 N , R 2 W , at dam on Missouri River, 1¾ miles downstream from Prickly Pear Creek, and 13 miles northeast of Helena

Drainage area --16,876 sq mi

Gage-height record --Water-stage indicator read daily at 2400 hours Datum of gage is at mean sea level (levels by The Montana Power Co)

Maxima --June 1964 Contents observed, 51,050 cfs 2400 hours June 1 (elevation, 3,634 90 ft)
1945 to May 1964 Contents observed, 53,630 acre-ft Aug 2, 1960, Dec 10, 1962, July 19, 20, Sept 4, 1963 (elevation, 3,635 60 ft)

Remarks --Reservoir is formed by concrete dam completed in 1907, separated from Lake Helena in April 1945 Usable capacity, 51,420 acre-ft (52,090 acre-ft prior to Nov 28, 1949) at elevation 3,635 00 ft (not including capacity of Lake Helena) Dead storage, 46,810 acre-ft below elevation 3,617 0 ft Not normally drawn below 3,621 00 ft (8,870 acre-ft) Water is used for power and recreation Records furnished by The Montana Power Co Figures given herein represent usable contents

Elevation, in feet, and contents, in acre-feet, at 2400 hours on indicated day, 1964

Day	May		June		Day	May		June	
	Elevation	Contents	Elevation	Contents		Elevation	Contents	Elevation	Contents
1	3,634 90	51,050	3,634 90	51,050	16	3,635 40	52,890	3,634 00	47,770
2	3,635 20	52,150	3,634 20	48,490	17	3,635 40	52,890	3,633 90	47,410
3	3,634 80	50,680	3,633 70	46,700	18	3,634 90	51,050	3,634 20	48,490
4	3,634 50	49,580	3,634 20	48,490	19	3,634 60	49,950	3,633 60	46,350
5	3,634 70	50,310	3,634 30	48,850	20	3,634 00	47,770	3,633 20	44,950
6	3,634 30	48,850	3,634 40	49,220	21	3,634 00	47,770	3,633 20	44,950
7	3,634 70	50,310	3,634 50	49,580	22	3,634 20	48,490	3,633 20	44,950
8	3,635 00	51,420	3,634 50	49,580	23	3,633 80	47,060	3,633 40	45,650
9	3,635 00	51,420	3,634 50	49,580	24	3,633 60	46,350	3,633 90	47,410
10	3,635 10	51,780	3,633 90	47,410	25	3,633 70	46,700	3,634 00	47,770
11	3,635 00	51,420	3,633 30	45,290	26	3,634 30	48,850	3,634 00	47,770
12	3,634 80	50,680	3,634 10	48,130	27	3,634 50	49,580	3,634 00	47,770
13	3,634 50	49,580	3,634 10	48,130	28	3,634 00	47,770	3,634 10	48,130
14	3,634 60	49,950	3,634 00	47,770	29	3,633 90	47,410	3,633 30	45,290
15	3,635 20	52,150	3,634 00	47,770	30	3,635 30	52,520	3,633 40	45,650
					31	3,635 40	52,890	-	-
Change in contents						-	+740	-	-7,240

(33) 6-660 Holter Lake near Wolf Creek, Mont

Location --Lat 46°59'30", long 112°00'30", on line between SE¼ sec 5 and NE¼ sec 8, T 14 N , R 3 W , at Holter Dam on Missouri River, 3½ miles southeast of Wolf Creek

Drainage area --17,149 sq mi

Gage-height record --Water-stage indicator read at 0800 hours daily Datum of gage is at mean sea level (levels by The Montana Power Co)

Maxima --June 1964 Contents observed, 80,730 acre-ft 0800 hours June 26 (elevation, 3,563 75 ft)
1936 to May 1964 Contents observed, 83,110 acre-ft Aug 31, 1951 (elevation, 3,564 25 ft)

Remarks --Reservoir is formed by concrete dam completed in 1918 Usable capacity, 81,920 acre-ft at elevation 3,564 0 ft Dead storage, 158,500 acre-ft below elevation 3,543 0 ft Not normally drawn below 3,548 0 ft (16,660 acre-ft) Water is used for power and recreation Records furnished by The Montana Power Co Figures given herein represent usable contents

Elevation, in feet, and contents, in acre-feet, at 0800 hours of indicated day, 1964

Day	May		June		Day	May		June	
	Elevation	Contents	Elevation	Contents		Elevation	Contents	Elevation	Contents
1	3,562 10	73,050	3,563 35	78,840	16	3,562 30	73,970	3,562 80	76,280
2	3,562 50	74,890	3,563 35	78,840	17	3,562 70	75,810	3,563 00	77,210
3	3,562 70	75,810	3,563 10	77,670	18	3,563 00	77,210	3,563 30	78,610
4	3,563 30	78,610	3,562 70	75,810	19	3,563 45	79,320	3,563 00	77,210
5	3,563 50	79,550	3,562 00	72,600	20	3,563 10	77,670	3,563 00	77,210
6	3,563 40	79,080	3,562 40	74,430	21	3,563 00	77,210	3,562 60	75,350
7	3,563 50	79,550	3,562 90	76,740	22	3,562 95	76,970	3,563 00	77,210
8	3,563 50	79,550	3,563 10	77,670	23	3,563 40	79,080	3,563 20	78,140
9	3,563 60	80,020	3,563 20	78,140	24	3,563 60	80,020	3,563 20	78,140
10	3,563 30	78,610	3,563 25	78,370	25	3,563 75	80,730	3,563 60	80,020
11	3,563 35	78,840	3,563 10	77,670	26	3,563 70	80,490	3,563 75	80,730
12	3,563 20	78,140	3,563 00	77,210	27	3,563 60	80,020	3,563 60	80,020
13	3,563 10	77,670	3,562 90	76,740	28	3,563 45	79,320	3,563 50	79,550
14	3,562 40	74,430	3,562 80	76,280	29	3,563 30	78,610	3,563 40	79,080
15	3,562 30	73,970	3,562 70	75,810	30	3,563 30	78,610	3,563 00	77,210
					31	3,563 20	78,140	-	-
Change in contents						-	+11,920	-	-930

(34) 6-665 Missouri River below Holter Dam, near Wolf Creek, Mont

Location --Lat 46°59'40", long 112°00'50", in S½ sec 5, T 14 N , R 3 W , on left bank a quarter of a mile downstream from Holter Dam and 3 miles southeast of Wolf Creek

Drainage area --17,149 sq mi

Gage-height record --Digital-recorder tape punched at 15-minute intervals Datum of gage is 3,464 11 ft above mean sea level, datum of 1929

Discharge record --Stage-discharge relation defined by current-meter measurements Mean daily discharges computed from 96 punch-tape recordings per day

Maxima --June 1964 Discharge, 27,100 cfs 2115 hours June 19 (gage height, 10 04 ft)
1945 to May 1964 Discharge, 34,800 cfs June 8, 1948 (gage height, 11 70 ft)

Remarks --Flow regulated by nine smaller irrigation reservoirs and powerplants having a combined capacity of 710,970 acre-ft and by Canyon Ferry Reservoir (see station 23)

Mean discharge, in cubic feet per second, 1964, of Missouri River below Holter Dam, near Wolf Creek, Mont

Day	May	June	Day	May	June	Day	May	June
1	3,060	12,500	11	7,530	6,890	21	11,400	21,100
2	3,410	13,800	12	7,420	13,700	22	10,300	21,200
3	2,390	13,100	13	7,700	16,800	23	6,600	20,600
4	1,910	11,400	14	5,890	16,400	24	7,170	21,200
5	2,640	10,900	15	4,740	15,800	25	7,170	23,300
6	2,910	10,600	16	4,680	15,000	26	7,120	24,200
7	4,100	11,300	17	6,100	19,000	27	8,030	22,600
8	6,820	10,400	18	8,230	22,500	28	9,440	22,500
9	7,350	5,580	19	12,000	25,200	29	9,620	22,300
10	6,510	5,540	20	11,700	25,600	30	8,900	20,900
						31	10,400	- - - - -
Monthly mean discharge, in cubic feet per second							6,879	16,730
Runoff, in acre-feet							423,000	995,500

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	5 58	11,900	June 10	1200	3 27	5,600	June 11	1600	4 49	8,540
	1000	5 60	11,900		2400	3 27	5,600		1800	5 36	11,000
	1200	5 82	12,600						2400	5 35	11,000
	1600	5 90	12,900	11	0200	3 21	5,350				
	1800	3 89	7,080		0400	3 08	5,070	12	0600	5 34	10,800
	2000	3 30	5,670		0600	1 87	2,770		1200	5 37	10,900
	2400	3 29	5,650		0800	2 87	4,620		1400	5 41	11,000
					1000	3 19	5,310		1600	7 24	17,100
9	1200	3 23	5,510		1200	3 18	5,290		1800	7 75	19,000
	2400	3 23	5,510		1400	3 21	5,350		2000	7 69	18,700
									2400	7 64	18,600

LITTLE PRICKLY PEAR CREEK BASIN

(35) 6-711 Little Prickly Pear Creek at Sieben Ranch, near Wolf Creek, Mont

Location --Lat 46°53'50", long 112°07'40", near east line of SE¼ sec 8, T 13 N , R 4 W , on left bank 30 ft downstream from farm bridge, a quarter of a mile upstream from Clark Creek, and 8 miles south of Wolf Creek

Drainage area --270 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 3,880 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 972 cfs 2230 hours June 9 (gage height, 5 78 ft)
1962 to May 1964 Daily discharge, 600 cfs May 30, 1964

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	70	350	11	244	699	21	380	253
2	117	278	12	269	554	22	340	245
3	139	232	13	244	446	23	300	220
4	175	220	14	258	359	24	250	196
5	180	220	15	271	318	25	200	162
6	171	212	16	271	318	26	190	129
7	164	216	17	284	422	27	180	115
8	157	338	18	358	323	28	210	110
9	169	663	19	400	292	29	300	110
10	208	857	20	410	283	30	600	98
						31	480	- - - - -
Monthly mean discharge, in cubic feet per second							258	308
Runoff, in inches							1 10	1 27
Runoff, in acre-feet							15,850	18,320

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	4 36	266	June 9	1200	5 21	631	June 10	1200	5 57	837
	1200	4 54	318		1300	5 40	735		2400	5 51	801
	2400	4 82	450		1600	5 42	747				
					2300	5 78	972				
9	0800	4 95	495		2400	5 75	952				

(36) 6-712 Lyons Creek near Wolf Creek, Mont

(Crest-stage station)

Location --Lat 46°56', long 112°08', in NE¼ sec 29, T 14 N , R 4 W , 135 ft upstream from mouth, 5½ miles southwest of Wolf Creek

Drainage area --29 4 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,730 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 490 cfs June 8 (gage height, 3 80 ft)
1959 to May 1964 Discharge, 158 cfs May 22, 1962 (gage height, 1 57 ft)

(37) 6-713 Little Prickly Pear Creek at Wolf Creek, Mont

Location --Lat 47°00'20", long 112°04'00", in SW¼SE¼ sec 35, T 15 N , R 4 W , on left bank 25 ft downstream from county bridge, 150 ft south of Wolf Creek post office, and half a mile downstream from Wolf Creek

Drainage area --381 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 3,577 82 ft above mean sea level, datum of 1929, supplementary adjustment of 1962

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 3,110 cfs 1200 hours June 9 (gage height, 7 65 ft)
1962 to May 1964 Discharge, 1,120 cfs May 30, 1964 (gage height, 5 13 ft)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	276	613	11	621	1,190	21	654	388
2	441	545	12	561	888	22	633	377
3	577	485	13	545	758	23	561	342
4	621	457	14	573	654	24	489	314
5	593	441	15	569	613	25	405	282
6	589	425	16	565	605	26	356	267
7	533	429	17	605	654	27	335	252
8	529	809	18	668	501	28	384	240
9	553	2,440	19	663	457	29	697	234
10	601	1,740	20	625	417	30	910	213
						31	726	- - - - -
Monthly mean discharge, in cubic feet per second							563	601
Runoff, in inches							1 70	1 76
Runoff, in acre-feet							34,630	35,760

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	3 91	501	June 9	0400	7 00	2,460	June 10	1200	6 10	1,710
	0500	4 40	668		0600	7 08	2,540		1800	5 90	1,540
	1200	4 43	681		0900	7 00	2,460		2400	5 70	1,420
	1500	4 50	690		1000	7 45	2,910				
	1800	4 80	780		1200	7 65	3,110	11	1200	5 38	1,190
	2000	5 25	975		1500	7 00	2,460		2400	5 05	975
	2200	5 88	1,440		1800	6 80	2,260				
	2400	6 40	1,890		2400	6 65	2,120	12	2400	4 72	802
9	0200	6 77	2,230	10	0600	6 40	1,940				

DOG CREEK BASIN

(38) 6-714 Dog Creek near Craig, Mont

(Crest-stage station)

Location --Lat 47°05', long 112°00', in NW¼ sec 4, T 15 N , R 3 W , at bridge on county road, 2 miles west of Craig

Drainage area --15 9 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,660 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 65 cfs June 8 (gage height, 1 97 ft)
1959 to May 1964 Discharge, 1,160 cfs May 30, 1961 (gage height, 4 40 ft), from slope-area measurement

WEGNER CREEK BASIN

(39) 6-716 Wegner Creek at Craig, Mont

(Crest-stage station)

Location --Lat 47°05', long 111°57', in NW¼ sec 11, T 15 N , R 3 W , at bridge on Interstate Highway 15 and U S Highway 91, 0 9 mile east of Craig

Drainage area --35 0 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,450 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 60 cfs June 8 (gage height, 0 54 ft)
1959 to May 1964 Discharge, 408 cfs July 6, 1961 (gage height, 2 54 ft)

DEARBORN RIVER BASIN

(40) 6-730 Dearborn River near Clemons, Mont

(Gaging station, discontinued 1953)

Location --Lat 47°17'30", long 112°27'00", in SE¼SE¼ sec 23, T 18 N , R 7 W , on right bank 300 ft upstream from highway bridge, half a mile southeast of former post office at Clemons, 2 miles downstream from Falls Creek, and 14 miles south of Augusta

Drainage area --123 sq mi (130 sq mi at slope-area site)

Gage-height record --High-water marks at gage site Altitude of gage is 4,560 ft (by barometer)

Discharge record --Peak discharge by slope-area measurement at site 3 miles downstream

Maxima --June 1964 Discharge, 17,400 cfs about 0300 hours June 9 (gage height, 9 15 ft, from high-water marks on gage house)
1921-23, 1929-53 Discharge, 3,200 cfs June 4, 1953 (gage height, 6 20 ft)
Flood of June 1964 exceeds that of June 1908 and is the highest since 1908, from information by local residents

(41) South Fork Dearborn River near Craig, Mont

(Miscellaneous site)

Location --Lat 47°09'40", long 112°13'00", in sec 10, T 16 N , R 5 W , on State Highway 434 and 13½ miles northwest of Craig

Drainage area --32 0 sq mi

Maxima --June 1964 Discharge, 1,230 cfs about 2400 hours June 8, from flow-through-culvert measurement

(42) Auchard Creek near Craig, Mont

(Miscellaneous site)

Location --Lat 47°15'30", long 112°13'00", in sec 3, T 17 N , R 5 W , on State Highway 20, 3 miles southwest of Bowman's corner and 17½ miles northwest of Craig

Drainage area --15 7 sq mi

Maximum --June 1964 Discharge, 353 cfs about 2200 hours June 8, from flow-through-culvert measurement

(43) 6-735 Dearborn River near Craig, Mont

Location --Lat 47°11'55", long 112°05'25", in NE¼SE¼ sec 27, T 17 N , R 4 W , on upstream side of old highway bridge, a quarter of a mile downstream from State Highway 287, 5 miles downstream from South Fork, and 10 miles northwest of Craig Water-stage recorder installation on right bank destroyed by flood on June 9 Type-A wire-weight gage on upstream side of bridge

Drainage area --325 sq mi

Gage-height record --Water-stage recorder graph May 1-31, graph reconstructed from high-water marks and outside gage readings June 1-13, observer's wire-weight gage readings June 14-30 Altitude of gage is 3,790 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 11,500 cfs and by slope-area measurement at 15,400 cfs

Maxima --June 1964 Discharge, 15,400 cfs about 0800 hours June 9 (gage height, 13 5 ft, from high-water profile)
1945 to May 1964 Discharge, 7,960 cfs June 4, 1953 (gage height, 9 58 ft)
Flood of June 1964 exceeded that of 1908 and is the highest since 1908, from information by local residents

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	349	2,130	11	799	3,670	21	1,620	922
2	625	1,640	12	759	2,560	22	1,390	837
3	1,020	1,510	13	806	2,080	23	1,100	772
4	1,090	1,510	14	938	1,780	24	954	752
5	799	1,440	15	938	1,530	25	892	822
6 ..	707	1,400	16 . .	962	1,440	26..	726	752
7	625	1,560	17	1,190	1,400	27	714	733
8 .	619	6,990	18	1,340	1,190	28	1,120	701
9	662	12,500	19	1,300	980	29	3,470	622
10	740	7,330	20	1,480	980	30	3,400	586
						31	2,310	- - - - -
Monthly mean discharge, in cubic feet per second							1,143	2,104
Runoff, in inches							4 06	7 22
Runoff, in acre-feet							70,300	125,200

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964, of Dearborn River near Craig, Mont

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	5.12	1,550	June 8	0500	9.25	7,370	June 9	0800	13.5	15,400
	0400	5.22	1,640		0700	9.48	7,780		1200	11.4	14,000
	0800	5.08	1,510		1100	9.30	7,460		1500	9.0	13,000
	1200	4.93	1,380		1800	8.94	6,810		1800	7.9	12,000
	1500	4.91	1,360		2400	10.20	9,080		1900	7.35	11,800
	1800	4.95	1,400						2400	√7.05	10,500
	2100	5.35	1,670	9	0400	11.5	11,500				
	2400	6.15	2,400		0700	13.3	15,000				

HARDY CREEK BASIN

(44) Hardy Creek near Cascade, Mont

(Miscellaneous site)

Location --Lat 47°11'00", long 111°48'40", in SW¼ sec 25, T 17 N , R 2 W , a quarter of a mile upstream from U S Highway 91 and 8 miles southwest of Cascade

Drainage area --9.46 sq mi

Maximum --June 1964 Discharge, 440 cfs about 2200 hours June 8, from slope-area measurement
Flood of June 1908 was much larger (from information by local residents)

MISSOURI RIVER MAIN STEM

(45) 6-740 Missouri River at Cascade, Mont

(Gaging station, discontinued 1915, U S Weather Bureau gage since 1950)

Location --Lat 47°16'10", long 111°41'45", in NW¼SE¼ sec 35, T 18 N , R 1 W , on downstream side of highway bridge at Cascade, 26 miles upstream from mouth of Smith River

Drainage area --18,493 sq mi

Gage-height record --Wire-weight gage read once daily at 0800 hours, except Saturdays and Sundays, and twice daily June 19, 22-26 Datum of gage is at mean sea level, datum of 1929

Maxima --June 1964 Elevation observed, 3,348.61 ft 1600 hours June 26, but may have been higher on June 9 when elevation observed was 3,348.45 ft
1902-1915, 1950 to May 1964 Discharge observed, 54,250 cfs June 5, 1908 (elevation 3,354.2 ft, revised), site then in use

Remarks --Flow regulated by 9 smaller irrigation reservoirs and powerplants having a combined capacity of 711,000 acre-ft and by Canyon Ferry Reservoir (see station 23)

Elevation, in feet, at 0800 hours on indicated day, 1964

Day	May	June	Day	May	June	Day	May	June
1	3,341.81	3,344.76	11	3,343.25	3,344.23	21	3,344.96	b 3,348.34
2	-	3,345.46	12	3,343.38	3,345.23	22	3,345.01	a 3,347.36
3	-	3,345.46	13	3,343.22	-	23	-	a 3,347.42
4	3,342.26	3,345.04	14	3,343.80	-	24	-	a 3,347.26
5	3,343.16	3,344.72	15	3,342.54	3,346.29	25	3,343.10	a 3,347.60
6	3,342.56	-	16	-	3,345.66	26	3,343.12	a 3,348.37
7	3,342.69	-	17	-	3,346.67	27	3,343.26	-
8	3,342.76	3,345.23	18	3,343.35	3,347.34	28	3,343.70	3,347.76
9	-	3,348.45	19	3,344.85	a 3,348.19	29	3,344.00	3,347.61
10	-	3,346.41	20	3,344.92	-	30	-	3,347.61
						31	-	- - - - -

a Average of readings made at 0800 and 1600 hours
b Reading made at 1800 hours

SMITH RIVER BASIN

(46) 6-750 Smith River Reservoir near White Sulphur Springs, Mont

Location --Lat 46°37', long 110°45', near center of south line of sec 17, T 10 N , R 8 E , at dam on Smith River, 9 miles northeast of White Sulphur Springs

Drainage area --72 3 sq mi

Gage-height record --Elevations determined by measuring from a reference mark about once a month Datum of gage is at mean sea level (levels by Montana Water Conservation Board)

Maxima --June 1964 Contents observed, 11,450 acre-ft May 29, June 30 (elevation, 5,488 45 ft)
1938-50, 1959 to May 1964 Contents observed, 11,600 acre-ft Apr 30, 1950 (elevation, 5,488 6 ft)

Remarks --Reservoir is formed by earthfill dam with concrete spillway completed in 1936 Total capacity, 10,700 acre-ft at elevation 5,486 0 ft Dead storage, 52 acre-ft below elevation 5,415 0 ft Water is used for irrigation Elevations and capacity table furnished by Montana Water Conservation Board Figures given herein represent usable contents

Elevation, in feet, and contents, in acre-feet, 1964

	Elevation	Contents
May 1	5,480 45	9,030
May 29	5,488 45	11,450
July 1	5,488 45	11,450

(47) 6-756 Five Mile Creek near White Sulphur Springs, Mont

(Crest-stage station)

Location --Lat 46°37', long 110°45', in SW¼ sec 20, T 10 N , R 8 E , at culvert on U S Highway 12, 8 miles northeast of White Sulphur Springs

Drainage area --6 00 sq mi

Gage-height record --Crest stages only Altitude of gage is 5,380 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 5 cfs

Maxima --June 1964 Discharge, 8 cfs June 8 (gage height, 1 16 ft)
1960 to May 1964 Discharge, about 20 cfs Feb 4, 1963 (gage height, 2 06 ft)

(48) 6-760 Newland Creek near White Sulphur Springs, Mont

(Gaging station, discontinued 1953, crest-stage station since 1960)

Location --Lat 46°44', long 110°50', near line between secs 9 and 10, T 11 N , R 7 E , 13 miles north of White Sulphur Springs and 15 miles upstream from mouth

Drainage area --6 74 sq mi

Gage-height record --Water-stage recorder graph used for crest stages only Altitude of gage is 5,590 ft (by barometer)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 13 cfs 2000 hours June 8 (gage height, 2 59 ft)
1946-53, 1960 to May 1964 Discharge, 56 cfs June 4, 1953 (gage height, 3 50 ft)

(49) 6-767 Sheep Creek near Neihart, Mont

(Crest-stage station)

Location --Lat 46°48', long 110°42', in SE¼ sec 15, T 12 N , R 8 E , at culvert on U S Highway 89, 10 miles south of Neihart

Drainage area --5 30 sq mi

Gage-height record --Crest stages only Altitude of gage is 6,600 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 113 cfs June 8 (gage height, 2 12 ft)
1960 to May 1964 Discharge, 78 cfs May 21, 1964 (gage height, 1 67 ft)

(50) 6-768 Nugget Creek near Neihart, Mont

(Crest-stage station)

Location --Lat 46°27', long 110°42', in NE¼ sec 27, T 12 N , R 8 E , at culvert on U S Highway 89, 11 miles south of Neihart

Drainage area --1 48 sq mi

Gage-height record --Crest stages only Altitude of gage is 6,400 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 8 cfs and from flow-through-culvert measurement at 14 cfs

Maxima --June 1964 Discharge, 10 cfs June 8 (gage height, 0 77 ft)
1959 to May 1964 Discharge, 15 cfs May 21, 1964 (gage height, 1 07 ft)

(51) 6-770 Sheep Creek near White Sulphur Springs, Mont

Location --Lat 46°46', long 110°49', in SW¼SE¼ sec 26, T 12 N , R 7 E , on right bank 7 miles upstream from Moose Creek and 16 miles north of White Sulphur Springs

Drainage area --54 4 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 5,820 ft (by barometer)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 362 cfs 0300 hours June 9 (gage height, 4 93 ft)
1941 to May 1964 Discharge, 460 cfs June 4, 1953 (gage height, 5 80 ft, from graph based on gage readings, at site 700 ft upstream and at datum 5 33 ft higher)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	56	217	11	52	266	21	274	152
2	67	208	12	54	246	22	271	139
3	45	209	13	69	226	23	241	125
4	33	213	14	89	212	24	219	118
5	40	223	15	113	199	25	213	109
6	35	227	16	149	192	26	206	99
7	30	243	17	210	189	27	203	95
8	32	282	18	227	179	28	222	94
9	38	343	19	229	170	29	236	89
10	50	306	20	255	166	30	233	90
						31	229	- - - - -
Monthly mean discharge, in cubic feet per second							143	188
Runoff, in inches							3 02	3 85
Runoff, in acre-feet							8,770	11,160

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964, of Sheep Creek near White Sulphur Springs, Mont

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	4 40	260	June 9	0300	4 93	362	June 10	1200	4 65	306
	1200	4 38	257		1200	4 84	344		2400	4 53	282
	2400	4 89	354		2400	4 77	330				

(52) 6-775 Smith River near Eden, Mont

Location --Lat 47°12', long 111°23', in SW¼SW¼ sec 29, T 17 N , R 3 E , on left bank a quarter of a mile upstream from Mullens Creek, 2 miles upstream from Hound Creek, and 7 miles southwest of Eden

Drainage area --1,594 sq mi

Gage-height record --Water-stage recorder graph Graph reconstructed on basis of partial recorder graph and observed gage height from 1800 hours June 8 to 0900 hours June 10 Altitude of gage is 3,500 ft (by barometer)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 3,860 cfs 1000 hours June 10 (gage height, 5 48 ft)
1951 to May 1964 Discharge, 12,300 cfs June 4, 1953 (gage height, 10 46 ft), from rating curve extended above 3,800 cfs on basis of slope-area measurement of peak flow, gage height, 12 50 ft Feb 4, 1963 (backwater from ice)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	914	2,030	11	1,650	3,180	21	3,590	1,700
2	1,280	1,910	12	1,560	2,860	22	3,450	1,550
3	1,360	1,910	13	1,580	2,500	23	3,020	1,380
4	1,390	1,990	14	1,780	2,240	24	2,580	1,250
5	1,280	2,040	15	1,930	2,100	25	2,320	1,170
6	1,340	2,060	16	2,230	2,010	26	2,200	1,130
7	1,240	2,180	17	2,790	1,940	27	2,050	1,110
8	1,270	2,610	18	3,380	1,880	28	2,140	1,060
9	1,310	3,580	19	3,200	1,740	29	2,460	992
10	1,480	3,750	20	3,400	1,800	30	2,390	910
						31	2,210	- - - - -
Monthly mean discharge, in cubic feet per second							2,089	1,952
Runoff, in acre-feet							128,500	116,200

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	3 98	2,060	June 8	1200	4 47	2,600	June 10	0600	5 46	3,840
	0600	4 05	2,140		1800	4 64	2,810		1000	5 48	3,860
	1200	4 13	2,220		2400	4 85	3,060		1200	5 45	3,820
	1600	4 15	2,240						1800	5 34	3,680
	2100	4 13	2,220	9	0600	5 13	3,410		2400	5 20	3,500
	2400	4 14	2,230		1200	5 34	3,680				
					1800	5 41	3,770	11	1200	4 93	3,160
8	0600	4 28	2,390		2400	5 45	3,820		2400	4 73	2,920

(53) 6-777 Smith River tributary near Eden, Mont

(Crest-stage station)

Location --Lat 47°18', long 111°26', in SW¼ sec 13, T 18 N , R 2 E , at bridge on county road, 7½ miles northwest of Eden

Drainage area --1 63 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,420 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 1 4 cfs June 8 (gage height, 0 24 ft)
1960 to May 1964 Discharge, 4 5 cfs June 15, 1962 (gage height, 0 72 ft)

(54) 6-778 Goodman Coulee near Eden, Mont

(Crest-stage station)

Location --Lat 47°20', long 111°25', in center sec 12, T 18 N , R 2 E , at culvert on county road, 8 miles northwest of Eden

Drainage area --21 8 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,370 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 80 cfs and by flow-through-culvert-measurement at 120 cfs

Maxima --June 1964 Discharge, 110 cfs June 8 (gage height, 3 58 ft, downstream gage)
1959 to May 1964 Discharge, about 150 cfs May 3, 1964 (gage height, 4 02 ft, downstream gage, 5 73 ft, upstream gage

MISSOURI RIVER MAIN STEM

(55) 6-782 Missouri River near Ulm, Mont

Location --Lat 47°26'10", long 111°23'10", in NW¼NW¼ sec 5, T 19 N , R 3 E , on left bank 6 miles east of Ulm and 9 miles downstream from Smith River

Drainage area --20,941 sq mi

Gage-height record --Digital-recorder tape punched at 15-minute intervals Altitude of gage is 3,310 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements Mean daily discharges computed from 96 punch-tape recordings per day and may not agree precisely with that derived from discharge at indicated times

Maxima --June 1964 Discharge, 27,500 cfs 0200 hours June 22 (gage height, 14 44 ft)
1957 to May 1964 Discharge, 19,100 cfs June 19, 1959 (gage height, 11 26 ft), maximum gage height, 12 20 ft Nov 17, 1959 (ice jam)
Flood in June 1953 reached a stage of about 17 ft (discharge, 35,000 cfs), flood in June 1948 reached a stage of about 16 ft (discharge, 32,000 cfs), from information by local residents

Remarks --Flow regulated by 10 smaller irrigation reservoirs and powerplants having a combined capacity of 721,620 acre-ft and by Canyon Ferry Reservoir (see station 23)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	5,420	16,700	11	12,600	23,000	21	18,300	27,200
2	6,120	17,000	12	13,000	18,300	22	18,300	27,200
3	7,890	18,000	13	12,800	19,700	23	17,100	25,700
4	9,350	17,800	14	12,800	22,200	24	13,200	24,700
5	9,450	16,400	15	11,900	22,000	25	12,000	24,200
6	9,220	15,400	16	10,400	21,500	26	11,500	24,600
7	9,250	14,900	17	10,700	20,600	27	11,200	25,800
8	9,690	16,400	18	12,600	22,300	28	11,800	25,800
9	11,600	21,700	19	14,600	24,100	29	13,500	25,300
10	12,800	26,100	20	17,500	25,900	30	16,600	24,900
						31	17,300	- - - - -
Monthly mean discharge, in cubic feet per second							12,270	21,850
Runoff, in acre-feet							754,700	1,300,000

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	9 55	15,300	June 9	2000	13 25	24,200	June 11	1200	12 91	23,200
	0400	9 72	15,700		2400	13 55	25,000		1600	12 48	22,000
	0800	9 83	15,900						2000	11 98	20,800
	1200	9 97	16,200	10	0400	13 79	25,700		2400	11 48	19,600
	1600	10 17	16,700		0800	13 95	26,200				
	2000	10 49	17,400		1200	14 04	26,400	12	0400	11 03	18,600
	2400	10 88	18,200		1500	14 07	26,500		0800	10 77	18,000
					2000	14 00	26,300		1200	10 71	17,900
9	0400	11 40	19,400		2400	13 86	25,900		1600	10 77	18,000
	0800	11 92	20,600						2000	10 87	18,200
	1200	12 39	21,800	11	0400	13 62	25,200		2400	11 01	18,500
	1600	12 87	23,100		0800	13 29	24,300				

(56) Missouri River above Sun River, at Great Falls, Mont

(City of Great Falls gage)

Location --Lat 47°29'30", long 111°18'20", near center of NW¼NE¼ sec 14, T 20 N , R 3 E , on right bank 800 ft upstream from mouth of Sun River at city water-supply pumping plant

Drainage area --21,175 sq mi (revised)

Gage-height record --Float-gage readings in forebay of pumping plant Graph based on hourly readings June 8-16 Datum of gage is at mean sea level (levels by city of Great Falls)

Maxima --June 1964 Elevation, 3,318 2 ft 0400 hours to 1200 hours June 10
1930 to May 1964 Elevation, 3,317 84 ft June 5, 1953 (from floodmarks)

Remarks --Records furnished by city of Great Falls

Elevation, in feet, at 2400 hours, on indicated day, 1964

Day	May	June	Day	May	June	Day	May	June
1	3,311 2	3,313 9	11	3,312 5	3,315 8	21	3,313 3	3,314 5
2	3,311 6	3,313 9	12	3,312 5	3,314 7	22	3,313 6	3,314 25
3	3,312 5	3,313 6	13	3,312 7	3,314 5	23	3,313 1	3,313 85
4	3,312 5	3,314 0	14	3,312 7	3,314 5	24	3,312 1	3,313 45
5	3,312 3	3,313 8	15	3,312 7	3,314 3	25	3,312 1	3,313 5
6	3,312 1	3,313 6	16	3,312 3	3,314 15	26	3,312 0	3,314 0
7	3,312 0	3,313 5	17	3,312 2	3,313 95	27	3,312 5	3,314 1
8	3,312 1	3,313 7	18	3,312 5	3,314 1	28	3,312 7	3,314 0
9	3,312 4	3,317 2	19	3,312 6	3,314 25	29	3,313 0	3,313 6
10	3,312 4	3,317 4	20	3,312 9	3,314 35	30	3,314 0	3,313 3
						31	3,313 5	- - - - -

Elevation, in feet, at indicated time, 1964

Date	Hour	Elevation	Date	Hour	Elevation	Date	Hour	Elevation
June 8	0000	3,313 5	June 9	2100	3,316 0	June 10	2400	3,317 4
	1500	3,313 25		2400	3,317 2			
	1800	3,313 4				11	0600	3,317 0
	2100	3,313 6	10	0100	3,317 45		1200	3,316 6
	2400	3,313 7		0200	3,317 7		1800	3,316 05
				0300	3,317 85		2400	3,315 8
9	0300	3,313 85		0400	3,318 2			
	0600	3,314 05		1200	3,318 2	12	0600	3,315 45
	0900	3,314 4		1300	3,317 95		1200	3,315 0
	1200	3,314 5		1500	3,317 85		1800	3,314 65
	1500	3,314 8		1820	3,317 9		2400	3,314 7
	1800	3,315 2		2100	3,317 65			

SUN RIVER BASIN

(57) 6-785 North Fork Sun River near Augusta, Mont

Location --Lat 47°38'30", long 112°51'30", in SW¼SW¼ sec 23, T 22 N , R 10 W , on left bank 400 ft upstream from Arsenic Creek, 1 mile upstream from confluence with South Fork, and 25 miles northwest of Augusta

Drainage area --258 sq mi

Gage-height record --Floodmarks at gage site Staff-gage readings at site three-quarters of a mile downstream at different datum used June 20-30 Datum of gage is 4,785 72 ft above mean sea level (levels by Bureau of Reclamation)

Discharge record --Stage-discharge relation defined by current-meter measurements below 4,000 cfs and by slope-area measurement at 51,100 cfs

Maxima --June 1964 Discharge, 51,100 cfs June 8 (gage height, 15 82 ft, from floodmarks)
1911-12, 1945 to May 1964 Discharge, 4,840 cfs June 3, 1948 (gage height, 7 03 ft)

Mean discharge, in cubic feet per second, 1964, of North Fork Sun River near Augusta, Mont

Day	May	June	Day	May	June	Day	May	June
1	303	1,900	11	386	5,000	21	2,200	1,410
2	316	1,800	12	428	3,500	22	2,300	1,320
3	288	1,700	13	542	3,000	23	1,800	1,400
4	278	1,600	14	596	2,800	24	1,500	1,620
5	272	1,600	15	655	2,500	25	1,300	1,740
6	266	2,500	16	836	2,300	26	1,100	1,570
7	254	4,000	17	1,180	2,000	27	1,000	1,560
8	275	20,000	18	1,430	1,800	28	1,400	1,390
9	306	14,000	19	1,590	1,700	29	3,100	1,200
10	363	7,000	20	1,940	1,560	30	3,000	1,090
						31	2,200	- - - - -
Monthly mean discharge, in cubic feet per second							1,078	3,219
Runoff, in inches							4 82	13 92
Runoff, in acre-feet							66,260	191,500

(58) 6-790 South Fork Sun River near Augusta, Mont
(Gaging station, discontinued 1912, formerly published as South Fork of North Fork Sun River)

Location --Lat 47°38', long 112°52", in SE¼ sec 27, T 22 N , R 10 W , 1 mile upstream from confluence with North Fork and 24 miles northwest of Augusta Altitude of gage was 4,730 ft (from topographic map)

Drainage area --252 sq mi

Maxima --June 1964 Discharge, 28,800 cfs June 8, from slope-area measurement
1911-12 Discharge, 2,740 cfs June 3, 1911 (gage height, 4 6 ft)

(59) 6-795 Gibson Reservoir near Augusta, Mont

Location --Lat 47°36'10", long 112°45'40", in NE¼NW¼SE¼ sec 4, T 21 N , R 9 W , at Gibson Dam on Sun River, 19 miles northwest of Augusta

Drainage area --575 sq mi

Gage-height recorder --Tape gage read once daily and more often during period June 7-13 Datum of gage is at mean sea level (levels by Bureau of Reclamation)

Discharge record --Inflow computed from gage readings at time intervals shown and from change in contents

Maxima --June 1964 Contents, 116,400 acre-ft 1930 hours June 8 (elevation, 4,732 23 ft, from floodmark) Rate of inflow, 60,000 cfs 1400 to 1600 hours June 8
1930 to May 1964 Contents observed, 107,100 acre-ft May 30, 1940 (elevation, 4,725 5 ft)

Remarks --Reservoir is formed by concrete dam with glory-hole type spillway completed in 1929 Usable capacity is 105,000 acre-ft (88,560 acre-ft prior to 1939) at elevation 4,724 00 ft No dead storage below elevation 4,560 0 ft Water is used for irrigation and recreation Records furnished by Bureau of Reclamation Figures given herein represent usable contents

Elevation, in feet, and contents, in acre-feet, at 0800 hours of indicated day, 1964

Day	May		June		Day	May		June	
	Elevation	Contents	Elevation	Contents		Elevation	Contents	Elevation	Contents
1	4,640 0	22,090	4,714 4	92,310	16	4,652 6	30,220	4,716 4	94,890
2	4,641 0	22,720	4,715 0	93,080	17	4,656 3	32,800	4,716 4	94,890
3	4,641 5	23,040	4,715 0	93,080	18	4,660 0	35,390	4,716 2	94,630
4	4,641 5	23 040	4,716 0	94,380	19	4,671 5	44,770	4,715 /	93,990
5	4,641 5	23,040	4,715 3	93,470	20	4,681 0	53,640	4,715 4	93,600
6	4,640 5	22,400	4,715 5	93,730	21	4,690 0	62,930	4,715 2	93,340
7	4,640 5	22,400	4,715 5	93,730	22	4,696 7	70,580	4,715 0	93,080
8	4,639 5	21,800	4,720 0	99,600	23	4,701 0	75,570	4,716 7	95,280
9	4,639 5	21,800	4,729 7	112,800	24	4,704 0	79,270	4,716 8	95,410
10	4,639 5	21,800	4,722 2	102,600	25	4,705 5	81,100	4,716 5	95,020
11	4,639 5	21,800	4,719 0	98,250	26	4,707 0	82,940	4,716 7	95,280
12	4,639 5	21,800	4,718 4	97,470	27	4,708 0	84,170	4,716 0	94,380
13	4,640 5	22,400	4,717 8	96,800	28	4,709 7	86,260	4,716 0	94,380
14	4,644 3	25,120	4,717 1	95,800	29	4,714 0	91,790	4,715 6	93,860
15	4,649 0	27,770	4,716 4	94,890	30	4,715 5	93,730	4,714 2	92,050
					31	4,715 0	93,080	-	-
Change in contents						-	+70,990	-	-1,030

Estimated average daily flows, in cubic feet per second, 1964, of Gibson Reservoir near Augusta, Mont

	Inflow	Outflow		Inflow	Outflow
June 8 ..	39,900	29,400	June 11	9,760	10,900
9	27,800	32,900	12 ..	8,110	8,660
10	13,400	16,300	13	7,400	7,650

Elevation, in feet, and computed inflow, in cubic feet per second, at indicated time, 1964

Date	Hour	Elevation	Inflow	Date	Hour	Elevation	Inflow
June 7	2400	4,716 41	6,300	June 8	2400	4,731 71	48,400
8	0100	4,716 43	6,700	9	0100	4,731 52	46,100
	0200	4,716 48	7,100		0200	4,731 30	43,500
	0300	4,716 61	9,800		0300	4,731 05	40,000
	0400	4,716 90	12,500		0400	4,730 78	38,000
	0500	4,717 35	16,000		0500	4,730 53	35,800
	0600	4,717 98	20,000		0600	4,730 26	33,900
	0700	4,718 83	25,500		0700	4,729 99	32,200
	0800	4,720 01	34,000		0800	4,729 70	30,600
	0900	4,721 37	38,300		0900	4,729 40	29,100
	1000	4,722 83	42,700		1000	4,729 11	27,800
	1100	4,724 37	47,000		1200	4,728 47	25,300
	1200	4,725 95	51,300		1800	4,726 33	20,000
	1300	4,727 55	55,700		2400	4,724 44	16,900
	1400	4,729 16	60,000				
	1500	4,730 53	60,000	10	0600	4,723 01	14,700
	1600	4,731 41	60,000		1200	4,721 85	13,000
	1700	4,731 90	58,900		1800	4,720 94	12,000
	1800	4,732 12	57,700		2400	4,720 23	11,000
	1900	4,732 20	56,600				
	1930	4,732 23	56,000	11	0600	4,719 63	10,300
	2000	4,732 20	55,300		1200	4,719 15	9,700
	2100	4,732 09	53,800		1800	4,718 77	9,200
	2200	4,732 00	52,200		2400	4,718 44	8,700
	2300	4,731 86	50,400				

(60) 6-796 Beaver Creek at Gibson Dam, near Augusta, Mont
(Crest-stage station)

Location --Lat 47°36', long 112°45', in SE¼ sec 4, T 21 N , R 9 W , at bridge on Bureau of Reclamation road, a quarter of a mile downstream from Gibson Dam, and 19 miles northwest of Augusta

Drainage area --20 3 sq mi

Gage-height record --Crest stages only Altitude of gage is 4,560 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 70 cfs and by slope-area measurements at 496 cfs and 4,360 cfs

Maxima --June 1964 Discharge, 4,360 cfs June 8, from slope-area measurement
1959 to May 1964 Discharge, 496 cfs May 26, 1962 (gage height, 2 45 ft), from slope-area measurement

(61) 6-800 Sun River near Augusta, Mont
(Gaging station, discontinued 1940, formerly called North Fork Sun River)

Location --Lat 47°37', long 112°42', in NW¼ sec 36, T 22 N , R 9 W , about 150 ft upstream from diversion dam and 18 miles northwest of Augusta

Drainage area --609 sq mi

Gage-height record --Staff-gage readings Peak stage determined from floodmark Datum of gage is 4,474 ft above mean sea level (levels by Bureau of Reclamation)

Discharge record --Peak discharge by flow-over-dam measurement Observed daily flow, adjusted flow based on change in contents of Gibson Reservoir, furnished by Bureau of Reclamation

Maxima --June 1964 Discharge, 59,700 cfs 0500 hours June 9 (gage height, 15 7 ft, from high-water mark on gage house)
1889-90, 1904 to May 1964 Discharge, 32,300 cfs June 21, 1916 (gage height, 11 4 ft)

Remarks --Flow regulated since 1930 by Gibson Reservoir (see station 59) Records 1916-36 furnished by Bureau of Reclamation

Computed flow over diversion dam, Sun River near Augusta, Mont , on indicated day 1964

Date	Contents in Gibson Reservoir (acre-feet)	Change in contents in Gibson Reservoir (equivalent cfs-days)	Flow in Pishkun Canal (cfs)	Flow in Willow Creek feeder canal (cfs)	Observed flow over diversion dam (cfs)	Adjusted flow over diversion dam (cfs)
May 1	22,090	0	430	0	110	540
2	22,720	+320	560	0	110	990
3	23,040	+160	620	0	140	920
4	23,040	0	620	0	150	770
5	23,040	0	620	0	140	760
6	22,400	-320	620	0	130	430
7	22,400	0	620	0	120	740
8	21,800	-300	620	0	120	440
9	21,800	0	620	0	120	740
10	21,800	0	620	0	120	740
11	21,800	0	470	0	120	590
12	21,800	0	380	50	120	550
13	22,400	+300	160	90	130	680
14	25,120	+1,370	20	90	250	1,730
15	27,770	+1,340	20	0	250	1,610
16	30,220	+1,230	20	0	250	1,500
17	32,800	+1,300	20	0	250	1,570
18	35,390	+1,300	20	0	260	1,580
19	44,770	+4,730	20	0	280	5,030
20	53,640	+4,470	140	0	290	4,900
21	62,930	+4,680	340	50	290	5,360
22	70,580	+3,860	680	90	290	4,920
23	75,570	+2,520	800	90	290	3,700
24	79,270	+1,860	800	90	290	3,040
25	81,100	+930	930	90	290	2,240
26	82,940	+930	1,100	100	290	2,420
27	84,170	+620	1,290	100	290	2,300
28	86,260	+1,050	1,340	100	430	2,920
29	91,790	+2,790	1,160	100	2,100	6,150
30	93,730	+980	1,000	100	3,990	6,070
31	93,080	-330	960	100	3,510	4,240
Total cfs-days	-	+35,790	17,620	1,240	15,520	70,170
Mean	-	-	568	40 0	501	2,264
June 1	92,310	-390	960	100	3,130	3,800
2	93,080	+390	960	100	3,280	4,730
3	93,080	0	1,110	100	3,510	4,720
4	94,380	+650	1,110	100	4,560	6,420
5	93,470	-460	1,340	100	2,230	3,210
6	93,730	+130	1,340	100	4,080	5,650
7	93,730	0	1,340	100	4,210	5,650
8	99,600	+2,960	1,340	100	27,960	32,360
9	112,800	+6,660	690	0	32,210	39,560
10	102,600	-5,140	100	0	16,200	11,160
11	98,250	-2,190	100	0	10,800	8,710
12	97,470	-390	100	0	8,560	8,270
13	96,800	-340	100	0	7,550	7,310
14	95,800	-510	100	0	6,800	6,390
15	94,890	-490	100	0	6,500	6,140
16	94,890	0	100	0	6,650	6,750
17	94,890	0	100	0	6,900	7,000
18	94,630	-130	100	0	6,160	6,130
19	93,990	-320	200	0	5,300	5,180
20	93,600	-200	200	0	3,990	3,990
21	93,340	-130	200	0	3,280	3,350
22	93,080	-130	200	0	3,550	3,620
23	95,280	+1,110	400	0	3,050	4,560
24	95,410	+70	640	0	3,390	4,100
25	95,020	-200	640	0	3,390	3,830
26	95,280	+130	830	0	4,510	5,470
27	94,380	-460	830	0	3,510	3,880
28	94,380	0	1,010	0	3,130	4,140
29	93,860	-260	1,010	0	3,130	3,880
30	92,050	-910	1,280	0	1,970	2,340
Total cfs-days	-	-520	18,530	800	203,490	222,300
Mean	-	-	618	26 7	6,783	7,410

(62) South Fork Willow Creek near Augusta, Mont

(Miscellaneous site)

Location --Lat 47°31'00", long 112°31'00", in center of sec 5, T 20 N , R 7 W , a quarter of a mile upstream from bridge on county road and 7 miles northwest of Augusta

Drainage area --26 9 sq mi

Maximum --June 1964 Discharge, 2,790 cfs about 1800 hours June 8, from slope-area measurement

(63) Sun River at State Highway 287, near Augusta, Mont

(Miscellaneous site)

Location --Lat 47°32'40", long 112°21'50", in NW¼ sec 27, T 21 N , R 6 W , at bridge on State Highway 287, 4 miles northeast of Augusta

Drainage area --827 sq mi

Maximum --June 1964 Discharge, 46,700 cfs June 9, from contracted-opening measurement

Remarks --Peak flow partly regulated by storage in Gibson Reservoir (see station 59)

(64) 6-835 Ford Creek near Augusta, Mont

(Gaging station, discontinued 1912)

Location --Lat 47°26', long 112°40', near center of south line sec 31, T 20 N , R 8 W , at Ford Ranch, 14 miles west of Augusta Altitude of gage is 4,760 ft (from topographic map)

Drainage area --19 4 sq mi

Discharge record --Peak discharge by slope-area measurement at site about 1 mile upstream

Maxima --June 1964 Discharge, 2,700 cfs 1300 hours June 8
1906-12 Discharge, 1,230 cfs June 19, 1909 (gage height, 5 5 ft, from graph based on gage readings), from rating curve extended above 140 cfs

(65) 6-840 Smith Creek below Ford Creek, near Augusta, Mont

(Gaging station, discontinued 1952)

Location --Lat 47°26', long 112°31', in S½ sec 32, T 20 N , R 7 W , on right bank 2 miles downstream from Ford Creek, 4 miles upstream from mouth, and 7 miles southwest of Augusta

Drainage area --74 0 sq mi

Gage-height record --High-water marks on the right bank at gage site Altitude of gage is 4,300 ft (from topographic map)

Discharge record --Peak discharge by slope-area measurement

Maxima --June 1964 Discharge, 6,140 cfs about 2100 hours June 8 (gage height, 13 4 ft, from floodmarks)
1945-52 Discharge, 1,830 cfs June 5, 1948 (gage height, 5 7 ft), from rating curve extended above 940 cfs

(66) Elk Creek near Augusta, Mont

(Miscellaneous site)

Location --Lat 47°27'00", long 112°26'00", in NE¼ sec 36, T 20 N , R 7 W , half a mile downstream from Smith Creek, and 3½ miles southwest of Augusta

Drainage area --145 sq mi

Maximum --June 1964 Discharge, about 12,000 cfs 2200 hours June 8, from slope-area measurement

(67) Sun River at Simms, Mont

(U S Weather Bureau gage)

Location --Lat 47°30'25", long 111°55'50", in SW¼NE¼ sec 12, T 20 N , R 3 W , on right bank at downstream side of county bridge 1 mile north of Simms and 1 mile downstream from Simms Creek

Drainage area --1,320 sq mi (1,224 sq mi at slope-area site 4 miles upstream)

Gage-height record --Once-daily staff-gage readings, except some additional observations during peak flows The maximum stage is based on floodmarks at the gage Datum of gage is at mean sea level, on basis of Great Northern Railway datum

Maxima --June 1964 Discharge, 69,800 cfs 0600-1000 hours June 9 (elevation, 3,561 6 ft, from floodmarks), from slope-area measurement of peak flow at site 4 miles upstream
1941 to May 1964 Elevation observed, 3,557 1 ft June 4, 1953

Remarks --Peak flow partly regulated by storage in Gibson Reservoir (see station 59)

Elevation, in feet, at about 0800 hours, on indicated day, 1964

Day	May	June	Day	May	June	Day	May	June
1	-	3,553 0	11	3,549 8	3,556 0	21	3,549 8	3,552 7
2	-	3,552 9	12	3,549 8	3,554 8	22	3,549 8	3,552 3
3	3,551 0	3,552 9	13	-	3,554 3	23	3,549 8	3,551 8
4	3,550 5	3,553 2	14	-	3,553 9	24	3,549 8	3,551 8
5	3,550 3	3,553 5	15	-	3,553 7	25	3,549 8	3,551 8
6	3,549 8	3,553 3	16	3,549 8	3,553 7	26	-	3,552 1
7	3,549 8	3,553 3	17	3,549 8	3,553 9	27	3,549 8	3,552 2
8	3,549 8	3,554 3	18	3,549 8	3,553 7	28	3,549 8	3,552 0
9	3,549 8	3,561 6	19	3,549 8	3,553 3	29	3,550 0	3,551 8
10	3,549 8	3,558 3	20	3 549 8	3,552 8	30	3,553 4	3,551 5
						31	3,553 4	- - - - -

Elevation, in feet, at indicated time, 1964

Date	Hour	Elevation	Date	Hour	Elevation	Date	Hour	Elevation
June 8	0800	3,554 3	June 9	1945	3,556 6	June 9	0600	3,561 6
	1030	3,555 3		2100	3,556 6		1000	3,561 6
	1500	3,555 3		2300	3,558 6			
	1700	3,556 1		2400	3,559 1			

(68) 6-879 Muddy Creek tributary near Power, Mont

(Crest-stage station)

Location --Lat 47°45', long 111°43', on south line of SW¼ sec 10 T 23 N , R 1 W , at culvert on county road, 3 miles west of U S Highway 91, 3½ miles northwest of Power, and 6 miles south of Dutton

Drainage area --3 15 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,710 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 100 cfs and by a combined flow-over-road and flow-through-culvert measurement at 284 cfs

Maxima --June 1964 Discharge, 220 cfs June 8 (gage height, 2 13 ft, downstream gage, 3 51 ft, upstream gage)
1963 to May 1964 Discharge, 284 cfs May 3, 1964 (gage height, 2 26 ft, downstream gage, 4 75 ft, upstream gage)

(69) Muddy Creek at Vaughn, Mont

Location --Lat 47°33'40", long 111°32'30", near center of S½NE¼ sec 24, T 21 N , R 1 E , near center of span on upstream side of old highway bridge at Vaughn, 1½ miles upstream from mouth

Gage-height record --Once-daily readings by observer and crest stages Graph based on gage readings and crest-stage gage June 7-15 Altitude of gage is 3,350 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964, Discharge, 3,720 cfs 0200 hours June 9 (gage height, 12 24 ft)
1925-26, 1934 to May 1964 Discharge, 7,600 cfs June 4, 1953 (gage height, 17 7 ft, from floodmarks), from rating curve extended above 3,000 cfs on basis of slope-area measurement of peak flow

Flood in June 1908 reached a stage of about 24 ft (discharge not determined), flood in June 1932 reached a stage of about 19 ft, present datum (discharge not determined)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	101	243	11	118	1,060	21	79	206
2	148	228	12	117	629	22	91	216
3	1,270	248	13	103	410	23	155	192
4	1,480	235	14	99	344	24	171	164
5	503	223	15	96	320	25	161	168
6	296	277	16	91	328	26	171	164
7	194	312	17	89	302	27	174	155
8	164	1,640	18	84	288	28	210	154
9	138	3,110	19	83	224	29	378	152
10	127	1,830	20	80	220	30	405	193
						31	296	- - - - -
Monthly mean discharge, in cubic feet per second							247	474
Runoff, in acre-feet..							15,220	28,230

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	4 00	378	June 9	0400	12 15	3,650	June 10	1600	9 30	1,630
	0200	4 20	414		0600	11 85	3,520		2000	8 85	1,510
	0400	4 45	460		0800	11 50	3,320		2400	8 40	1,370
	0600	4 85	540		1000	11 60	3,240				
	0800	5 60	790		1200	12 05	3,140	11	0600	7 80	1,200
	1000	6 60	1,130		1400	12 10	2,980		1200	7 10	1,020
	1200	7 30	1,400		1600	12 05	2,840		1800	6 40	920
	1400	8 20	1,770		1800	11 95	2,730		2400	6 05	815
	1600	9 00	2,130		2000	11 89	2,580				
	1800	10 05	2,640		2200	11 70	2,510	12	0600	5 85	728
	2000	10 80	2,920		2400	11 45	2,400		1200	5 50	615
	2200	11 75	3,480						1800	5 15	530
	2400	12.20	3,680	10	0400	10 90	2,180		2400	4 90	470
					0800	10 25	2,000				
9	0200	12 24	3,720		1200	9 80	1,790	13	1200	4 50	405
									2400	4 20	360

(70) 6-890 Sun River near Vaughn, Mont

Location --Lat 47°31'35", long 111°29'05", in SE¼SW¼ sec 33, T 21 N , R 2 E , on right bank 4 miles downstream from Muddy Creek, 4 miles southeast of Vaughn, and 13 miles upstream from mouth

Drainage area --1,854 sq mi

Gage-height record --Water-stage recorder graph for main channel Graph reconstructed from engineer's readings and floodmarks for 1000 hours June 9 to 1700 hours June 12 Datum of gage is 3,317 12 ft above mean sea level, datum of 1929, supplementary adjustment of 1962

Discharge record --Stage-discharge relation defined by current-meter measurements for main channel flow Bypass flow from slope-area measurement at peak stage Bypass flow 1400 hours June 9 to 1800 hours June 10 included in discharge data

Maxima --June 1964 Discharge, 53,500 cfs 1800 hours June 9 (gage height, 23 4 ft, from floodmarks), includes 11,300 cfs bypass flow
1934 to May 1964 Discharge, 17,900 cfs June 4, 1953 (gage height, 16 38 ft, from high-water mark on gage house)
Flood of June 1964 exceeded the stage of the June 1908 flood by about 3 ft and is the highest since 1908, from information by local residents

Remarks --Flow partly regulated by storage in Gibson Reservoir (see station 59)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	315	3,910	11	360	21,400	21	360	5,180
2	532	3,420	12	345	14,300	22	391	4,500
3	1,700	3,460	13	300	10,400	23	439	4,080
4	2,990	3,900	14	300	8,750	24	399	3,880
5	1,340	4,490	15	308	7,950	25	360	4,210
6	864	4,250	16	322	7,690	26	368	4,430
7	585	4,260	17	330	7,860	27	368	4,220
8	506	6,700	18	360	7,610	28	415	3,880
9	431	29,500	19	368	6,680	29	675	3,550
10	391	37,000	20	375	5,670	30	2,760	3,280
						31	4,460	- - - - -
Monthly mean discharge, in cubic feet per second							775	8,014
Runoff, in acre-feet							47,640	476,800

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	5 48	4,180	June 9	0700	12 27	12,800	June 10	0600	22 15	42,100
	0600	5 48	4,180		0800	12 50	13,200		1200	21 35	36,300
	1200	5 52	4,220		0900	12 73	13,600		1800	20 45	31,500
	1800	5 63	4,330		1000	13 11	14,200		2400	19 45	27,800
	2400	5 77	4,470		1100	14 20	16,200				
					1200	15 27	18,400	11	0600	18 45	23,600
8	0600	6 29	4,990		1300	17 80	24,500		1200	17 70	20,800
	0900	6 66	5,370		1400	20 70	32,700		1800	17 00	18,700
	1200	7 36	6,140		1500	23 05	49,800		2400	16 40	17,100
	1400	7 86	6,720		1600	23 26	52,000				
	1600	8 43	7,410		1700	23 35	52,900	12	0600	15 80	15,600
	1800	9 07	8,200		1800	23 4	53,500		1200	15 25	14,300
	2000	9 70	9,020		1900	23 35	52,900		1800	14 52	12,800
	2200	10 39	9,960		2000	23 26	52,000		2400	13 83	11,800
	2400	10 99	10,840		2100	23 15	51,000				
					2200	23 05	50,000	13	0600	13 17	10,900
9	0200	11 38	11,400		2300	22 95	49,000		1200	12 57	10,300
	0400	11 76	12,000		2400	22 05	48,100		1800	12 03	9,780
	0500	11 94	12,300						2400	11 61	9,360
	0600	12 09	12,500								

(71) 6-893 Sun River tributary near Great Falls, Mont

(Crest-stage gage)

Location --Lat 47°32', long 111°24', in SW¼ sec 31, T 21 N , R 3 E , at culvert on old U S Highway 89 and 91, 4 miles northwest of Great Falls

Drainage area --21 1 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,330 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 110 cfs and by flow-through-culvert measurement at 470 cfs

Maxima --June 1964 Discharge, 470 cfs June 8 (gage height, 5 46 ft)
1956 to May 1964 Discharge, 215 cfs May 5, 1964 (gage height, 3 94 ft)

(72) Sun River at Great Falls, Mont

(Corps of Engineers gage)

Location --Lat 47°29'40", long 120°20'00", in NE¼ sec 15, T 20 N , R 3 E , at 14th Street Bridge, 1 mile upstream from mouth

Drainage area --1,937 sq mi

Gage-height record --Stage observations made from one to thirty times daily by measuring down to water surface from reference point on handrail of bridge Datum of gage is at mean sea level (levels by Corps of Engineers)

Maxima --June 1964 Elevation observed, 3,324 6 ft 0045 hours June 10
Peak of 1908 reached a stage of about 3,328 ft, Corps of Engineers estimate

Remarks --Stage observations furnished by Corps of Engineers Peak stages partly affected by storage in Gibson Reservoir (see station 59)

Elevation in feet, at indicated time, 1964

Date	Hour	Elevation	Date	Hour	Elevation	Date	Hour	Elevation
June 8	1130	3,313 9	June 10	0045	3,324 6	June 16	0800	3,315 0
	1700	3,314 4		0200	3,324 5	17	0800	3,314 8
	2245	3,315 1		0615	3,323 9	18	-	3,314 9
	2400	3,315 2		1200	3,322 9	19	-	3,314 9
				1800	3,322 1	20	-	3,314 8
9	0900	3,315 9		2215	3,321 3			
	1115	3,316 1				21	-	3,314 8
	1400	3,316 6	11	0800	3,320 0	22	-	3,314 8
	1600	3,317 1		1115	3,319 5	23	-	3,314 5
	1800	3,318 2				24	-	3,314 3
	1900	3,318 4	12	0800	3,317 4	25	-	3,314 2
	2000	3,319 4						
	2055	3,321 6	13	0800	3,315 8	26	-	3,314 3
	2200	3,323 3		1050	3,315 7	27	-	3,314 4
	2300	3,324 1				28	-	3,314 4
	2400	3,324 45	14	0800	3,315 3	29	-	3,314 3
			15	0800	3,315 0			

MISSOURI RIVER MAIN STEM

(73) 6-903 Missouri River near Great Falls, Mont

Location --Lat 47°34'55", long 111°03'35", in NE¼SW¼ sec 14, T 21 N , R 5 E , at Morony Dam, 10 miles northeast of Great Falls

Drainage area --23,292 sq mi

Gage-height record --Water-stage recorder on reservoir determines head on taintor gates Daily and hourly records of outflow furnished by The Montana Power Co , adjusted on basis of discharge measurements, except 1800 hours June 9 to 1700 hours June 11, for which a graph was based on a discharge measurement, hourly outflow figures, and comparison with adjacent stations Datum of gage is at mean sea level (levels by The Montana Power Co)

Discharge record --Daily records of outflow and hourly records June 8-13 supplied by The Montana Power Co

Maxima --June 1964 Discharge, 72,000 cfs 1000 hours June 10 (from graph based on outflow figures)
1953, 1956 to May 1964 Discharge, 66,600 cfs June 4, 1953
Flood of June 10, 1964, is the highest since 1908

Remarks --Records collected by The Montana Power Co

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	6,750	21,200	11	14,100	54,300	21	18,600	32,600
2	5,980	20,300	12	13,300	38,300	22	19,200	33,100
3	9,520	21,400	13	13,800	31,400	23	18,200	31,700
4	14,200	21,800	14	13,800	30,800	24	15,300	29,600
5	11,500	21,400	15	13,400	31,600	25	13,000	29,200
6	10,800	20,200	16	11,400	29,800	26	12,800	29,300
7	10,900	19,200	17	11,400	29,000	27	11,500	29,900
8	10,600	22,700	18	12,900	29,300	28	11,900	30,300
9	11,600	32,300	19	14,200	30,400	29	14,200	29,700
10	13,700	63,400	20	17,700	31,700	30	17,700	28,900
						31	21,700	- - - - -
Monthly mean discharge, in cubic feet per second							13,410	30,160
Runoff, in acre-feet							824,400	1,795,000

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	-	19,800	June 9	0600	-	26,800	June 10	1200	-	71,400
	0600	-	22,000		1000	-	33,200		1800	-	67,700
	1200	-	22,400		1200	-	31,500		2400	-	63,700
	1500	-	22,300		1800	-	35,000				
	1800	-	23,900		2400	-	40,000	11	0600	-	60,000
	2100	-	25,300						1200	-	55,000
	2400	-	28,400	10	0400	-	52,000		1800	-	47,800
					0800	-	70,000		2000	-	45,500
9	0200	-	30,300		1000	-	72,000		2400	-	45,500

BELT CREEK BASIN

(74) 6-905 Belt Creek near Monarch, Mont

Location --Lat 47°12', long 110°56', in SE¼NW¼ sec 26, T 17 N , R 6 E , on left bank half a mile south of Riceville and 9 miles northwest of Monarch

Drainage area --368 sq mi

Gage-height record --Water-stage recorder graph High-water marks at peak stage

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 4,710 cfs 0600 hours June 9 (gage height, 7 74 ft, from inside gage, 7 91 ft, from floodmarks)
1951 to May 1964 Discharge, 11,000 cfs June 4, 1953 (gage height, 10 12 ft), from rating curve extended above 2,500 cfs on basis of slope-area measurement of peak flow
Flood in June 1908 was several feet lower than that in 1953, from information by local resident

Mean discharge, in cubic feet per second, 1964, of Belt Creek near Monarch, Mont

Day	May	June	Day	May	June	Day	May	June
1	502	1,280	11	878	2,340	21	2,800	853
2	664	1,240	12	836	1,920	22	2,560	783
3	642	1,320	13	938	1,590	23	1,980	706
4	612	1,410	14	1,110	1,400	24	1,560	662
5	515	1,490	15	1,220	1,340	25	1,450	640
6	502	1,510	16	1,420	1,250	26	1,380	630
7	489	1,530	17	2,020	1,200	27	1,330	625
8	485	2,290	18	2,360	1,160	28	1,380	581
9	533	4,360	19	2,150	1,050	29	1,500	536
10	741	3,070	20	2,570	958	30	1,490	518
						31	1,370	- - - - -
Monthly mean discharge, in cubic feet per second							1,290	1,341
Runoff, in inches							4 0	4 07
Runoff, in acre-feet							79,310	79,820

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	4 96	1,520	June 8	1200	5 43	1,920	June 9	1200	7 71	4,640
	1200	4 88	1,460		1800	5 92	2,370		1800	7 52	4,260
	1800	4 98	1,530		2100	6 63	3,080		2400	7 12	3,680
	2400	5 27	1,770		2400	7 37	3,980				
8	0600	5 57	2,040	9	0600	a 7 74	4,710				

a 7 91 ft, from floodmark

HIGHWOOD CREEK BASIN

(75) Highwood Creek near Highwood, Mont

(Miscellaneous site)

Location --Lat 47°33'40", long 110°46'40", near center of sec 24, T 21 N , R 7 E , 1¾ miles southeast of Highwood

Drainage area --75 2 sq mi

Maxima --June 1964 Discharge, 1,830 cfs June 8, from slope-area measurement
Flood of June 4, 1953, reached a discharge of 9,210 cfs, from slope-area measurement

MISSOURI RIVER MAIN STEM

(76) 6-908 Missouri River at Fort Benton, Mont

Location --Lat 47°49'03", long 110°39'59", in SE¼SE¼ sec 23, T 24 N , R 8 E , on left bank at downstream side of former highway bridge at Fort Benton, 4 miles upstream from Shonkin Creek

Drainage area --24,749 sq mi

Gage-height record --Digital-recorder tape punched at 15-minute intervals except 0100 hours June 10 to 0900 hours June 11, when water-stage recorder graph was used Datum of gage is 2,614 05 ft above mean sea level, datum of 1929

Discharge record --Stage-discharge relation defined by current-meter measurements Mean daily discharges computed from 96 punch-tape recordings per day June 8, 9, 12 may not agree precisely with that derived from discharge at indicated times

Maxima --June 1964 Discharge, 77,400 cfs 1000 hours June 10 (gage height, 13 44 ft)
1890 to May 1964 Discharge observed, about 140,000 cfs June 6, 1908 (gage height, 18 5 ft), from rating curve extended above 63,000 cfs

Remarks --Flow regulated by 18 small reservoirs and powerplants and Canyon Ferry Reservoir (see station 23)

Mean discharge, in cubic feet per second, 1964, of Missouri River at Fort Benton, Mont

Day	May	June	Day	May	June	Day	May	June
1	6,760	22,800	11	15,000	59,100	21	21,200	32,100
2	6,760	21,900	12	14,600	42,100	22	21,700	32,800
3	10,700	22,600	13	14,800	33,900	23	21,400	31,900
4	18,200	23,300	14	15,000	31,600	24	18,400	30,100
5	14,600	23,200	15	15,100	31,500	25	15,400	29,500
6	12,000	22,300	16	13,100	31,000	26	14,100	28,900
7	11,500	21,100	17	13,000	30,100	27	13,800	29,500
8	11,600	24,600	18	14,800	29,800	28	13,700	30,100
9	12,100	35,400	19	16,900	30,600	29	15,500	29,900
10	14,400	68,900	20	19,300	31,400	30	18,300	29,200
						31	23,800	- - - - -
Monthly mean discharge, in cubic feet per second							15,080	31,370
Runoff, in acre-feet							927,300	1,867,000

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	6 18	21,000	June 9	0400	7 86	31,100	June 10	0800	13 28	75,800
	0200	6 16	20,900		0600	8 26	33,800		1000	13 44	77,400
	0400	6 26	21,400		0800	8 39	34,700		1200	13 40	77,000
	0600	6 31	21,700		1000	8 28	34,000		1800	12 93	72,300
	0800	6 37	22,000		1200	8 38	34,700		2400	12 45	67,500
	1000	6 54	23,000		1400	8 55	35,800				
	1200	7 03	25,900		1600	8 66	36,600	11	0600	12 02	63,600
	1400	7 28	27,400		1800	8 74	37,200		1000	11 72	60,900
	1600	7 03	25,900		2000	8 83	37,900		1200	11 54	59,000
	1800	7 19	26,800		2200	9 25	41,000		1800	11 07	54,400
	2000	7 32	27,600		2400	9 97	46,400		2400	10 72	50,800
	2200	7 38	28,000								
	2400	7 49	28,700	10	0200	10 37	49,600	12	0800	10 12	44,300
					0400	11 25	56,800		1600	9 51	39,800
9	0200	7 64	29,700		0600	12 85	71,500		2400	9 00	36,000

MARIAS RIVER BASIN

(77) Two Medicine Creek above Trick Falls, near East Glacier, Mont

(Miscellaneous site)

Location --Lat 48°30', long 113°22', half a mile upstream from Trick Falls, three-quarters of a mile downstream from Two Medicine Lake, and 7½ miles northwest of East Glacier

Drainage area --26 8 sq mi

Maximum --June 1964 Discharge, 13,600 cfs June 8, from slope-area measurement

(78) Dry Fork Two Medicine Creek near East Glacier, Mont

(Miscellaneous site)

Location --Lat 48°30'45", long 113°23'30", in an unsurveyed area about 2½ miles upstream from mouth and 10 miles northwest of East Glacier

Drainage area --7 66 sq mi

Maximum --June 1964 Discharge, 3,940 cfs June 8, from slope-area measurement

(79) 6-909 Lower Two Medicine Lake near East Glacier, Mont

(Discontinued June 8, 1964, due to dam failure)

Location --Lat 48°30', long 113°16', in NE¼ sec 34, T 32 N , R 13 W , at dam on Two Medicine Creek, 4 miles northwest of East Glacier

Drainage area --50 2 sq mi

Gage-height record --Wire-weight gage read about once a month Datum of gage is at mean sea level (levels by Bureau of Indian Affairs)

Maxima --June 1964 Contents, 20,930 acre-ft 1530 hours June 8 (elevation, 4,883 3 ft, from floodmark in gage box)
1938 to May 1964 Contents observed, 14,800 acre-ft May 31, 1944 (elevation, 4,875 67 ft)

Remarks --Reservoir was formed by earthfill dam completed in 1913 Usable capacity, 16,620 acre-ft at elevation 4,878 0 ft Dead storage unknown below 4,848 0 ft (elevation of natural outlet) Water is used for irrigation and recreation Figures given herein represent usable contents Records furnished by Bureau of Indian Affairs

Elevation, in feet, and contents, in acre-feet, 1964

	Elevation	Contents
May 2	4,875 8	14,900
May 31	4,875 9	14,980
June 8	4,883 3	20,930

(80) 6-910 Two Medicine River near East Glacier, Mont

(Gaging station, discontinued May 31, 1964)

Location --Lat 48°29'30", long 113°15'40", in NW¼ sec 35, T 32 N , R 13 W , on right bank 85 ft upstream from timber bridge, 125 ft upstream from Fortymile Creek, a quarter of a mile downstream from Lower Two Medicine Dam, and 3½ miles northwest of East Glacier

Drainage area --51 1 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 4,870 ft (from topographic map) Gage destroyed by flood on June 8 and datum not recovered

Discharge record --Stage-discharge relation defined by current-meter measurements below 640 cfs Peak discharge by slope-area measurement

Maxima --June 1964 Discharge, 63,500 cfs about 1600 hours June 8 (partly due to failure of Lower Two Medicine Dam)
1912, 1918-24, 1962 to May 1964 Discharge, 1,390 cfs June 11, 1918 (gage height, 7 85 ft, at site three-quarters of a mile downstream and at datum then in use)

Remarks --Flow regulated by storage in Lower Two Medicine Lake (see station 79)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	59	-	11	107	-	21	133	-
2	81	-	12	111	-	22	120	-
3	96	-	13	111	-	23	111	-
4	103	-	14	106	-	24	170	-
5	111	-	15	107	-	25	256	-
6	103	-	16	115	-	26	336	-
7	101	-	17	116	-	27	340	-
8	103	a 63,500	18	121	b 710	28	368	-
9	96	-	19	130	-	29	524	-
10	105	-	20	144	-	30	638	-
						31	641	- - - - -
Monthly mean discharge, in cubic feet per second							186	-
Runoff, in acre-feet							11,430	-

a From indirect measurement of peak flow
b From current-meter measurement

(81) South Fork Two Medicine River near East Glacier, Mont

(Miscellaneous site)

Location --Lat 48°24', long 113°10', near east edge of sec 33, T 31 N , R 12 W , half a mile upstream from bridge on East Glacier-Heart Butte road, 4 miles southeast of East Glacier

Drainage area --78 2 sq mi

Maximum --June 1964 Discharge, 25,600 cfs June 8, from slope-area measurement

(82) 6-920 Two Medicine River near Browning, Mont

Location --Lat 48°28'30", long 112°48'10", in SE¼ sec 5, T 31 N , R 9 W , on right bank 800 ft upstream from new bridge on U S Highway 89, 11 miles southeast of Browning, and 15 miles upstream from Badger Creek

Drainage area --317 sq mi

Gage-height record --Water-stage recorder graph, except 1200 hours June 8 to 1100 hours June 11 Reconstructed graph based on floodmark used 1200 hours to 2400 hours June 8 Altitude of gage is 3,930 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 3,600 cfs and by slope-area measurement at 100,000 cfs

Maxima --June 1964 Discharge, 100,000 cfs 1200 hours June 8 (gage height 13 5 ft, from floodmark in gage well, 14 0 ft, from flood profile)
1907-24, 1951 to May 1964 Discharge, 7,950 cfs June 23, 1907 (gage height, 8 6 ft, from graph based on gage readings, site and datum then in use) Flood in June 1908, which destroyed gage, was larger

Remarks --The 1964 maximum was not affected by failure of Lower Two Medicine Lake Dam

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	915	1,830	11	1,060	3,490	21	2,280	1,380
2	1,130	1,760	12	1,090	2,830	22	1,660	1,260
3	1,260	1,940	13	1,250	2,310	23	1,180	1,240
4	1,090	2,180	14	1,150	2,030	24	1,150	1,250
5	915	2,290	15	987	1,980	25	1,230	1,290
6	769	2,380	16	1,030	1,960	26	1,330	1,210
7	649	2,480	17	1,450	1,950	27	1,390	1,120
8	649	30,000	18	1,740	1,750	28	1,690	1,020
9	853	14,200	19	1,690	1,620	29	3,240	900
10	1,030	4,450	20	2,180	1,500	30	2,410	802
						31	2,100	- - - - -
Monthly mean discharge, in cubic feet per second							1,372	3,213
Runoff, in acre-feet							84,390	191,200

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	3 67	2,150	June 8	0300	5 08	5,370	June 8	1000	7 80	22,700
	0500	3 71	2,270		0600	6 78	8,020		1100	11 50	65,500
	1100	3 51	2,070		0700	6 30	11,200		1200	a13 5	100,000
	1800	3 93	2,680		0800	6 88	15,300				
	2400	4 50	3,610		0900	7 25	17,700				

a 14 0 ft, from floodmark

(83) 6-925 Badger Creek near Browning, Mont

Location --Lat 48°21'00", long 112°50'20", in NE¼ sec 24, T 30 N , R 10 W , on right bank just upstream from point of diversion to Four Horns Canal, 15 miles upstream from mouth, and 17 miles southeast of Browning

Drainage area --133 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 4,179 26 ft above mean sea level (Bureau of Reclamation bench mark)

Discharge record --Stage-discharge relation defined by current-meter measurements below 1,900 cfs, by logarithmic extension from 2,000 cfs to 10,000 cfs, and by slope-area measurement at 49,700 cfs

Maxima --June 1964 Discharge, 49,700 cfs at 1600 hours June 8 (gage height, 10 37 ft)
1951 to May 1964 Discharge, 4,220 cfs June 4, 1953 (gage height, 6 28 ft), from rating curve extended above 2,000 cfs

Remarks --Figures of discharge given herein are sum of flow over diversion dam and that diverted by Four Horns Canal (canal headgates inundated June 8)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	255	1,170	11	304	1,720	21	1,330	900
2	333	1,150	12	316	1,480	22	992	855
3	304	1,220	13	392	1,360	23	795	891
4	277	1,260	14	410	1,330	24	735	972
5	261	1,250	15	404	1,310	25	711	954
6	245	1,230	16	434	1,290	26	714	855
7	224	1,270	17	596	1,180	27	813	784
8	218	16,300	18	834	1,100	28	1,210	734
9	234	4,140	19	982	1,040	29	1,640	653
10	277	2,140	20	1,860	954	30	1,340	617
						31	1,190	- - - - -
Monthly mean discharge, in cubic feet per second							665	1,737
Runoff, in inches							5 77	14 57
Runoff, in acre-feet							40,920	103,400

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Dis-charge	Date	Hour	Gage height	Dis-charge	Date	Hour	Gage height	Dis-charge
June 8	0000	4 67	1,540	June 8	1700	9 62	29,900	June 9	1200	6 05	3,710
	0200	4 79	1,720		2000	8 78	15,800		1800	5 76	3,080
	0400	5 39	2,650		2200	8 22	10,500		2400	5 58	2,720
	0600	6 10	4,040		2400	7 68	8,330				
	0800	7 12	6,670					10	0600	5 37	2,350
	1000	8 15	10,200	9	0200	7 22	6,820		1200	5 21	2,080
	1200	9 50	27,400		0400	6 75	5,440		1800	5 09	1,880
	1400	10 15	43,400		0600	6 39	4,480		2400	5 04	1,800
	1600	10 37	49,700		0800	6 25	4,150				

(84) North Fork Birch Creek near Dupuyer, Mont

(Miscellaneous site)

Location --Lat 48°10'00", long 112°55'40", in sec 29, T 28 N , R 10 W (unsurveyed), 2 miles upstream from Swift Reservoir and 20 miles west of Dupuyer

Drainage area --19 0 sq mi

Maximum --June 1964 Discharge, 8,890 cfs June 8, from slope-area measurement

(85) South Fork Birch Creek near Dupuyer, Mont

(Miscellaneous site)

Location --Lat 48°07', long 112°54', in sec 9, T 27 N , R 10 W (unsurveyed), half a mile upstream from Middle Fork Birch Creek, and 19 miles southwest of Dupuyer

Drainage area --25 3 sq mi

Maximum --June 1964 Discharge, 9,770 cfs June 8, from slope-area measurement

(86) 6-940 Swift Reservoir near Dupuyer, Mont

(Discontinued June 8, 1964, due to dam failure)

Location --Lat 48°10', long 112°52', in NE¼ sec 27, T 28 N , R 10 W , at Swift Dam on Birch Creek, 17 miles west of Dupuyer

Drainage area --75 3 sq mi

Gage-height record --Elevations determined by measuring from reference mark about once a month and high-water marks at the damsite for June 8, 1964 Datum of gage is at mean sea level (levels by Pondera County Canal and Reservoir Co) To obtain U S Coast and Geodetic Survey datum, subtract 63 67 ft

Maxima --June 1964 Contents, 34,300 acre-ft 1000 hours June 8 (elevation, 4,956 30 ft, from floodmarks)
1936 to May 1964 Contents observed, 30,620 acre-ft June 4, 1953 (elevation, 4,948 38 ft)
During flood of June 29, 1916, the reservoir reached an elevation of 4,959 94 ft (contents, 36,070 acre-ft) This high elevation was caused by an inadequate spillway capacity that was enlarged in 1917

Remarks --Reservoir was formed by a rockfill dam with a concrete face completed in 1915 Usable capacity, 30,000 acre-ft at elevation 4,947 0 ft Dead storage is negligible Water is used for irrigation Records furnished by Pondera County Canal and Reservoir Co Figures given herein represent usable contents

Elevation, in feet, and contents, in acre-feet, 1964

	Elevation	Contents
Apr 30	4,905 7	14,100
June 1	4,926 5	21,560
June 8	4,956 3	34,300

(87) 6-950 Birch Creek near Dupuyer, Mont

(Gaging station, discontinued 1937)

Location --Lat 48°15', long 112°39', near center of sec 28, T 29 N , R 8 W , half a mile upstream from 13 canal headgates and 8 miles northwest of Dupuyer Altitude of gage is 4,180 ft (from topographic map) Gage site completely destroyed by flood caused by failure of Swift Dam

Drainage area --105 sq mi

Maxima --June 1964 Discharge, 881,000 cfs about 1200 hours June 8, from slope-area measurement (result of dam failure)
1909-37 Discharge, 7,000 cfs June 21, 1916 (gage height 10 0 ft, from floodmarks), from rating curve extended above 1,200 cfs by logarithmic plotting
Flood of June 6, 1908 (discharge not determined) was larger

Remarks --Flow regulated since 1913 by Swift Reservoir (see station 86)

(88) Blacktail Creek near Dupuyer, Mont

(Miscellaneous site)

Location --Lat 48°21', lont 112°35', in NE¼ sec 24, T 30 N , R 8 W , 1 mile upstream from U S Highway 89 and 12 miles northwest of Dupuyer

Drainage area --62 7 sq mi

Maxima --June 1964 Discharge, 3,730 cfs about 1200 hours June 8, from slope-area measurement
1948 Discharge, 4,680 cfs about June 17, 1948, from slope-area measurement

(89) Cartwright Coulee near Valier, Mont

(Miscellaneous site)

Location --Lat 48°18'30", long 112°25'10", in NW¼ sec 5, T 29 N , R 6 W , 1 mile upstream from mouth and 5 miles south of Valier

Drainage area --21 8 sq mi

Maxima --June 1964 Discharge, 2,950 cfs 1300 hours June 8, from contracted-opening measurement
1948 Discharge, 2,890 cfs about June 17, 1948, from contracted-opening measurement

Remarks --The 1964 maximum may include some water from Birch Creek drainage via the B canal which was breached

(90) 6-980 Dupuyer Creek near Valier, Mont

(Gaging station, discontinued 1937)

Location --Lat 48°14'10", long 112°23'50", in NW¼ sec 33, T 29 N , R 6 W , 6 miles downstream from Sheep Creek and 8 miles southwest of Valier Altitude of gage is 3,920 ft (from topographic map) The 1964 measurement was made at site 3 miles upstream

Drainage area --137 sq mi (129 sq mi at 1964 measurement site)

Maxima --June 1964 Discharge, 21,600 cfs 1200 hours June 8, from slope-area measurement
1912-37 Discharge, 3,330 cfs June 7, 1934 (gage height, 7 40 ft, from graph based on gage readings)
Flood of about June 17, 1948, reached a discharge of 7,370 cfs, from slope-area measurement

(91) Laughlin Coulee near Valier, Mont

(Miscellaneous site)

Location --Lat 48°17'50", long 112°21'30", in SW¼ sec 2, T 29 N , R 6 W at culverts on county road 5 miles west of Valier

Drainage area --8 4 sq mi

Maxima --June 1964 Discharge, 912 cfs 1600 hours June 8, from combined culvert and flow-over-road measurements
1948 Discharge, 820 cfs about June 17, 1948, from slope-area measurement

(92) Two Medicine River below Birch Creek, near Ethridge, Mont

(Miscellaneous site)

Location --Lat 48°28'50", long 112°13'40", in NE¼ sec 3, T 31 N , R 5 W , about 0 2 mile upstream from Cut Bank Creek and 7 miles southwest of Ethridge

Drainage area --1,288 sq mi

Maximum --June 1964 Discharge, 204,000 cfs June 9, from slope-area measurement (affected by failure of Swift Dam)

(93) Willow Creek at Browning, Mont

(Miscellaneous site)

Location --Lat 48°33'40", long 113°02'00", on east line of sec 4, T 32 N , R 11 W , at bridge on old county road, about 1 mile northwest of Browning

Drainage area --23 6 sq mi

Maximum --June 1964 Discharge, 1,230 cfs June 8, from contracted-opening measurement

(94) 6-990 Cut Bank Creek at Cut Bank, Mont

Location --Lat 48°38'00", long 112°20'40", in SE¼NE¼ sec 11, T 33 N , R 6 W , on right bank at highway bridge, half a mile west of Cut Bank and 17 miles upstream from confluence with Two Medicine Creek

Drainage area --1,065 sq mi

Gage-height record --Water-stage recorder graph and high water-marks near the gage Altitude of gage is 3,550 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 12,000 cfs and by slope-area measurement at 16,600 cfs

Maxima --June 1964 Discharge, 16,600 cfs 0530 hours June 9 (gage height, 13 93 ft, 14 2 ft, from floodmarks)
1905-20, 1922-24, 1951 to May 1964 Discharge, 10,400 cfs June 5, 1908 (gage height 11 04 ft, from graph based on gage readings, at site half a mile upstream and at datum then in use), from rating curve extended above 1,200 cfs

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	158	535	11	252	2,490	21	596	708
2	452	520	12	252	1,610	22	696	662
3	1,950	591	13	235	1,330	23	586	586
4	1,640	674	14	242	1,160	24	416	602
5	1,010	798	15	255	1,110	25	324	608
6	532	786	16	245	1,110	26	279	635
7	308	846	17	248	1,100	27	255	613
8	258	1,790	18	304	993	28	276	510
9	229	11,200	19	450	890	29	416	455
10	220	5,080	20	500	774	30	690	408
						31	657	- - - - -
Monthly mean discharge, in cubic feet per second							482	1,372
Runoff, in inches							0 52	1 44
Runoff, in acre-feet							29,620	81,670

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	4 13	890	June 9	0300	10 33	8,930	June 10	0400	9 00	6,540
	0400	4 24	961		0400	10 59	9,420		0800	8 44	5,600
	0800	4 45	1,100		0530	a13 93	16,600		1200	7 95	4,830
	1200	4 77	1,330		0600	13 87	16,500		1600	7 53	4,240
	1400	5 05	1,550		0800	13 48	15,600		2000	7 10	3,680
	2000	5 61	2,050		1000	12 88	14,100		2400	6 80	3,320
	2100	7 13	3,720		1200	12 34	12,900				
	2200	7 90	4,760		1400	11 70	11,600	11	0600	6 38	2,860
	2400	7 92	4,790		1600	11 22	10,600		1200	5 96	2,400
					2000	10 44	9,140		1800	5 67	2,110
9	0100	8 78	6,150		2400	9 70	7,800		2400	5 41	1,860
	0200	9 87	8,110								

a 14 2 ft, from floodmark

(95) 6-995 Marias River near Shelby, Mont

Location --Lat 48°26', long 111°53', in SE¼ sec 20, T 31 N , R 2 W , on left bank 200 ft downstream from bridge on U S Highway 91, 6 miles south of Shelby, and 24 miles downstream from Cut Bank Creek

Drainage area --3,242 sq mi, of which 518 sq mi is probably noncontributing

Gage-height record --Water-stage recorder graph, except June 10 when graph was reconstructed on basis of engineer's wire-weight gage readings and June 11, 12, when there was no gage-height record The maximum gage height was determined from high-water mark in the well Datum of gage is 3,087 72 ft above mean sea level, datum of 1929

Discharge record --Stage-discharge relation defined by current-meter measurements below 34,000 cfs and by slope-area measurement at 241,000 cfs

Maxima --June 1964 discharge, 241,000 cfs 0100 hours June 9 (gage height, 23 64 ft, from floodmark in well), largely the result of failure of Swift Dam
1902-7, 1911 to May 1964 Discharge, 40,000 cfs June 18, 1948 (gage height, 17 75 ft, from floodmark)
Flood of June 1908 may have exceeded that of June 1948

Remarks --Floodflows only slightly affected by storage in four reservoirs on tributary streams

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	913	4,500	11	1,890	16,100	21	3,520	4,060
2	1,950	4,100	12	1,850	11,400	22	3,560	3,780
3	6,840	4,100	13	1,880	8,420	23	2,930	3,480
4	6,360	4,580	14	1,980	7,170	24	2,250	3,350
5	3,660	4,710	15	1,880	6,290	25	1,990	3,450
6	2,390	4,880	16	1,770	6,050	26	2,010	3,480
7	1,840	4,890	17	1,900	5,950	27	1,960	3,310
8	1,570	9,440	18	2,580	5,450	28	2,220	3,080
9	1,500	109,000	19	2,980	4,850	29	3,580	2,910
10	1,660	29,000	20	3,170	4,460	30	5,720	2,710
						31	5,000	- - - - -
Monthly mean discharge, in cubic feet per second							2,752	9,632
Runoff, in acre-feet							169,200	573,100

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	5 58	5,010	June 8	2230	10 05	13,200	June 9	1800	18 17	54,600
	1400	5 39	4,710		2300	11 50	18,100		2000	17 58	47,100
	2200	5 61	5,060		2330	16 80	42,100		2200	17 08	43,700
	2400	5 64	5,110		2400	22 00	160,000		2400	16 78	42,000
8	0300	5 65	5,120	9	0100	23 64	241,000	10	0300	a16 00	37,700
	0600	5 76	5,300		0200	23 30	220,000		0600	a15 28	34,100
	0900	5 91	5,560		0300	22 85	196,000		0900	a14 58	30,800
	1200	6 17	6,010		0400	22 40	176,000		1200	a13 95	28,000
	1400	6 53	6,710		0600	21 50	141,000		1500	a13 40	25,800
	1500	6 96	7,220		0800	20 88	120,000		1800	a12 88	23,500
	1600	7 07	7,460		0930	21 17	130,000		2100	a12 38	21,500
	1800	7 67	8,420		1200	20 45	107,000		2400	a12 00	20,000
	2000	8 35	9,650		1400	19 60	83,800				
	2200	9 30	11,700		1600	18 83	66,600				

a From graph based on wire-weight-gage readings

(96) 6-997 Middle Fork Dry Fork Marias River near Dupuyer, Mont

(Crest-stage gage, formerly published as North Fork Dry Fork)

Location --Lat 48°09', long 112°28', in NE¼ sec 35, T 28 N , R 7 W , at culvert on county road, 4 miles southeast of Dupuyer

Drainage area --20 2 sq mi

Gage-height record --Crest stages and high-water marks only Elevation of gage is 4,120 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 75 cfs and by combined culvert and flow-over-road measurements at 401 and 4,240 cfs

Maxima --June 1964 Discharge, 4,240 cfs June 8 (gage height, 6 56 ft, from floodmarks)
1960 to May 1964 Discharge, 401 cfs May 3, 1964 (gage height, 4 79 ft, 4 57 ft, from floodmarks)

(97) Lake Frances tributary near Valier, Mont

(Miscellaneous site)

Location --Lat 48°15', long 112°17', in NW¼ sec 29, T 29 N , R 5 W , at culvert on county road, 4 miles south of Valier

Drainage area --0 083 sq mi

Maxima --June 1964 Discharge, 39 cfs June 8, from flow-through-culvert measurements
1948 Discharge, 20 cfs about June 17, 1948, from flow-through-culvert measurement

(98) 6-1002 Heines Coulee tributary near Valier, Mont

(Crest-stage gage)

Location --Lat 48°15', long 112°14', in NE¼ sec 27, T 29 N , R 5 W , at culvert on county road, 4 miles south of Valier

Drainage area --0 60 sq mi

Gage-height record --Crest stages and high-water marks only Altitude of gage is 3,860 ft (from topographic map)

Discharge record --Stage-discharge relation defined by flow-through-culvert measurements

Maxima --June 1964 Discharge, 64 cfs June 8 (upstream gage height, 10 57 ft, from floodmarks, downstream gage height, 1 01 ft)
1960 to May 1964 Discharge, 9 cfs May 1, 1960 (upstream gage height, 1 20 ft, downstream gage height, 0 92 ft)

(99) Lone Man Coulee above Miller Coulee, near Valier, Mont

(Miscellaneous site)

Location --Lat 48°14'00", long 112°14'20", near center of N½ sec 34, T 29 N , R 5 W , half a mile upstream from Miller Coulee and 5 miles south of Valier

Drainage area --11 3 sq mi

Maxima --June 1964 Discharge, 1,460 cfs about 1500 hours June 8, from slope-area measurement, furnished by Montana State College
1948 Discharge, 1,820 cfs about June 17, from slope-area measurement

(100) Miller Coulee near Valier, Mont

(Miscellaneous site)

Location --Lat 48°14'20", long 112°14'00", in SE¼ sec 27, T 29 N , R 5 W , near mouth and 5 miles south of Valier

Drainage area --1 91 sq mi

Maxima --June 1964 Discharge, 282 cfs about 1500 hours June 8, from slope-area measurement furnished by Montana State College
1948 Discharge, 197 cfs about June 17, from slope-area measurement

(101) 6-1003 Lone Man Coulee near Valier, Mont

(Crest-stage gage)

Location --Lat 48°14', long 112°14', in SE¼ sec 27, T 29 N , R 5 W , at culvert on county road, 5 miles south of Valier Culvert washed out by flood on June 8

Drainage area --14 1 sq mi

Gage-height record --Crest stages and high-water marks Water-stage recorder graph obtained at supplementary site 300 ft downstream by Montana State College, used to determine time of peak Elevation of gage is about 3,780 ft (from topographic map) Datum at the recorder site is 2 23 ft higher

Discharge record --Stage-discharge relation defined by current-meter measurements below 25 cfs, by flow through culvert measurement at 180 cfs, and by slope-area measurement at site half a mile upstream, 1,460 cfs, added to slope-area measurement of Miller Coulee, 282 cfs, to obtain a natural peak of 1,740 cfs Artificial peak caused by failure of road grade was determined to be 2,680 cfs from slope-area measurement at the recorder site)

Maxima --June 1964 Natural discharge, 1,740 cfs 1530 hours June 8 (gage height observed, 2 38 ft, from downstream crest-stage gage, 4 20 ft, at recorder site), due to failure of road grade, discharge, 2,680 cfs 1700 hours June 8 (gage height, 4 98 ft at recorder site)
1960 to May 1964 Discharge, 180 cfs May 3, 1964 (gage height, 0 72 ft, 2 81 ft at recorder site)

(102) Dry Fork Marias River at Ledger, Mont

(Miscellaneous site)

Location --Lat 48°15'30", long 111°49'10", in NE¼NE¼ sec 23, T 29 N , R 2 W , at bridge on county road at Ledger

Drainage area --263 sq mi

Maxima --June 1964 Discharge, 7,870 cfs June 8, by contracted-opening measurement
Flood of June 1948, reached a discharge of 13,000 cfs at site about 9 miles upstream, drainage area, 241 sq mi, from contracted-opening measurement

(103) 6-1013 Tiber Reservoir near Chester, Mont

Location --Lat 48°19', long 111°06', in NW¼ sec 33, T 30 N , R 5 E , in control house of river outlet tunnel of Tiber Dam on Marias River, 15 miles southwest of Chester

Drainage area --4,923 sq mi, of which 518 sq mi is probably noncontributing

Gage-height record --Tape and staff gages read once daily or more frequently June 8-16 Graph based on observed readings used Apr 30 to June 30 to obtain midnight elevations Datum of gage is at mean sea level (levels by Bureau of Reclamation)

Discharge record --Inflow computed from change in contents adjusted for outflow

Maxima --June 1964 Contents observed, 1,116,000 acre-ft 0525 hours June 13 (elevation, 3,001 91 ft) Rate of inflow, 200,000 cfs 0800 hours June 9
1955 to May 1964 Contents observed, 834,800 acre-ft June 27, 1959 (815,900 acre-ft, capacity table used prior to Oct 1, 1963) at elevation 2,986 47 ft

Remarks --Reservoir formed by rolled earthfill dam with concrete spillway chute, construction began September 1952, completed March 1956 Storage began Oct 28, 1955 Usable capacity, 1,347,000 acre-ft (1,313,000 acre-ft prior to Oct 1, 1963) at controlled spillway elevation (3,012 5 ft) Dead storage, 21,580 acre-ft (24,000 acre-ft prior to Oct 1, 1963) Reservoir is presently used for recreation and flood control Records furnished by Bureau of Reclamation Figures given herein represent usable contents

Elevation, in feet, and contents, in acre-feet, at 2400 hours and daily computed inflow, in cubic feet per second, on indicated day, 1964

Day	May			June		
	Elevation†	Contents	Inflow	Elevation†	Contents	Inflow
1	2,973 56	644,800	1,200	2,982 44	771,300	3,980
2	2,973 72	646,900	1,990	2,982 83	777,200	3,970
3	2,974 52	657,600	6,320	2,983 17	782,500	3,610
4	2,975 73	674,100	9,220	2,983 58	788,800	4,180
5	2,976 38	683,000	5,460	2,984 02	795,700	4,420
6	2,976 76	688,300	3,600	2,984 45	802,500	4,400
7	2,976 96	691,100	2,340	2,984 88	809,300	4,400
8	2,977 08	692,800	1,790	2,985 86	824,900	9,050
9	2,977 18	694,200	1,660	2,996 53	1,011,000	95,400
10	2,977 30	695,900	1,800	3,000 40	1,086,000	44,500
11	2,977 46	698,100	2,080	3,001 65	1,111,000	22,600
12	2,977 62	700,400	2,080	3,001 88	1,116,000	12,400
13	2,977 78	702,700	2,080	3,001 82	1,114,000	9,490
14	2,977 93	704,800	2,010	3,001 62	1,110,000	8,060
15	2,978 07	706,800	1,950	3,001 37	1,105,000	7,450
16	2,978 20	708,600	1,890	3,001 10	1,100,000	7,190
17	2,978 33	710,500	1,890	3,000 92	1,096,000	6,940
18	2,978 51	713,100	2,250	3,000 77	1,093,000	6,400
19	2,978 78	717,000	2,910	3,000 56	1,089,000	5,770
20	2,979 08	721,300	3,130	3,000 28	1,083,000	5,000
21	2,979 40	725,900	3,300	2,999 96	1,077,000	4,550
22	2,979 71	730,500	3,240	2,999 60	1,070,000	4,140
23	2,979 99	734,500	3,020	2,999 19	1,062,000	3,940
24	2,980 21	737,800	2,600	2,998 93	1,057,000	3,650
25	2,980 38	740,300	2,230	2,998 42	1,047,000	3,420
26	2,980 50	742,100	1,860	2,997 92	1,037,000	3,420
27	2,980 63	744,000	1,940	2,997 42	1,028,000	3,400
28	2,980 83	747,000	2,450	2,996 93	1,018,000	3,420
29	2,981 17	752,000	3,520	2,996 44	1,009,000	3,360
30	2,981 56	757,900	3,930	2,995 94	999,600	3,230
31	2,982 05	765,300	4,690	-	-	-
Change in contents	-	+121,000	-	-	+234,300	-

† Elevations at midnight from graph drawn through observed gage readings

Elevation, in feet, and average computed inflow in cubic feet per second, for time period shown, 1964, of Tiber Reservoir near Chester, Mont

Date	Hour	Elevation	Inflow†	Date	Hour	Elevation	Inflow†
June 9	0000	2,985 86	-	June 9	2200	2,995 86	90,300
	0300	2,986 04	13,200		2300	2,996 20	79,800
	0600	2,986 26	15,900		2400	2,996 53	78,000
	0700	2,986 80	107,000				
	0800	2,987 80	200,000	10	0300	2,997 40	69,300
	0900	2,988 60	162,000		0600	2,998 13	59,200
	1000	2,989 31	145,000		0900	2,998 72	50,400
	1100	2,990 00	143,000		1200	2,999 18	42,400
	1200	2,990 70	147,000		1500	2,999 55	37,800
	1300	2,991 35	138,000		1800	2,999 91	38,000
	1400	2,992 03	146,000		2100	3,000 20	32,900
	1500	2,992 73	152,000		2400	3,000 40	25,900
	1600	2,993 23	110,000				
	1700	2,993 73	111,000	11	0600	3,000 80	26,100
	1800	2,994 20	105,000		1200	3,001 20	26,200
	1900	2,994 64	99,500		1800	3,001 46	20,600
	2000	2,995 06	95,300		2400	3,001 65	17,700
	2100	2,995 47	94,300				

† Average during period

(104) 6-1015 Marias River near Chester, Mont

Location --Lat 48°18', long 111°05', in SW¼SW¼ sec 34, T 30 N , R 5 E , on left bank 1 mile downstream from Tiber Dam, 4 miles upstream from Pondera Coulee, and 15 miles southwest of Chester

Drainage area --4,927 sq mi, of which 516 sq mi is probably noncontributing

Gage-height record --Water-stage recorder graph Datum of gage is 2,814 03 ft above mean sea level (Bureau of Reclamation bench mark)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 10,400 cfs 2000 hours June 16 (gage height, 10 63 ft)
1921, 1945-47, 1955 to May 1964 Discharge not determined, occurred about Mar 20, 1947
Flood in June 1948 reached a stage of 16 ft

Remarks --Flow completely regulated by Tiber Reservoir since Oct 28, 1955 (see station 103) and four other reservoirs having a combined capacity of 177,900 acre-ft

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	930	968	11	945	9,960	21	952	7,760
2	930	968	12	945	10,100	22	960	7,710
3	930	968	13	945	10,100	23	960	8,000
4	938	968	14	945	10,100	24	960	6,220
5	938	975	15	945	10,000	25	960	8,410
6	938	975	16	952	9,940	26	960	8,300
7	938	982	17	952	8,760	27	968	8,220
8	938	1,150	18	952	7,910	28	960	8,140
9	945	1,700	19	952	7,880	29	960	8,020
10	945	6,640	20	952	7,810	30	968	7,980
						31	968	- - - - -
Monthly mean discharge, in cubic feet per second							949	6,254
Runoff, in acre-feet							58,380	372,100

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Dis-charge	Date	Hour	Gage height	Dis-charge	Date	Hour	Gage height	Dis-charge
June 8	0000	4 05	982	June 9	1200	4 86	1,630	June 10	0900	7.41	4,880
	1000	4 07	998		1700	4 89	1,660		1200	9 00	7,540
	1300	4 06	990		1800	5 12	1,890		1300	9 50	8,390
	1400	4 26	1,130		2100	5 15	1,920		1400	9 65	8,640
	1600	4 37	1,220		2200	5 68	2,500		1500	10 00	9,240
	1700	4 30	1,170		2300	5 77	2,600		1600	10 15	9,510
	1800	4 64	1,440		2400	5 78	2,620		2000	10 25	9,690
	2000	4 66	1,450						2400	10 32	9,820
	2400	4 66	1,450	10	0600	5.85	2,700				
					0700	6 85	4,040				
9	1000	4 68	1,470		0800	7 31	4,720				

(105) Pondera Coulee near Chester, Mont

(Miscellaneous site)

Location --Lat 48°16'10", long 111°08'30", in center west line sec 18, T 29 N , R 5 E , at bridge 19 miles southwest of Chester

Drainage area --598 sq mi

Maximum --June 1964 Discharge, 1,950 cfs June 8 from contracted-opening measurement

(106) 6-1016 Marias River tributary No 3 near Chester, Mont

(Crest-stage station)

Location --Lat 48°14', long 110°53', in NE¼ sec 36, T 29 N , R 6 E , at culvert on State Highway 223, 2 miles south of Marias River bridge, and 20 miles southeast of Chester

Drainage area --0 32 sq mi

Gage-height record --Crest-stages only Altitude of gage is 2,900 ft (from topographic map)

Discharge record --Stage-discharge relation defined by flow-through-culvert measurements at 9 cfs and 29 cfs

Maxima --June 1964 Discharge, 11 cfs June 8 (gage height, 1 37 ft)
1962 to May 1964 Discharge, 29 cfs May 21, 1962 (gage height, 3 18 ft)

(107) 6-1017 Cottonwood Creek tributary near Chester, Mont

(Crest-stage station)

Location --Lat 48°27', long 111°05', near center of east line of sec 9, T 31 N , R 5 E , at culvert on county road, 3½ miles south of Tiber Siding on Great Northern Railway and U S Highway 2, and 6½ miles southwest of Chester

Drainage area --2 28 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,100 ft (from topographic map)

Discharge record --Stage-discharge relation defined by flow-through-culvert measurements at 66 cfs, 80 cfs and 99 cfs

Maxima --June 1964 Discharge, about 10 cfs June 8 (gage height, 0 98 ft)
1963 to May 1964 Discharge, 99 cfs June 28, 1963 (gage height, 4 08 ft)

(108) 6-1018 Cottonwood Creek tributary No 2 near Chester, Mont

(Crest-stage station)

Location --Lat 48°20', long, 110°57', in NW¼ sec 27, T 30 N , R 6 E , at bridge on State Highway 223, 5½ road miles north of Marias River bridge, and 12½ miles south of Chester

Drainage area --24 6 sq mi

Gage-height record --Crest stages only Altitude of gage is 2,950 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 75 cfs June 8 (gage height, 2 35 ft)
1963 to May 1964 No flow

(109) 6-1019 Dead Indian Coulee near Fort Benton, Mont

(Crest-stage station)

Location --Lat 48°05', long 110°50', in center of sec 21, T 27 N , R 7 E , at culvert on State Highway 223, 20 miles northwest of Fort Benton

Drainage area --2 73 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,250 ft (from topographic map)

Discharge record --Stage-discharge relation defined by flow-through-culvert measurement at 13 cfs

Maxima --June 1964 Discharge, 0 2 cfs June 8 (gage height, 0 64 ft upstream gage, 0 50 ft downstream gage)
1963 to May 1964 Discharge, 13 cfs May 3, 1964 (gage height, 2 19 ft upstream gage, 0 95 ft downstream gage)

(110) 6-1020 5 Marias River near Loma, Mont

Location --Lat 47°53'20", long 110°34'45", in SE¼SW¼ sec 4, T 25 N , R 9 E , on left bank 3½ miles northwest of Loma, and 6¾ miles upstream from mouth

Drainage area --6,995 sq mi, of which 518 sq mi is probably noncontributing

Gage-height record --Water-stage recorder graph Altitude of gage is 2,570 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 10,800 cfs 0400 hours June 16 (gage height, 8 72 ft)
1959 to May 1964 Discharge, 3,050 cfs June 8, 1961 (gage height, 4 62 ft)
Flood of June 1908, the greatest known, reached a discharge of about 70,000 cfs at a site 34 miles upstream with a drainage area of 6,425 sq mi (6-1020 Marias River near Brinkman)

Remarks --Flow regulated by Tiber Reservoir (see station 103) and four other reservoirs having a combined capacity of 177,900 acre-ft

Mean discharge, in cubic feet per second, 1964 of Marias River near Loma, Mont

Day	May	June	Day	May	June	Day	May	June
1	912	912	11	983	8,640	21	912	7,790
2	956	904	12	974	9,850	22	904	7,790
3	1,060	904	13	956	9,740	23	912	7,750
4	1,320	904	14	938	9,650	24	920	6,520
5	1,070	912	15	938	9,760	25	920	7,080
6	1,450	929	16	938	10,300	26	920	8,420
7	1,430	956	17	929	10,200	27	920	8,400
8	1,210	1,060	18	929	8,100	28	920	8,260
9	1,070	1,150	19	920	7,900	29	938	8,120
10	1,000	1,750	20	920	7,840	30	920	8,040
						31	912	- - - - -
Monthly mean discharge, in cubic feet per second							1,000	6,018
Runoff, in acre-feet							61,490	358,100

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	3 03	947	June 9	1200	3 16	1,060	June 10	2000	4 34	2,312
	1200	3 03	947		2400	3 48	1,360		2100	4 43	2,429
	2400	3 07	983						2200	4 53	2,559
				10	1200	3 63	1,510		2300	4 68	2,754
8	1200	3 13	1,040		1500	3 72	1,600		2400	5 00	3,180
	2000	3 25	1,150		1800	4 07	1,984				
	2400	3 23	1,130		1900	4 23	2,176				

(111) 6-1021 Dry Fork Coulee tributary near Loma, Mont

(Crest-stage station)

Location --Lat 47°57', long 110°33', in SW¼ sec 2, T 25 N , R 9 E , at culvert on county road, 2 miles west of Loma

Drainage area --0 84 sq mi

Gage-height record --Crest stages only Altitude of gage is 2,580 ft (from topographic map)

Discharge record --Stage-discharge relation defined by flow-through-culvert measurements at 16 cfs and 71 cfs

Maxima --June 1964 No flow
1959 to May 1964 Discharge, 71 cfs Mar 1, 1959 (gage height, 4 02 ft)

(112) 6-1022 Marias River tributary at Loma, Mont

(Crest-stage station)

Location --Lat 47°57', long 110°31', in SW¼SE¼ sec 1, T 25 N , R 9 E , at bridge on county road, five eighths of a mile west of Loma

Drainage area --1 62 sq mi

Gage-height record --Crest stages only Altitude of gage is 2,590 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurement at 4 cfs and slope-area measurement at 6 cfs

Maxima --June 1964 No flow
1956 to May 1964 Discharge about 20 cfs May 21, 1962 (gage height, 2 11 ft)

(113) 6-1023 Marias River tributary No 2 at Loma, Mont

(Crest-stage station)

Location --Lat 47°57', long 110°30', in NE¼NE¼ sec 12, T 25 N , R 9 E , at culvert on approach to U S Highway 87, a quarter of a mile north of Loma

Drainage area --0 25 sq mi

Gage-height record --Crest stages only Altitude of gage is 2,590 ft (from topographic map)

Discharge record --Stage-discharge relation defined by flow-through-culvert measurement at 15 cfs

Maxima --June 1964 No flow
1956 to May 1964 Discharge, about 20 cfs May 27, 1956 (gage height, 2 97 ft)

(114) 6-1025 Teton River near Farmington, Mont

(Gaging station, discontinued 1954)

Location --Lat 47°53'00", long 112°36'35", in NE¼NE¼ sec 34, T 25 N , R 8 W , 300 ft downstream from highway bridge, 1 1/8 miles downstream from South Fork, and 20 miles west of Farmington Gage site destroyed by flood Altitude of gage was 4,770 ft (from topographic map)

Drainage area --105 sq mi

Maxima --June 1964 Discharge, 54,600 cfs June 8, from slope-area measurement
1947-54 Discharge, 2,780 cfs June 3, 1948 (gage height, 5 32 ft), from rating curve extended above 1,100 cfs, gage height observed, 7 34 ft Jan 6, 1950 (ice jam)

(115) 6-1058 Bruce Coulee tributary near Choteau, Mont

(Crest-stage gage)

Location --Lat 47°44', long 112°15', near center sec 21, T 23 N , R 5 W , at bridge on county road, 1 2 miles west of State Highway 287, 6 miles southwest of Choteau

Drainage area --1 70 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,940 ft (from topographic map)

Maxima --June 1964 Discharge, 148 cfs June 8 (gage height, 1 76 ft), from slope-area measurement
1963 to May 1964 Discharge, about 18 cfs June 28, 1963 (gage height, 0 65 ft)

(116) 6-1060 Deep Creek near Choteau, Mont

(Gaging station, discontinued 1924)

Location --Lat 47°45', long 112°14', in SW¼NW¼ sec 15, T 23 N , R 5 W , 2 miles downstream from Willow Creek and 5 miles southwest of Choteau

Drainage area --223 sq mi (269 sq mi at 1964 measurement site)

Gage-height record --Gage datum not recovered Altitude of gage was 3,860 ft (by barometer)

Maxima --June 1964 Discharge, 41,800 cfs 1900 hours June 8, from slope-area measurement at site 2½ miles downstream
1911-24 Discharge observed, 3,700 cfs June 21, 1916 (gage height, 10 5 ft), from rating curve extended above 1,300 cfs by logarithmic plotting

(117) Teton River below Deep Creek, near Choteau, Mont

(Miscellaneous site)

Location --Lat 47°49'15", long 112°04'30", in E½ sec 23 T 24 N , R 4 W , 5 miles east of Choteau and 7 miles downstream from Deep Creek

Drainage area --510 sq mi

Maximum --June 1964 Discharge, 64,300 cfs 2000 hours June 8, from slope-area measurements on main and overflow channels

(118) Muddy Creek near Collins, Mont

(Miscellaneous site)

Location --Lat 47°57'40", 111°51'45", near center of S½ sec 33, T 26 N , R 2 W , 3 miles northwest of Collins

Drainage area --385 sq mi

Maximum --June 1964 Discharge, 13,900 cfs June 8, from slope-area measurement

(119) 6-1080 Teton River near Dutton, Mont

Location --Lat 47°55'55", long 111°33'05", in SE¼SW¼ sec 12, T 25 N , R 1 E , on left bank 300 ft downstream from Kerr Bridge, 1 mile downstream from Hunt Coulee, and 10 miles northeast of Dutton

Drainage area --1,308 sq mi

Gage-height record --Water-stage recorder graph, except 0700 hours June 9 to 1900 hours June 19 Mean daily gage heights based on inside gage readings June 14, 18 Altitude of gage is 3,235 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 2,700 cfs and by slope-area measurement at 71,300 cfs

Maxima --June 1964 Discharge, 71,300 cfs 0800 hours June 9 (gage height, 19 8 ft from floodmarks)
1954 to May 1964 Discharge, 1,310 cfs June 21, 1958 (gage height, 5 96 ft), gage height, 8 68 ft Mar 9, 1959 (ice jam)

Remarks --Floodflows may be affected by diversions for storage in Bynum Reservoir (usable capacity, 75,000 acre-ft)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	158	704	11	416	8,000	21	180	1,550
2	302	518	12	362	5,000	22	178	1,440
3	1,540	444	13	318	3,500	23	178	1,310
4	3,140	401	14	284	2,680	24	158	1,210
5	2,870	362	15	257	2,200	25	136	1,150
6	1,610	349	16	232	2,000	26	120	1,090
7	910	339	17	211	1,900	27	115	981
8	668	660	18	196	2,560	28	120	953
9	538	20,000	19	196	2,030	29	134	904
10	452	15,000	20	198	1,720	30	344	848
						31	840	- - - - -
Monthly mean discharge, in cubic feet per second							560	2,727
Runoff, in acre-feet							34,440	162,300

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	3 62	342	June 8	1600	4 56	682	June 9	0200	6 47	1,750
	0700	3 77	394		1800	4 95	845		0400	7 07	2,320
	0800	3 99	463		2000	5 40	1,030		0600	7 54	2,800
	0900	4 06	490		2200	5 85	1,280		0800	19 8	71,300
	1200	4 17	530		2400	6 13	1,470				
	1400	4 32	582								

(120) 6-1082 Kinley Coulee near Dutton, Mont

(Crest-stage station)

Location --Lat 47°51', long 111°36', in center of north line of sec 15, T 24 N , R 1 E , at culverts on county road, 5 1 miles east of Dutton on Diamond Valley Road

Drainage area --9 67 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,560 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 20 cfs and by flow-through-culvert measurements at 139 cfs and 364 cfs

Maxima --June 1964 Discharge, 364 cfs June 21 (gage height, 8 0 ft)
1963 to May 1964 Discharge, 139 cfs May 3, 1964 (gage height, 3 74 ft)

(121) 6-1083 Kinley Coulee tributary near Dutton, Mont

(Crest-stage station)

Location --Lat 47°51', long 111°33', on north line of NW¼ sec 13, T 24 N , R 1 E , at culverts on county road, 6 5 miles east of Dutton on Diamond Valley Road

Drainage area --2 65 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,610 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 25 cfs and by flow-through-culvert measurements at 49 cfs and 76 cfs

Maxima --June 1964 Discharge, 76 cfs June 8 (gage height, 2 98 ft)
1963 to May 1964 Discharge, 49 cfs May 3, 1964 (gage height, 2 28 ft)

(122) Teton River near Carter, Mont

(Miscellaneous site)

Location --Lat 47°51'15", long 110°58'20", in NE¼ sec 9, T 24 N , R 6 E , just upstream from bridge on county highway, 5 miles north of Carter

Drainage area --1,762 sq mi

Maximum --June 1964 Discharge, 84,300 cfs June 9, from slope-area measurement

MISSOURI RIVER MAIN STEM

(123) 6-1095 Missouri River at Virgelle, Mont

Location --Lat 48°00'14", long 110°15'19", in SW¼SE¼ sec 13, T 26 N , R 11 E , on left bank a quarter of a mile upstream from Virgelle Ferry, half a mile southwest of Virgelle, and 3 miles downstream from Spring Coulee

Drainage area --34,379 sq mi

Gage-height record --Digital-recorder tape punched at 15-minute intervals Datum of gage is 2,507 50 ft above mean sea level, datum of 1929

Discharge record --Stage-discharge relation defined by current-meter measurements Mean daily discharges computed from 96 punch-tape recordings per day June 8, 9, 13, may not agree precisely with that derived from discharge at indicated times

Maxima --June 1964 Discharge, 105,000 cfs 2330 hours June 10 (gage height, 21 27 ft)
1935 to May 1964 Discharge, 122,000 cfs June 5, 1953 (gage height, 23 4 ft, from floodmark), from rating curve for former site at Loma extended above 66,000 cfs, adjusted to present site
Flood in June 1908 reached a stage about 2 ft higher than that of June 5, 1953, from information by local residents

Remarks --Flow regulated by 23 smaller irrigation reservoirs and powerplants, Canyon Ferry Reservoir (see station 23), and Tiber Reservoir (see station 103)

Mean discharge, in cubic feet per second, 1964, of Missouri River at Virgelle, Mont

Day	May	June	Day	May	June	Day	May	June
1	6,460	25,100	11	17,500	96,600	21	22,900	42,900
2	8,390	23,900	12	17,100	70,700	22	23,500	43,400
3	10,500	24,100	13	17,200	51,300	23	23,900	41,900
4	18,400	24,800	14	17,000	50,500	24	21,800	39,000
5	23,500	25,100	15	17,000	49,900	25	17,200	37,300
6	18,500	24,200	16	16,000	49,300	26	15,800	38,700
7	16,500	23,100	17	14,500	48,700	27	15,100	39,400
8	14,800	25,000	18	15,500	47,000	28	15,200	39,900
9	14,800	34,600	19	17,700	42,800	29	15,800	39,300
10	16,100	77,000	20	20,000	42,600	30	18,200	38,500
						31	24,100	- - - - -
Monthly mean discharge, in cubic feet per second							17,130	41,910
Runoff, in acre-feet							1,053,000	2,494,000

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	8 16	22,600	June 9	1600	11 09	36,400	June 11	1200	20 36	98,100
	0400	8 31	23,300		1800	11 29	37,400		1800	19 57	92,200
	0800	8 22	22,900		2400	11 89	40,600		2400	18 50	84,200
	1200	8 39	23,700								
	1800	9 18	27,200	10	0600	13 14	47,900	12	1200	16 49	69,800
	2000	9 48	28,600		1200	18 58	84,800		1800	15 62	63,900
	2200	9 43	28,300		1600	20 29	97,600		2400	15 03	60,100
	2400	9 49	28,600		2000	21 06	103,400				
					2330	21 27	105,000	13	0600	14 45	56,300
9	0600	9 87	30,400		2400	21 25	104,800		1200	14 01	53,400
	1200	10 82	35,100						1800	13 66	51,200
	1400	11 03	36,200	11	0600	20 82	101,600		2400	13 62	50,900

JUDITH RIVER BASIN

(124) 6-1098 South Fork Judith River near Utica, Mont

Location --Lat 46°45', long 110°19', in S½ sec 34, T 12 N , R 11 E , on right bank just downstream from Trask Gulch, 8 miles upstream from confluence with Middle Fork and 18 miles southwest of Utica

Drainage area --58 7 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 5,300 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 180 cfs and by slope-area measurement at 1,290 cfs

Maxima --June 1964 Discharge, 1,290 cfs 2230 hours June 8 (gage height, 6 80 ft, in gage well, 7 4 ft, from outside floodmarks)
1958 to May 1964 Discharge, 277 cfs May 25, 1962 (gage height, 4 90 ft)
Flood of June 8, 1964, is the highest since 1927, from information by local resident

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	39	96	11	90	257	21	162	103
2	51	87	12	85	217	22	146	93
3	54	87	13	125	186	23	127	81
4	43	83	14	149	164	24	107	73
5	40	74	15	167	153	25	97	67
6	45	73	16	196	143	26	82	64
7	44	105	17	225	139	27	76	59
8	47	421	18	206	129	28	123	55
9	56	615	19	186	119	29	132	51
10	82	336	20	179	122	30	111	50
						31	103	- - - - -
Monthly mean discharge, in cubic feet per second							109	143
Runoff, in inches							2 14	2 73
Runoff, in acre-feet							6,690	8,530

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964, of South Fork Judith River near Utica, Mont

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	3 51	76	June 8	1100	4 10	156	June 9	0800	5 77	658
	0300	3 54	80		1300	4 18	167		1200	5 56	550
	1000	3 52	77		1500	4 55	225		1800	5 35	455
	1400	3 60	87		1800	5 64	590		2400	5 17	384
	1800	3 89	127		2100	6 53	1,100				
	2400	4 38	197		2230	a 6 80	1,290	10	0800	5 04	357
					2400	6 66	1,190		1600	4 86	312
8	0100	4 43	204						1900	4 86	312
	0200	4 42	203	9	0200	6 31	966		2400	4 74	285
	0600	4 22	173		0400	6 01	791				

a 7 4 ft, from floodmark

(125) 6-1100 Judith River near Utica, Mont

Location --Lat 46°54', long 110°14', in NW¼ sec 17, T 13 N , R 12 E , on left bank at Noel Ranch, 3½ miles downstream from confluence of South and Middle Forks and 9 miles southwest of Utica

Drainage area --328 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 4,790 ft (by barometer)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 1,070 cfs 1100 hours June 9 (gage height, 5 77 ft)
1919 to May 1964 Discharge observed, 1,120 cfs June 11, 12, 1927 (gage height, 5 70 ft), from rating curve extended above 580 cfs

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	1 5	366	11	126	886	21	464	431
2	24	344	12	126	806	22	470	394
3	64	364	13	149	722	23	414	355
4	65	369	14	193	655	24	369	330
5	52	386	15	230	608	25	361	320
6	59	406	16	283	581	26	347	307
7	59	445	17	344	551	27	327	288
8	64	634	18	403	548	28	372	268
9	69	1,020	19	394	500	29	414	244
10	95	973	20	417	482	30	400	240
						31	389	- - - - -
Monthly mean discharge, in cubic feet per second							243	494
Runoff, in inches							0 86	1 68
Runoff, in acre-feet							14,960	29,400

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	3 75	414	June 8	1800	4 84	725	June 9	1000	5 70	1,040
	1200	3 80	428		2100	5 07	798		1100	5 77	1,070
	1800	3 93	464		2400	5 42	920		1500	5 72	1,040
	2100	4 01	488						1800	5 67	1,020
	2400	4 17	527	9	0100	5 12	812		2100	5 67	1,020
					0200	5 68	1,020		2400	5 65	1,010
8	0300	4 17	527		0300	5 64	1,010				
	0600	4 22	536		0400	5 55	972	10	0600	5 60	992
	0900	4 30	554		0500	5 75	1,060		1200	5 55	972
	1200	4 32	560		0600	5 75	1,060		1800	5 52	960
	1500	4 62	648		0800	5 73	1,050		2400	5 44	928

(126) 6-1117 Casino Creek tributary near Lewistown, Mont

(Crest-stage station)

Location --Lat 47°00', long 109°26', in NE¼ sec 9, T 14 N , R 18 E , at culvert on county road, 5 miles south of Lewistown

Drainage area --3 53 sq mi

Gage-height record --Crest stages only Altitude of gage is 4,200 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 16 cfs and by flow-through-culvert measurements at 36 and 38 cfs

Maxima --June 1964 Discharge, 40 cfs June 8 (gage height, 3 27 ft)
1960 to May 1964 Discharge, 44 cfs May 3, 1964 (gage height, 3 67 ft)

(127) 6-1121 Cottonwood Creek near Moore, Mont

(Gaging station, crest-stage station beginning 1964)

Location --Lat 46°59', long 109°29', in NW¼ sec 18, T 14 N , R 18 E , on right bank 30 ft downstream from bridge, 9½ miles east of Moore, and 12 miles upstream from mouth

Drainage area --47 9 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 4,300 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 700 cfs and by contracted-opening measurement at 1,220 cfs

Maxima --June 1964 Discharge, 1,220 cfs 0700 hours June 9 (gage height, 7 68 ft)
1957 to May 1964 Discharge, 683 cfs May 22, 1962 (gage height, 6 77 ft)

MISSOURI RIVER MAIN STEM

(128) 6-1150 Missouri River at powerplant ferry, near Zortman, Mont

Location --Lat 47°43'51", long 108°56'06", in NE¼NE¼ sec 30, T 23 N , R 22 E , on left bank at powerplant ferry, 1½ miles downstream from Woodhawk Creek and 22 miles southwest of Zortman

Drainage area --40,763 sq mi

Gage-height record --Digital-recorder tape punched at 15-minute intervals, except 2300 hours June 9 to 2300 hours June 10, 2100 hours June 13 to 0500 hours June 16, and 1500 hours June 23 to 1500 hours June 24, for which graphs were drawn based on staff-gage readings

Discharge record --Stage-discharge relation defined by current-meter measurements Mean daily discharges computed from 96 punch-tape recordings per day June 9, 11, 12 may not agree precisely with that derived from discharge at indicated times

Maxima --June 1964 Discharge, 114,700 cfs 2000 hours June 11 (gage height, 19 74 ft)
1934 to May 1964 Discharge, 137,000 cfs June 6, 1953 (gage height, 22 20 ft, from graph based on gage readings), maximum gage height, 30 16 ft Mar 19, 1947 (ice jam)

Remarks --Flow regulated by 24 small irrigation reservoirs and powerplants, Canyon Reservoir (see station 23), and Tiber Reservoir (see station 103)

Mean discharge, in cubic feet per second, 1964, of Missouri River at powerplant ferry near Zortman, Mont

Day	May	June	Day	May	June	Day	May	June
1	7,980	26,600	11	18,700	105,000	21	22,800	48,700
2	7,500	26,500	12	19,200	101,000	22	25,000	48,800
3	11,500	25,600	13	18,600	71,900	23	25,700	49,000
4	16,000	25,900	14	18,500	58,500	24	25,200	46,600
5	27,300	26,500	15	18,400	54,600	25	22,000	41,500
6	25,900	26,500	16	18,600	54,500	26	18,200	41,900
7	22,000	25,700	17	16,900	53,000	27	16,900	43,100
8	19,000	24,900	18	16,300	51,500	28	16,500	43,900
9	17,100	34,300	19	17,800	48,900	29	16,600	43,400
10	17,100	58,300	20	20,200	48,700	30	17,700	42,500
						31	20,800	- - - - -
Monthly mean discharge, in cubic feet per second							18,770	46,590
Runoff, in acre-feet							1,154,000	2,772,000

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 9	0000	8 50	25,600	June 11	1200	19 22	110,000	June 13	0600	15 33	76,300
	0600	8 97	28,600		1600	19 64	113,800		0800	15 12	74,500
	1200	9 73	33,900		2000	19 74	114,700		1000	14 93	72,900
	1800	10 48	39,500		2400	19 61	113,500		1200	14 74	71,300
	2400	11 24	45,200						1400	14 59	70,000
				12	0600	19 12	109,100		1600	14 36	68,100
10	0600	11 95	50,500		1200	18 31	101,800		1800	14 22	66,900
	1200	12 77	56,900		1800	17 31	93,100		2000	14 05	65,400
	1800	13 73	64,500		2400	16 31	84,600		2200	13 79	63,300
	2400	15 38	77,700						2400	13 65	62,200
				13	0200	15 96	81,700				
11	0600	17 75	96,800		0400	15 64	78,900				

MUSSELSHELL RIVER BASIN

(129) 6-1305 Musselshell River at Mosby, Mont

Location --Lat 47°00', long 107°54', near northwest corner of sec 11, T 14 N , R 30 E , on left bank 800 ft downstream from highway bridge, half a mile west of Mosby and 6 miles downstream from Flatwillow Creek

Drainage area --7,846 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 2,500 ft (by barometer)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 4,920 cfs 2330 hours June 21 (gage height, 10 00 ft) 1929-32, 1934 to May 1964 Discharge, 18,000 cfs June 18, 1944 (gage height, 14 43 ft, at site 800 ft upstream and at datum 1 12 ft higher), from rating curve extended above 10,000 cfs

Remarks --Some regulation by Durand, Martinsdale, and Deadmans Basin Reservoirs (combined capacity, 102,340 acre-ft)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	51	199	11	565	1,540	21	286	4,590
2	52	199	12	459	3,100	22	268	3,840
3	370	308	13	408	3,010	23	250	3,060
4	1,160	359	14	380	2,740	24	268	2,600
5	1,410	320	15	370	2,660	25	274	2,310
6	1,390	271	16	348	2,240	26	310	2,100
7	1,240	242	17	334	1,880	27	328	2,000
8	1,060	222	18	328	2,380	28	292	1,850
9	850	233	19	314	3,870	29	239	1,690
10	676	378	20	298	4,380	30	212	1,660
						31	201	- - - - -
Monthly mean discharge, in cubic feet per second							484	1,874
Runoff, in acre-feet							29,730	111,500

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964, of Musselshell River at Mosby, Mont

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 10	0000	3 24	233	June 11	0300	4 82	952	June 12	1200	8 04	3,350
	0300	3 27	242		0600	5 24	1,230		1400	8 07	3,380
	0600	3 37	271		1200	5 74	1,580		1500	8 07	3,380
	0900	3 47	301		1800	6 17	1,900		1800	7 92	3,260
	1200	3 58	338		2100	6 63	2,240		2400	7 73	3,100
	1800	3 90	455		2400	6 67	2,270				
	2100	4 12	550								
	2400	4 40	700	12	0600	7 69	3,070				

MISSOURI RIVER MAIN STEM

(130) 6-1315 Fort Peck Reservoir at Fort Peck, Mont

Location --Lat 48°00'26", long 106°23'49", in sec 14, T 26 N , R 41 E , in No 4 emergency gate shaft of dam on Missouri River at Fort Peck, 2 miles downstream from Bear Creek, 9½ miles southwest of Nashua, and about 9½ miles upstream from Milk River

Drainage area --57,500 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is at mean sea level, datum of 1929

Maxima --June 1964 Contents, 15,220,000 acre-ft 2400 hours June 30 (elevation, 2,231 5 ft)
1937 to May 1964 Contents, 18,170,000 acre-ft July 15, 1948 (elevation, 2,244 80 ft)

Remarks --Reservoir is formed by earthfill dam completed in 1939, storage began in 1937 Total capacity, 19,410,000 acre-ft below elevation 2,250 ft (top of 25-foot gates) Normal operating level, 18,450,000 acre-ft (elevation, 2,246 ft) Elevation of crest of spillway, 2,225 ft Dead storage, 617,000 acre-ft below elevation 2,095 ft Minimum operating level, 2,160 ft for on-site power generation (usable contents, 4,535,000 acre-ft) Water is stored for navigation, recreation, flood control and power generation Elevations materially affected by wind Elevations and capacity table furnished by Corps of Engineers Figures given here represent total contents

Elevation, in feet, and contents, in thousands of acre-feet, at 2400 hours of indicated day, 1964

Day	May		June		Day	May		June	
	Elevation	Contents†	Elevation	Contents†		Elevation	Contents†	Elevation	Contents†
1	2,214 4	11,920	2,219 3	12,810	16	2,216 6	12,310	2,225 4	13,980
2	2,214 4	11,920	2,219 5	12,850	17	2,216 7	12,330	2,225 9	14,080
3	2,214 9	12,010	2,219 7	12,890	18	2,216 8	12,350	2,226 8	14,260
4	2,215 1	12,040	2,219 9	12,920	19	2,216 9	12,370	2,227 3	14,360
5	2,215 2	12,060	2,220 2	12,980	20	2,217 2	12,420	2,227 8	14,460
6	2,215 4	12,100	2,220 4	13,020	21	2,217 3	12,440	2,228 2	14,540
7	2,215 6	12,130	2,220 5	13,040	22	2,217 5	12,480	2,228 6	14,630
8	2,215 7	12,150	2,220 9	13,110	23	2,217 7	12,520	2,229 0	14,710
9	2,215 7	12,150	2,221 1	13,150	24	2,218 0	12,570	2,229 4	14,790
10	2,215 8	12,170	2,221 5	13,230	25	2,218 1	12,590	2,229 8	14,870
11	2,215 8	12,170	2,222 0	13,320	26	2,218 3	12,630	2,230 1	14,930
12	2,216 0	12,200	2,222 8	13,480	27	2,218 4	12,650	2,230 5	15,020
13	2,216 1	12,220	2,223 6	13,630	28	2,218 5	12,660	2,230 9	15,100
14	2,216 3	12,260	2,224 3	13,770	29	2,218 8	12,720	2,231 1	15,140
15	2,216 4	12,280	2,224 8	13,870	30	2,218 9	12,740	2,231 5	15,220
					31	2,219 1	12,780	-	-
Change in contents						-	+860	-	+2,440

† In thousands of acre-feet

MILK RIVER BASIN

(131) 6-1322 South Fork Milk River near Babb, Mont
(International gaging station)

Location --Lat 48°45'20", long 113°10'00", in NW¼ sec 34, T 35 N , R 12 W , on right bank 300 ft upstream from bridge on FAS 464 ("Duck Lake Road"), 14½ miles southeast of Babb, and 15½ miles northwest of Browning

Drainage area --68 6 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 4,731 6 ft above mean sea level, datum of 1929

Discharge record --Stage-discharge relation defined by current-meter measurements below 250 cfs and by slope-area measurement (made at site 3 miles downstream and corrected for intervening drainage) at 12,000 cfs

Maxima --June 1964 Discharge, 12,000 cfs 1300 hours June 8 (gage height, 6 61 ft)
1961 to May 1964 Discharge, about 500 cfs Feb 5, 1963 (gage height, 5 33 ft, from floodmark, backwater from ice)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	82	86	11	145	288	21	97	141
2	155	78	12	117	248	22	94	132
3	148	76	13	114	230	23	82	124
4	148	82	14	108	206	24	68	115
5	143	82	15	90	218	25	65	106
6	132	88	16	86	244	26	59	101
7	132	130	17	97	244	27	59	101
8	143	4,940	18	112	189	28	103	93
9	159	734	19	101	167	29	168	89
10	154	355	20	101	151	30	117	87
						31	94	- - - - -
Monthly mean discharge, in cubic feet per second							112	331
Runoff, in inches							1.88	5.38
Runoff, in acre-feet							6,890	19,690

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	3 01	92	June 8	0400	4 08	518	June 8	1600	6 49	10,200
	0600	3 01	92		0600	4 66	1,060		1800	6 20	6,800
	1200	3 09	110		0800	5 32	2,560		2400	5 21	1,720
	1500	3 13	120		1000	6 00	5,820				
	1800	3 25	151		1200	6 48	10,000	9	0600	4 72	834
	2100	3 37	186		1300	6 61	12,000		1200	4 46	578
	2400	3 65	290		1430	6 59	11,600		1800	4 29	460
									2400	4 20	410

(132) 6-1322 5 Livermore Creek near Babb, Mont
(Crest-stage station)

Location --Lat 48°46', long 113°11', in NE¼ sec 28, T 35 N , R 12 W , at bridge on State Highway 464, 13½ miles southeast of Babb Gage destroyed by flood Datum of gage not recovered

Drainage area --25 0 sq mi

Gage-height record --Crest stages only Altitude of gage is 4,730 ft (from topographic map)

Maxima --June 1964 Discharge, 4,880 cfs 1600 hours June 8, from slope-area measurement
1962 to May 1964 Discharge, 152 cfs Apr 13, 1962 (gage height, 3 43 ft), from flow-through-culvert measurement

(133) South Fork Milk River below Livermore Creek, near Babb, Mont

(Miscellaneous site)

Location --Lat 48°45'00", long 113°07'30", in SE¼ sec 13, T 35 N , R 12 W , at Jeff Harwood Ranch, 2 miles downstream from Livermore Creek, and 15 miles southeast of Babb

Drainage area --101 sq mi

Maximum --June 1964 Discharge, 14,900 cfs 1600 hours June 8, from slope-area measurement

(134) 6-1323 Middle Fork Milk River near Babb, Mont

(Crest-stage station)

Location --Lat 48°51', long 113°13', in SE¼ sec 30, T 36 N , R 12 W , at culvert on State Highway 464, 10 miles east of Babb

Drainage area --14 0 sq mi

Gage-height record --Crest stages only Altitude of gage is 4,810 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 25 cfs and by flow-over-road plus flow-through-culvert measurements at 107 and 558 cfs

Maxima --June 1964 Discharge, 558 cfs 1430 hours June 8 (gage height, 2 96 ft)
1962 to May 1964 Discharge, 107 cfs Apr 13, 1962 (gage height, 2 62 ft)

(135) 6-1324 Dry Fork Milk River near Babb, Mont

(Crest-stage station)

Location --Lat 48°50', long 113°12', in SE¼ sec 32, T 36 N , R 12 W , at bridge on State Highway 464, 11 miles east of Babb

Drainage area --17 4 sq mi

Gage-height record --Crest stages only Altitude of gage is 4,750 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 65 cfs and by contracted-opening measurement at 1,880 cfs

Maxima --June 1964 Discharge, 1,880 cfs 1400 hours June 8 (gage height, 5 20 ft)
1962 to May 1964 Discharge, 394 cfs Apr 13, 1962 (gage height, 3 96 ft), from flow-through-culvert measurement

(136) 6-1327 Milk River near Del Bonita, Mont

Location --Lat 48°57', long 112°45', in center of N½ sec 23, T 37 N , R 9 W , at bridge on State Highway 483, 3½ miles southeast of Del Bonita Port of Entry

Drainage area --325 sq mi

Gage-height record --Once-daily readings of staff gage, infrequent engineer's gage readings and crest stages Graph based on gage readings used May 2-6, June 7-24 Altitude of gage is 4,030 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 3,800 cfs and by sum of flow-over-road, contracted-opening, and four flow-through-culvert measurements at 17,300 cfs

Maxima --June 1964 Discharge, 17,300 cfs 2330 hours June 8 (gage height, 9 0 ft, from floodmarks)
1905-30, 1962 to May 1964 Discharge, about 13,000 cfs June 6, 1908 (gage height, 15 4 ft, at site 5 miles upstream and at datum then in use), from rating curve extended above 600 cfs on basis of velocity-area study

Mean discharge, in cubic feet per second, 1964, of Milk River near Del Bonita, Mont

Day	May	June	Day	May	June	Day	May	June
1	262	166	11	331	1,030	21	222	209
2	550	104	12	284	662	22	198	139
3	1,740	138	13	262	507	23	193	221
4	1,350	141	14	234	458	24	166	172
5	907	145	15	231	414	25	155	161
6	496	127	16	198	680	26	127	153
7	402	150	17	204	924	27	122	128
8	345	3,380	18	265	544	28	141	126
9	304	5,780	19	231	343	29	234	125
10	317	1,880	20	216	286	30	284	125
						31	204	- - - - -
Monthly mean discharge, in cubic feet per second							360	647
Runoff, in inches							1 28	2 22
Runoff, in acre-feet							22,170	38,500

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	2 02	132	June 8	1500	5 70	3,800	June 9	1200	6 40	4,600
	1200	2 03	134		1800	5 85	4,180		1800	6 15	3,920
	1800	2 06	141		2100	6 50	6,000		2400	5 70	2,910
	2100	2 23	184		2330	9 00	17,300				
	2400	2 53	275		2400	8 95	17,000	10	0600	5 32	2,230
									1200	5 00	1,770
8	0300	2 70	331	9	0200	8 10	11,800		2400	4 50	1,180
	0600	2 80	366		0400	7 15	7,300				
	1200	4 50	1,650		0600	6 80	5,900				

(137) 6-1330 Milk River at western crossing of international boundary

(International gaging station)

Location --Lat 49°00'30", long 112°32'40", in NE¼ sec 1, T 1, R 20 W , fourth meridian, on left bank half a mile north of international boundary, 22 miles upstream from North Milk River, and 23 miles southwest of Milk River, Alberta

Drainage area --397 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 3,820 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 7,930 cfs 0600 hours June 9 (gage height, 9 77 ft)
1931 to May 1964 Discharge, 4,750 cfs June 18, 1948 (gage height, 6 83 ft, at site 0 4 mile downstream and at datum then in use), from rating curve extended above 1,300 cfs

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	267	165	11	346	915	21	217	284
2	433	143	12	326	612	22	210	253
3	1,180	125	13	270	510	23	190	233
4	1,070	118	14	253	447	24	155	207
5	939	121	15	246	424	25	134	178
6	527	121	16	204	471	26	123	155
7	490	133	17	198	638	27	114	147
8	438	927	18	217	554	28	114	138
9	363	5,410	19	253	393	29	165	129
10	372	1,980	20	213	398	30	273	125
						31	210	- - - - -
Monthly mean discharge, in cubic feet per second							339	548
Runoff, in inches							0 98	1 54
Runoff, in acre-feet							20,850	32,640

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964, of Milk River at western crossing of international boundary

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	3 39	123	June 8	1700	5 59	1,400	June 10	0600	6 54	2,310
	1200	3 38	121		1900	5 57	1,380		1000	6 20	1,940
	1800	3 45	140		2100	5 76	1,550		1400	6 02	1,750
	2400	3 57	178		2400	6 30	2,080		1800	5 83	1,560
									2400	5 49	1,260
8	0200	3 70	226	9	0100	6 49	2,290				
	0600	4 16	443		0300	7 72	3,930	11	0600	5 15	988
	0700	4 12	420		0500	9 72	7,850		1200	5 00	881
	0900	4 31	519		0600	9 77	7,930		2400	4 74	718
	1100	4 80	790		1200	9 12	6,550				
	1200	4 89	848		1700	8 40	5,110				
	1400	5 30	1,150		2400	7 28	3,240				

(138) 6-1335 North Fork Milk River above St Mary Canal, near Browning, Mont

(International gaging station)

Location --Lat 48°59', long 113°03', in NE¼ sec 16, T 37 N , R 11 W , on left bank 1½ miles upstream from outlet of canal, 2 miles south of international boundary, and 29 miles north of Browning

Drainage area --61 8 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 4,220 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 110 cfs and extended above on basis of slope-area measurement, made in 1953, at 2,120 cfs

Maxima --June 1964 Discharge, 653 cfs 1500 hours June 8 (gage height, 4 91 ft)
1911 to May 1964 Discharge, 2,120 cfs Apr 22, 1953 (gage height, 7 55 ft, from floodmarks)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	40 6	17 8	11	46.2	46 2	21	22 4	33 4
2	103	17 3	12	39 1	41 4	22	21 9	32 7
3	176	16 8	13	36 2	43 0	23	20 3	30 6
4	141	16 3	14	33 4	36 9	24	18 8	29 2
5	92 9	16 3	15	29 2	44 6	25	18 8	28 6
6	62 0	16 3	16	27 3	54 3	26	18 3	27 9
7	74 0	22 6	17	27 3	57 0	27	17 8	27 9
8	59 0	391	18	27 3	37 6	28	21 3	27 3
9	50 7	148	19	24 8	34 8	29	23 0	27 3
10	56 1	59 0	20	24 2	33 4	30	20 3	26 6
						31	18 8	- - - - -
Monthly mean discharge, in cubic feet per second							44 9	48 1
Runoff, in inches							0 84	0 87
Runoff, in acre-feet							2,760	2,860

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	1 14	16 3	June 8	0900	3 43	296	June 9	0300	3 14	247
	1400	1 16	17 3		1200	4 23	468		0600	2 54	156
	2000	1 39	30 6		1500	4 91	653		1200	2 14	105
	2400	1 66	51 6		1800	4 78	614		1800	1 93	81 3
					2000	4 36	500		2400	1 82	70 0
8	0200	1 90	76 0		2100	4 38	505				
	0500	2 51	149		2300	4 68	585				
	0700	3 12	242		2400	4 47	528				

(139) 6-1340 North Milk River near international boundary

(International gaging station)

Location --Lat 40°01'20", long 112°58'20", in SW¼NE¼ sec 11, T 1, R 23 W , fourth meridian, on left bank 1,500 ft upstream from highway bridge, 1½ miles north of international boundary, 3 miles east of Whiskey Gap, Alberta, and 11 miles southeast of Kimball, Alberta

Drainage area --91 8 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 4,112 16 ft above mean sea level (Geodetic Surveys of Canada datum)

Discharge record --Stage-discharge relation defined by current-meter measurements below 700 cfs and by slope-area measurement at 1,940 cfs

Maxima --June 1964 Discharge, 1,940 cfs 1600 hours June 8 (gage height, 7 98 ft)
1909 to May 1964 Discharge, 2,950 cfs June 17, 1948 (gage height, 6 47 ft, at site 1500 ft downstream and at datum then in use), from rating curve extended above 1,500 cfs

Remarks --Since 1917, flow increased during irrigation season by water from St Mary Canal (see station 15)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	186	680	11	639	86 9	21	635	474
2	314	680	12	631	60 0	22	639	470
3	521	687	13	631	58 7	23	651	448
4	578	691	14	623	51 7	24	660	470
5	557	691	15	618	57 5	25	655	509
6	561	696	16	614	70 1	26	651	497
7	573	724	17	631	79 6	27	664	459
8	586	1,360	18	614	50 6	28	676	423
9	623	697	19	623	46 2	29	680	372
10	627	172	20	623	118	30	676	353
						31	680	- - - - -
Monthly mean discharge, in cubic feet per second							601	408
Runoff, in acre-feet							36,970	24,260

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	5 94	696	June 8	1600	7 98	1,940	June 9	2400	4 78	287
	1200	5 95	700		2000	7 51	1,620				
	1800	6 06	751		2400	7 16	1,390	10	0600	4 47	206
	2400	6 15	799						1200	4 23	153
				9	0600	6 37	934		2400	4 00	111
8	0600	6 50	988		1200	5 68	605				
	1200	7.28	1,460		1800	5 18	412				

(140) 6-1345 Milk River at Milk River, Alberta

(International gaging station)

Location --Lat 49°09', long 112°05', in SE¼ sec 28, T 2, R 16 W , fourth meridian, on left bank 700 ft downstream from highway bridge at Milk River, Alberta, and 22 miles downstream from North Milk River

Drainage area --1,036 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 3,402 78 ft above mean sea level (Geodetic Surveys of Canada datum)

Discharge record --Stage-discharge relation defined by current-meter measurements below 3,800 cfs and above on basis of logarithmic extension

Maxima --June 1964 Discharge, 8,110 cfs 2300 hours June 9 (gage height, 10 40 ft)
1909 to May 1964 Discharge, 8,730 cfs May 22, 1927 (gage height, 11 41 ft), from rating curve extended above 4,000 cfs on basis of area-velocity study of peak discharge

Remarks --Since 1917, flow increased during irrigation season by water from St Mary Canal)

Mean discharge, in cubic feet per second, 1964, of Milk River at Milk River, Alberta

Day	May	June	Day	May	June	Day	May	June
1	524	877	11	1,020	1,540	21	865	483
2	607	846	12	1,020	929	22	865	754
3	1,360	827	13	969	725	23	865	719
4	2,190	809	14	929	628	24	852	673
5	2,290	803	15	910	569	25	833	673
6	1,620	815	16	890	564	26	821	696
7	1,390	840	17	858	707	27	809	667
8	1,240	1,200	18	871	760	28	815	622
9	1,080	4,560	19	890	569	29	846	585
10	1,040	4,310	20	896	518	30	922	538
						31	948	- - - - -
Monthly mean discharge, in cubic feet per second							1,030	994
Runoff, in acre-feet							63,540	59,120

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	3 37	884	June 9	1300	7 30	4,210	June 10	0700	8 22	5,310
	0200	3 41	910		1400	7 89	4,920		0800	7 78	4,790
	0400	3 43	922		1600	8 50	5,650		1000	7 15	4,040
	1000	3 63	1,060		1800	9 10	6,420		1200	6 68	3,560
	1400	3 75	1,150		1900	9 75	7,260		1400	6 31	3,200
	2000	4 20	1,440		2300	10 40	8,110		2000	5 52	2,480
	2400	5 03	2,060		2400	10 30	7,980		2400	5 18	2,180
9	0700	5 83	2,760	10	0200	9 95	7,520	11	0600	4 72	1,810
	0800	5 77	2,700		0400	9 53	6,980		1200	4 30	1,480
	0900	5 99	2,900		0500	9 25	6,620		1800	3 98	1,240
	1100	6 73	3,610		0600	8 77	5,990		2400	3 80	1,100

(141) 6-1348 Van Cleeve Coulee tributary near Sunburst, Mont

(Crest-stage station)

Location --Lat 48°53', long 111°49', on north line of NE¼ sec 14, T 36 N , R 2 W , at culverts on county road, 3 7 miles east of interchange on Interstate Highway 15 at Sunburst

Drainage area --10 8 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,350 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 0 5 cfs and by flow-through-culvert measurement at 35 cfs

Maxima --June 1964 No flow
1963 to May 1964 Discharge, 35 cfs May 3, 1964 (gage height, upstream gage, 2 08 ft, downstream gage, 1 69 ft)

(142) 6-1350 Milk River at eastern crossing of international boundary

(International gaging station)

Location --Lat 48°59'50", long 110°35'30", in NE¼ sec 6, T 37 N , R 9 E , on right bank 500 ft south of international boundary, 500 ft downstream from Canada Coulee, 30 miles north of Rudyard, Mont, and 37 miles south of Many Berries, Alberta

Drainage area --2,588 sq mi

Gage-height record --Water-stage recorder graph, except June 13-16 Graph reconstructed on basis of gage readings June 13, 14 Datum of gage is 2,698 4 ft above mean sea level (International Boundary Survey datum)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 7,770 cfs 0600 to 0800 hours June 11 (gage height, 6 71 ft)
1909 to May 1964 Discharge, 9,530 cfs Mar 31, 1952 (gage height, 9 34 ft), but may have been higher Mar 28, 1952 (gage height, 13 65 ft, backwater from ice)

Remarks --Since 1917 flow increased during irrigation season by water from St Mary Canal

Mean discharge, in cubic feet per second, 1964, of Milk River at eastern crossing of international boundary

Day	May	June	Day	May	June	Day	May	June
1	506	903	11	1,260	5,790	21	958	645
2	567	941	12	1,230	2,220	22	965	545
3	666	861	13	1,140	1,300	23	874	531
4	2,170	843	14	1,130	974	24	867	650
5	3,460	837	15	1,030	864	25	881	710
6	2,830	825	16	980	752	26	839	660
7	2,100	831	17	958	630	27	825	645
8	1,650	897	18	930	650	28	846	660
9	1,560	1,120	19	895	720	29	818	640
10	1,340	3,820	20	930	778	30	837	590
						31	849	- - - - -
Monthly mean discharge, in cubic feet per second							1,190	1,090
Runoff, in acre-feet							73,170	65,120

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 10	0000	2 23	1,220	June 10	2400	6 18	6,760	June 11	2400	3 87	3,000
	0400	2 29	1,260								
	0600	2 74	1,700	11	0600	6 71	7,770	12	0600	3 47	2,500
	0900	3 80	2,910		0800	6 71	7,770		1200	3 23	2,220
	1200	4 56	3,990		1100	6 39	7,160		1800	2 88	1,840
	1800	5 60	5,700		1700	4 56	3,990		2400	2 66	1,620

PEND OREILLE RIVER BASIN

(143) Landers Fork above Copper Creek, near Lincoln, Mont

(Miscellaneous site)

Location --Lat 47°03'40", long 112°33'10", near north line of sec 13, T 15 N , R 8 W , 4 miles upstream from Copper Creek and 10½ miles northeast of Lincoln

Drainage area --78 0 sq mi

Maximum --June 1964 Discharge, 5,120 cfs June 9, from slope-area measurement

(144) Copper Creek near Lincoln, Mont

(Miscellaneous site)

Location --Lat 47°01'00", long 112°33'40", in NW¼ sec 36, T 15 N , R 8 W , half a mile above Landers Fork and 7 miles northeast of Lincoln

Drainage area --40 8 sq mi

Maximum --June 1964 Discharge, 803 cfs June 8, from contracted-opening measurement

(145) 12-3355 Nevada Creek above reservoir, near Finn, Mont

Location --Lat 46°46'30", long 112°45'20", near south line of sec 20, T 12 N , R 9 W , on right bank a quarter of a mile downstream from Gallagher Creek, 2 miles upstream from Buffalo Creek, and 3 miles west of Finn

Drainage area --116 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 4,660 ft (from river-profile map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 524 cfs 1500 hours June 9 (gage height, 4 22 ft)
1939 to May 1964 Discharge, 1,800 cfs June 2, 1953 (gage height, 6 00 ft, at site 1 mile downstream at different datum), from rating curve extended above 400 cfs on basis of inflow-outflow study of Nevada Creek Reservoir, gage height, 7 40 ft May 29, 1953, at site 1 mile downstream at different datum (backwater from diversion dam)

Mean discharge, in cubic feet per second, 1964, of Nevada Creek above reservoir, near Finn, Mont

Day	May	June	Day	May	June	Day	May	June
1	88	211	11	100	374	21	380	124
2	105	210	12	95	285	22	356	113
3	68	206	13	107	228	23	271	99
4	72	213	14	116	210	24	196	81
5	170	214	15	116	207	25	161	64
6	141	213	16	132	204	26	134	52
7	129	240	17	178	187	27	131	56
8	128	446	18	235	170	28	166	59
9	107	512	19	250	148	29	267	55
10	101	455	20	316	133	30	278	52
						31	230	- - - - -
Monthly mean discharge, in cubic feet per second							172	194
Runoff, in inches							1 71	1 87
Runoff, in acre-feet							10,560	11,550

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	3 42	235	June 8	0900	4 14	446	June 9	0400	4 21	512
	1200	3 32	220		1200	4 10	410		1500	4 22	524
	1800	3 43	237		1500	4 07	392		2400	4 19	491
	2400	3 90	320		1800	4 14	446				
					2100	4 21	512	10	1200	4 15	455
8	0300	4 17	473		2400	4 21	512		2400	4 11	419
	0600	4 17	473								

(146) 12-3380 North Fork Blackfoot River near Ovando, Mont

(Gaging station, discontinued 1923)

Location --Lat 47°03'00", long 112°59'00", in NW¼NW¼ sec 22, T 15 N , R 11 W , on left bank at Pitkin's ranch, 11 miles northeast of Ovando Altitude of gage was 4,270 ft (from topographic map) Gage and datum not recovered

Drainage area --228 sq mi

Discharge record --Peak discharge by slope-area measurement

Maxima --June 1964 Discharge, 11,800 cfs June 8
1921-23 Discharge observed, 2,900 cfs June 5, 1922 (gage height, 7 58 ft)
Flood of about May 22, 1948, reached a stage of 9 0 ft, from floodmarks (discharge, 4,380 cfs, from slope-area measurement)

(147) 12-3398 Blackfoot River near Potomac, Mont

Location --Lat 46°57'10", long 113°34'00", in NE¼SW¼ sec 24, T 14 N , R 16 W , on right bank an eighth of a mile upstream from Belmont Creek and 5 miles north of Potomac

Drainage area --2,046 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 3,533 36 ft above mean sea level, datum of 1929 (levels by Bureau of Reclamation)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 17,500 cfs 1500 hours June 10 (gage height, 11 33 ft)
1957 to May 1964 Discharge, 10,900 cfs June 15, 1959 (gage height. 8 54 ft)

Mean discharge, in cubic feet per second, 1964, of Blackfoot River near Potomac, Mont

Day	May	June	Day	May	June	Day	May	June
1	1,710	6,660	11	2,440	14,800	21	7,790	5,360
2	2,120	6,470	12	2,570	11,800	22	8,110	4,920
3	2,350	6,590	13	2,810	9,940	23	7,540	4,540
4	2,330	7,190	14	3,060	8,850	24	6,950	4,500
5	2,330	7,380	15	3,370	8,320	25	6,040	4,690
6	2,330	7,460	16	3,760	8,230	26	5,480	4,710
7	2,330	7,680	17	4,480	8,280	27	5,250	4,550
8	2,250	9,290	18	5,270	7,560	28	5,700	4,330
9	2,200	13,700	19	5,880	6,760	29	6,440	4,070
10	2,280	16,300	20	6,640	5,980	30	6,550	3,820
						31	6,660	- - - - -
Monthly mean discharge, in cubic feet per second							4,355	7,490
Runoff, in inches							2 45	4 08
Runoff, in acre-feet							267,800	445,700

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	6 96	7,770	June 9	2400	10 09	14,500	June 11	1200	10 24	14,800
	0600	7 12	8,070						1800	9 83	13,900
	1200	7 61	8,980	10	0600	10 33	15,100		2400	9 40	12,900
	1900	8 51	10,800		0900	10 73	16,000				
	2400	8 69	11,200		1200	11 18	17,100	12	1200	8 92	11,800
					1500	11 33	17,500		2400	8 41	10,600
9	0400	9 15	12,300		1800	11 30	17,400				
	0700	9 82	13,800		2400	10 93	16,500	13	1200	8 14	10,000
	1100	9 90	14,000						2400	7 78	9,160
	1500	10 11	14,500	11	0600	10 62	15,700				

(148) 12-3399 West Twin Creek near Bonner, Mont

(Crest-stage station)

Location --Lat 46°55', long 113°43', in NW¼ sec 2, T 13 N , R 17 W , at bridge on State Highway 20, 8 miles east of Bonner

Drainage area --7 47 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,410 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 80 cfs

Maxima --June 1964 Discharge, about 150 cfs June 8 (gage height, 1 10 ft)
1959 to May 1964 Discharge, 128 cfs May 27, 1961 (gage height, 0 91 ft)

(149) 12-3400 Blackfoot River near Bonner, Mont

Location --Lat 46°53'50", long 113°45'20", near center of sec 9, T 13 N , R 17 W , on right bank 5 miles northeast of Bonner, 5 miles downstream from Union Creek, and 7 miles upstream from mouth

Drainage area --2,290 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 3,344 76 ft above mean sea level, datum of 1929, supplementary adjustment of 1947

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 19,200 cfs 1400 hours June 10 (gage height, 10 89 ft)
1899-1901, 1903-5, 1940 to May 1964 Discharge, 18,300 cfs June 4, 1953 (gage height, 11 65 ft, from graph based on gage readings at site 1 3 miles downstream and at datum 21 82 ft lower)

Mean discharge, in cubic feet per second, 1964, of Blackfoot River near Bonner, Mont

Day	May	June	Day	May	June	Day	May	June
1	2,200	7,600	11	3,060	15,200	21	9,260	6,100
2	2,640	7,460	12	3,200	12,000	22	9,290	5,680
3	2,860	7,750	13	3,510	10,200	23	8,400	5,290
4	2,880	8,350	14	3,840	9,180	24	7,650	5,240
5	2,820	8,430	15	4,180	8,690	25	6,750	5,420
6	2,800	8,480	16	4,610	8,640	26	6,120	5,460
7	2,770	8,720	17	5,420	8,820	27	5,840	5,350
8	2,700	10,800	18	6,340	8,160	28	6,300	5,130
9	2,680	16,400	19	7,010	7,340	29	7,120	4,680
10	2,830	18,000	20	8,040	6,640	30	7,410	4,260
						31	7,530	- - - - -
Monthly mean discharge, in cubic feet per second							5,099	8,316
Runoff, in inches							2 57	4 05
Runoff, in acre-feet							313,500	494,800

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	7 53	8,900	June 9	1600	10 50	17,900	June 11	1200	9 67	15,100
	0600	7 71	9,370		2400	10 14	16,700		1800	9 36	14,100
	1200	8 08	10,300						2400	9 07	13,200
	1300	8 16	10,600	10	0200	10 12	16,600				
	1600	8 47	11,400		0400	10 17	16,800	12	0600	8 83	12,500
	1900	8 88	12,600		0600	10.28	17,200		1200	8 63	11,900
	2200	9 10	13,300		1200	10 80	18,900		1800	8 45	11,400
	2400	9 13	13,400		1400	10 89	19,200		2400	8 25	10,800
					1600	10 85	19,100				
9	0400	9 35	14,100		1800	10 79	18,900	13	0600	8 12	10,500
	0800	9 98	16,100		2400	10 45	17,700		1200	8 02	10,200
	1200	10 46	17,800						1800	7 91	9,890
	1400	10 54	18,000	11	0600	10 00	16,200		2400	7 78	9,550

(150) 12-3402 Marshall Creek near Missoula, Mont

(Crest-stage station)

Location --Lat 46°53', long 113°55', in NW¼ sec 18, T 13 N , R 18 W , at culvert on Interstate Highway 90 and U S Highways 10 and 12, 3 miles east of Missoula

Drainage area --5 47 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,310 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 25 cfs

Maxima --June 1964 Discharge, 10 cfs June 8 (gage height, 0 28 ft)
1959 to May 1964 Discharge, about 50 cfs May 21, 1964 (gage height, 1 05 ft)

(151) 12-3405 Clark Fork above Missoula, Mont

Location --Lat 46°52'40", long 113°55'40", in NW¼NW¼ sec 19, T 13 N , R 18 W , on right bank 3 miles downstream from Blackfoot River and 3 miles east of Missoula

Drainage area --5,999 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 3,230 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 31,700 cfs 1800 hours, June 10, (gage height, 13 35 ft)
1929 to May 1964 Discharge, 31,500 cfs, May 23, 1948 (gage height, 13 07 ft)
Flood in June 1908 reached a discharge of about 48,000 cfs (furnished by The Montana Power Co)

Remarks --Flood stages not affected by regulation of powerplant at Bonner

Mean discharge, in cubic feet per second, 1964, of Clark Fork above Missoula, Mont

Day	May	June	Day	May	June	Day	May	June
1	5,040	13,200	11	6,250	27,500	21	15,000	12,800
2	5,560	13,000	12	6,140	21,900	22	15,300	12,100
3	5,800	13,400	13	6,420	18,500	23	14,200	11,300
4	5,700	14,200	14	6,870	16,500	24	12,600	10,800
5	5,480	14,400	15	7,390	15,700	25	11,300	10,800
6	5,660	14,500	16	8,080	15,400	26	10,300	10,900
7	5,760	15,100	17	9,400	16,000	27	11,200	10,900
8	5,600	18,900	18	10,800	16,000	28	10,700	10,500
9	5,520	27,400	19	11,400	14,500	29	12,600	9,750
10	5,840	30,500	20	12,900	13,700	30	13,500	8,800
						31	13,300	- - - - -
Monthly mean discharge, in cubic feet per second							9,084	15,300
Runoff, in acre-feet							558,600	910,300

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	8 86	14,700	June 9	2400	12 69	29,200	June 11	1800	11 82	25,800
	1200	8 93	15,000						2400	11 42	24,200
	2400	9 15	15,800	10	0300	12 65	29,000				
					0600	12 71	29,200	12	0600	11 09	22,900
8	0600	9 41	16,700		1200	13 11	30,800		1200	10 74	21,600
	1200	9 82	18,200		1500	13 26	31,300		1800	10 62	21,100
	1800	10 49	20,700		1800	13 35	31,700		2400	10 28	19,900
	2400	11 32	23,900		2100	13 28	31,400				
					2400	13 36	31,700	13	1200	9 89	18,400
9	0600	11 64	25,100						2400	9 54	17,200
	1200	12 47	28,300	11	0600	12 64	29,000				
	1800	12 80	29,600		1200	12 24	27,400				

(152) 12-3410 Rattlesnake Creek at Missoula, Mont

Location --Lat 46°52'20", long 113°59'00", in SW¼NE¼ sec 22, T 13 N , R 19 W , on upstream side of Vine Street Bridge in Missoula, half a mile upstream from mouth

Drainage area --79 7 sq mi

Gage-height record --Once-daily wire-weight gage readings Altitude of gage is 3,220 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge observed, 1,830 cfs 1820 hours June 8 (gage height, 10 15 ft)
1899, 1958 to May 1964 Discharge observed, 2,050 cfs June 18, 1899 (gage height, 6 25 ft, site and datum then in use)
Discharge known, 2,400 cfs June 6, 1948, from flow-over-dam measurement at site 4 miles upstream

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	173	690	11	170	770	21	1,200	580
2	200	770	12	185	690	22	855	580
3	176	828	13	295	706	23	510	615
4	161	855	14	290	706	24	340	666
5	161	770	15	295	770	25	315	650
6	123	770	16	340	770	26	290	636
7	128	770	17	810	770	27	375	580
8	135	1,590	18	855	730	28	706	510
9	142	1,480	19	960	650	29	690	390
10	170	900	20	980	706	30	510	290
						31	492	- - - - -
Monthly mean discharge, in cubic feet per second							420	740
Runoff, in inches							6 08	10 35
Runoff, in acre-feet							25,850	44,000

(153) 12-3530 Clark Fork below Missoula, Mont

Location --Lat 46°52',10", long 114°07'30", in NE¼SE¼ sec 21, T 13 N , R 20 W , on right bank 1 mile downstream from Bitterroot River and 5 miles west of Missoula

Drainage area --9,003 sq mi

Gage-height record --Water stage recorder graph Altitude of gage is 3,090 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 50,100 cfs 2100 hours, June 10 (gage height, 11 45 ft)
1929 to May 1964 Discharge, 52,800 cfs May 23, 1948 (gage height, 12 08 ft)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	7,190	25,200	11	8,860	45,600	21	27,600	25,900
2	8,320	25,800	12	9,250	37,400	22	28,700	24,300
3	8,660	27,400	13	9,830	32,200	23	25,700	22,600
4	8,320	28,700	14	11,100	29,900	24	22,000	22,300
5	7,840	28,100	15	11,900	29,500	25	19,300	23,400
6	7,720	28,600	16	13,300	29,800	26	17,600	24,800
7	7,600	30,500	17	16,100	30,900	27	17,000	25,100
8	7,310	34,800	18	19,500	31,200	28	19,200	24,000
9	7,340	45,000	19	21,100	28,700	29	24,100	21,700
10	7,810	49,100	20	23,900	27,800	30	26,900	18,800
						31	25,800	- - - - -
Monthly mean discharge, in cubic feet per second							15,380	29,320
Runoff, in acre-feet							945,800	1,744,000

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	8 48	29,600	June 9	0600	10 34	41,600	June 11	0600	11 21	48,200
	0600	8 58	30,100		1200	10 77	44,800		1200	10 91	45,600
	1200	8 66	30,600		1600	11 22	48,300		1800	10 61	43,000
	1800	8 68	30,700		2000	11 33	49,100		2400	10 41	41,200
	2400	8 82	31,500		2400	11 33	49,100				
								12	1200	9 94	37,300
8	0600	9 04	32,800	10	0900	11 24	48,400		2400	9 53	34,000
	1200	9 29	34,400		1200	11 30	48,900				
	1800	9 62	36,600		1800	11 38	49,500	13	1200	9 21	32,000
	2400	10 03	39,200		2100	11 45	50,100		2400	9 03	30,800
					2400	11 40	49,700				

(154) 12-3534 Nigger Gulch near Alberton, Mont

(Crest-stage gage)

Location --Lat 47°01', long 114°32', in NW¼ sec 33, T 15 N , R 23 W , at culvert on county road, 2 6 miles west of Alberton

Drainage area --8 02 sq mi

Gage-height record --Crest-stages only Altitude of gage is 3,000 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 67 cfs June 9 (gage height, 1 01 ft)
1959 to May 1964 Discharge, 50 cfs May 21, 1964 (gage height, 0 82 ft)

(155) 12-3538 Thompson Creek near Superior, Mont

(Crest-stage station)

Location --Lat 47°12', long 114°55', in SW¼ sec 28, T 17 N , R 26 W , 1¼ miles west of Superior

Drainage area --12 2 sq mi

Gage-height record --Crest stages only Altitude of gage is 2,710 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 72 cfs June 8 (gage height, 0 40 ft)
1961 to May 1964 Discharge, 85 cfs Apr 24, 1962 (gage height, 0 82 ft)

(156) 12-3538 5 East Fork Timber Creek near Haugan, Mont

(Crest-stage station)

Location --Lat 47°25', long 115°25', in NE¼ sec 16, T 19 N , R 30 W , at culvert on county road 2 miles north of Haugan

Drainage area --2 72 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,350 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 32 cfs June 8 (gage height, 0 71 ft)
1961 to May 1964 Discharge, 45 cfs Apr 15, 1962 (gage height, 0 82 ft), gage height, 0 87 ft May 21, 1964

(157) 12-3540 St Regis River near St Regis, Mont

Location --Lat 47°17'50", long 115°07'20", in NE¼ sec 26, T 18 N , R 28 W , on left bank at county road bridge, 500 ft upstream from Little Joe Creek, 1¼ miles west of St Regis, and 1½ miles upstream from mouth

Drainage area --303 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 2,645 00 ft above mean sea level, datum of 1929

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 5,120 cfs 2200 hours June 8 (gage height, 6 16 ft)
1910-17, 1958 to May 1964 Discharge observed, 7,740 cfs May 28, 1917 (gage height, 8 65 ft at site 2 miles upstream and at datum then in use)
Flood of about Dec 20, 1933, reached a stage of about 14 5 ft, from information by local residents (discharge unknown) Flood of May 19, 1954, reached a discharge of about 11,000 cfs (gage height, 9 4 ft), from rating curve extended above 5,100 cfs

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	940	3,660	11	1,290	2,130	21	3,750	1,220
2	950	3,240	12	1,400	2,380	22	2,780	1,160
3	880	3,160	13	1,620	2,220	23	2,040	1,140
4	789	2,910	14	1,590	2,130	24	1,700	1,200
5	729	2,600	15	1,590	2,010	25	1,520	1,180
6	671	2,800	16	1,840	2,020	26	1,480	1,100
7	663	2,820	17	2,560	1,820	27	1,470	1,060
8	712	4,150	18	2,700	1,620	28	2,000	950
9	900	4,420	19	3,000	1,430	29	2,860	861
10	1,190	3,460	20	3,440	1,290	30	2,400	816
						31	2,980	- - - - -
Monthly mean discharge, in cubic feet per second							1,740	2,099
Runoff, in inches							6.62	7 73
Runoff, in acre-feet							107,000	124,900

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964, of St Regis River near St Regis, Mont

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	4 78	2,790	June 8	1800	6 01	4,850	June 9	2400	5 50	3,960
	0300	4 82	2,850		2000	6 08	4,970				
	0400	4 90	2,970		2100	6 09	4,990	10	0600	5 35	3,720
	0600	5 10	3,270		2200	6 16	5,120		1200	5 15	3,400
	0900	5 40	3,770		2400	6 14	5,090		1400	5 03	3,220
	1200	5 83	4,520						1800	4 98	3,150
	1400	5 96	4,760	9	0600	5 97	4,780		2100	5 03	3,220
	1500	6 05	4,920		1200	5 71	4,320		2400	5 02	3,210
	1700	6 06	4,940		1800	5 56	4,060				

(158) 12-3541 North Fork Little Joe Creek near St Regis, Mont

(Crest-stage station)

Location --Lat 47°16', long 115°09', in SW¼SE¼ sec 34, T 18 N , R 28 W , at bridge on county road, 3 miles southwest of St Regis

Drainage area --14 7 sq mi

Gage-height record --Crest stages only Altitude of gage is 2,850 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 212 cfs June 8 (gage height, 1 91 ft)
1960 to May 1964 Discharge, 185 cfs May 26, 1961 (gage height, 1 88 ft)

(159) 12-3545 Clark Fork at St Regis, Mont

Location --Lat 47°18'05", long 115°05'15", in center of SW¼ sec 19, T 18 N , R 27 W , on left bank at St Regis, half a mile downstream from St Regis River

Drainage area --10,709 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 2,600 ft (river-profile map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 60,900 cfs 1200 hours June 10'(gage height, 18 54 ft)
1910 to May 1964 Discharge, 68,900 cfs May 24, 1948 (gage height, 19 96 ft, from graph based on gage readings)

Remarks --Many diversions above station

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	8,350	34,500	11	11,500	59,700	21	36,300	33,500
2	9,980	35,400	12	12,700	52,200	22	38,000	31,200
3	10,900	37,100	13	13,700	45,400	23	35,200	29,400
4	10,700	38,500	14	14,800	40,900	24	30,600	28,400
5	10,200	38,500	15	16,100	39,000	25	26,600	28,700
6	9,710	38,400	16	17,700	38,900	26	24,100	29,700
7	9,630	39,800	17	21,100	38,900	27	22,500	30,400
8	9,500	45,300	18	25,500	39,500	28	24,200	29,800
9	9,630	53,700	19	29,100	37,600	29	28,800	27,800
10	10,400	60,000	20	32,100	34,700	30	33,800	24,300
						31	35,000	- - - - -
Monthly mean discharge, in cubic feet per second							20,270	38,040
Runoff, in acre-feet							1,246,000	2,264,000

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964, of Clark Fork at St Regis, Mont

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	15 04	38,700	June 9	1200	17 55	54,000	June 11	1400	18 44	60,200
	0600	15 19	39,600		1800	17 80	55,700		1800	18 34	59,500
	1200	15 23	39,900		2400	18 05	57,400		2400	17 98	57,000
	1800	15 26	40,100								
	2400	15 35	40,600	10	0400	18 28	59,100	12	0600	17 59	54,200
					0800	18 45	60,200		1200	17 23	51,900
8	0600	15 63	42,300		1200	18 54	60,900		1800	16 92	50,000
	1200	16 21	45,800		1800	18 48	60,500		2400	16 61	48,200
	1800	16 59	48,000		2400	18 44	60,200				
	2400	16 88	49,800					13	0600	16 43	47,100
				11	0400	18 45	60,200		1200	16 11	45,200
9	0600	17 19	51,600		0800	18 50	60,600		2400	15 68	42,600

(160) 12-3550 Flathead River at Flathead, British Columbia

(International gaging station)

Location --Lat 49°00'14", long 114°28'45", on left bank at highway bridge, 0 2 mile north of international boundary, 0 2 mile northwest of Flathead, British Columbia, and 7 miles northwest of Trail Creek, Mont

Drainage area --450 sq mi, approximately

Gage-height record --Water-stage recorder graph Altitude of gage is 3,980 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 8,000 cfs and by slope-area measurement at 16,300 cfs

Maxima --June 1964 Discharge, 16,300 cfs 2315 hours June 8 (gage height, 8 0 ft, from recorder graph, 8 6 ft, from floodmarks)
1929 to May 1964 Discharge, 14,600 cfs May 23, 1948 (gage height, 9 1 ft, from floodmark)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	1,100	6,080	11	3,330	6,710	21	8,220	3,290
2	1,290	6,330	12	3,350	6,510	22	5,650	3,210
3	2,270	6,410	13	3,910	5,780	23	3,980	3,320
4	2,850	7,260	14	4,150	5,550	24	3,370	3,540
5	2,560	6,540	15	3,730	5,010	25	3,000	3,400
6	2,160	6,830	16	3,840	4,740	26	3,080	3,200
7	1,930	6,440	17	4,630	4,640	27	3,760	3,060
8	2,060	11,900	18	5,310	4,040	28	4,770	2,780
9	2,470	13,500	19	6,050	3,710	29	5,050	2,440
10	3,350	8,450	20	6,970	3,580	30	5,480	2,320
						31	5,780	- - - - -
Monthly mean discharge, in cubic feet per second							3,850	5,350
Runoff, in inches							9 87	13 27
Runoff, in acre-feet							236,900	318,500

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	4 76	6,310	June 8	1200	6 75	12,100	June 9	0300	7 83	15,700
	0500	4 64	6,000		1500	7 30	14,000		0400	7 58	14,900
	1200	4 78	6,360		1700	7 50	14,600		0530	7 39	14,300
	1800	4 88	6,620		1800	7 80	15,600		0800	7 70	15,300
	2400	5 12	7,260		2000	7 88	15,900		1200	7 40	14,300
					2200	7 80	15,600		1500	7 02	13,000
8	0300	5 37	7,940		2315	a8 00	16,300		1800	6 65	11,800
	0600	5 60	8,590		2400	7 88	15,900		2100	6 38	11,000
	0900	6 06	9,960						2400	6 08	10,000

a Gage height, 8 6 ft, from floodmark

(161) Trail Creek near Polebridge, Mont

(Miscellaneous site)

Location --Lat 48°55', long 114°25', in center of S½ sec 35, T 37 N , R 22 W , 1½ miles upstream from mouth and 12 miles northwest of Polebridge

Drainage area --64 6 sq mi

Maximum --June 1964 Discharge, 2,100 cfs June 8, from slope-area measurement

(162) Bowman Creek near Polebridge, Mont

(Miscellaneous site)

Location --Lat 48°50', long 114°12', in NE¼ sec 5, T 35 N , R 20 W , at outlet of Bowman Lake, 6 miles northeast of Polebridge

Drainage area --44 0 sq mi

Maximum --June 1964 Discharge, 2,780 cfs June 8, from slope-area measurement

(163) Big Creek at Big Creek ranger station, near West Glacier, Mont

(Miscellaneous site)

Location --Lat 48°36', long 114°10', in sec 21, T 33 N , R 20 W , at Big Creek ranger station, 500 ft upstream from road, a quarter of a mile upstream from mouth, 15½ miles northeast of Whitefish, and 11 miles northwest of West Glacier

Drainage area --84 2 sq mi

Maximum --June 1964 Discharge, 2,130 cfs June 8, from slope-area measurement

(164) 12-3555 Flathead River near Columbia Falls, Mont

Location --Lat 48°29'40", long 114°07'40", near center of W½ sec 35, T 32 N , R 20 W , on right bank 1½ miles downstream from Canyon Creek, 3¾ miles upstream from Middle Fork, and 9 miles northeast of Columbia Falls

Drainage area --1,548 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 3,145 59 ft above mean sea level, datum of 1929, supplementary adjustment of 1947

Discharge record --Stage-discharge relation defined by current-meter measurements below 37,000 cfs and by slope-area measurement at 69,100 cfs

Maxima --June 1964 Discharge, 69,100 cfs 0900 hours June 9 (gage height, 18 60 ft, from floodmarks)
1910-17, 1929 to May 1964 Discharge, 31,500 cfs May 21, 1954 (gage height, 12 25 ft, at site 2¼ miles downstream and at datum then in use)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	3,360	14,800	11	9,510	24,800	21	19,600	11,200
2	3,890	15,700	12	9,180	21,000	22	18,400	10,700
3	5,180	16,400	13	9,990	19,400	23	13,200	10,800
4	7,890	17,800	14	10,900	18,600	24	10,600	11,700
5	8,180	17,800	15	10,100	17,900	25	9,270	12,200
6	8,210	16,900	16	9,750	16,500	26	8,550	11,500
7	7,060	17,200	17	11,100	16,100	27	8,830	11,000
8	6,930	26,500	18	13,400	14,500	28	11,000	10,100
9	7,320	58,000	19	15,000	13,000	29	12,800	8,860
10	8,690	37,100	20	16,900	12,000	30	13,500	7,870
						31	14,000	- - - - -
Monthly mean discharge, in cubic feet per second							10,400	17,260
Runoff, in inches							7 74	12 44
Runoff, in acre-feet							639,300	1,027,000

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964, of Flathead River near Columbia Falls, Mont

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	8 78	16,400	June 8	2400	14 25	41,500	June 10	1200	13 44	37,200
	1200	9 00	17,200						1800	12 45	32,200
	1800	9 10	17,600	9	0300	15 84	51,000		2400	11 77	28,800
	2400	9 27	18,200		0500	17 00	58,000				
					0900	18 60	69,100	11	0600	11 28	26,400
8	0400	9 50	19,100		1200	18 44	68,000		1200	10 75	24,000
	0600	9 67	19,700		1400	17 72	62,900		1800	10 64	23,600
	0800	9 92	20,700		1800	16 65	55,900		2400	10 25	22,000
	1000	10 22	21,900		2100	16 16	53,000				
	1200	10 67	23,700		2400	15 51	49,100	12	1200	9 92	20,700
	1600	11 93	29,600						2400	9 92	20,700
	2000	13 25	36,200	10	0600	14 03	40,200				

(165) 12-3557 Middle Fork Flathead River near Essex, Mont

(Gaging station, discontinued 1961)

Location --Lat 48°10'20", long 113°32'40", near center sec 19, T 28 N , R 15 W , on right bank a quarter of a mile downstream from Spruce Park Cabin (destroyed in flood), 1 mile downstream from Charlie Creek, and 7½ miles southeast of Essex Altitude of gage was 3,130 ft (from river-profile map)

Drainage area --408 sq mi

Maxima --June 1964 Discharge, 57,900 cfs June 8, from slope-area measurement
1957-61 Discharge, 10,500 cfs June 6, 1959 (gage height, 11 32 ft)

(166) 12-3560 Skyland Creek near Essex, Mont

(Gaging station, partial-record station beginning 1959)

Location --Lat 48°17'30", long 113°23'10", in SE¼NW¼ sec 9, T 29 N , R14 W , on left bank 150 ft upstream from mouth and 10 miles east of Essex

Drainage area --8 09 sq mi

Gage-height record --Water-stage recorder graph, except maximum stage obtained from high-water mark in gage house Datum of gage is 4,835 83 ft above mean sea level, datum of 1929 (Corps of Engineers bench mark)

Discharge record --Stage-discharge relation defined by current-meter measurements below 240 cfs Discharge for 1964 determined by slope-area measurement

Maxima --June 1964 Discharge, 3,580 cfs 1500 hours June 8 (gage height, 9 55 ft, from high-water mark in well)
1946-52, 1954, 1959 to May 1964 Discharge, 284 cfs May 22, 1948 (gage height, 2 15 ft)

(167) 12-3565 Bear Creek near Essex, Mont

(Gaging station, discontinued 1952)

Location --Lat 48°16'50", long 113°25'30", in SE¼NW¼ sec 18, T 29 N , R 14 W , on right bank 1 mile downstream from Autumn Creek and 8½ miles northeast of Essex

Drainage area --20 7 sq mi

Gage-height record --High-water marks at gage site Datum of gage is 4,484.14 ft above mean sea level (Corps of Engineers bench mark)

Discharge record --Peak discharge by slope-area measurement

Maxima --June 1964 Discharge, 8,380 cfs June 8 (gage height, about 7 2 ft, from floodmarks)
1946-52 Discharge, 696 cfs May 22, 1948 (gage height, 3 01 ft)

(168) 12-3570 Middle Fork Flathead River at Essex, Mont

Location --Lat 48°16'30", long 113°36'10", in NE¼SW¼ sec 14, T 29 N , R 16 W , on right bank 0 6 mile upstream from Ole Creek, 0 7 mile southeast of Essex, and 4 miles downstream from Bear Creek

Drainage area --510 sq mi

Gage-height record --Water-stage recorder graph, except May 14, to June 30 Datum of gage is 3,721 93 ft above mean sea level, datum of 1929, supplementary adjustment of 1947

Discharge record --Stage-discharge relation defined by current-meter measurements below 12,000 cfs and by slope-area measurements at 75,300 cfs Discharges May 14 to June 13 estimated on basis of four discharge measurements, weather records, and records for station near West Glacier

Maxima --June 1964 Discharge, 75,300 cfs about 1830 hours June 8 (gage height, 26 7 ft, from floodmark)
1939-53, 1956 to May 1964 Discharge, 14,500 cfs May 22, 1948 (gage height, 10 95 ft, from partly estimated gage-height record)
Flood in May 1954 reached a stage of 12 7 ft (discharge, 18,000 cfs, from rating curve extended above 12,000 cfs)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	2,010	6,900	11	2,560	9,200	21	9,210	3,300
2	2,070	7,200	12	2,610	6,300	22	6,660	3,200
3	1,860	7,600	13	3,080	5,900	23	5,600	3,300
4	1,740	8,600	14	3,700	5,600	24	4,500	4,000
5	1,660	7,900	15	3,600	5,400	25	4,000	4,300
6	1,510	8,100	16	3,800	5,200	26	3,800	3,700
7	1,380	7,900	17	5,000	5,100	27	4,000	3,500
8	1,390	23,000	18	6,200	4,400	28	5,700	3,200
9	1,620	37,000	19	6,600	3,900	29	7,200	2,600
10	2,220	14,500	20	7,900	3,600	30	7,100	2,400
						31	6,800	- - - - -
Monthly mean discharge, in cubic feet per second							4,099	7,227
Runoff, in inches							9 27	15 81
Runoff, in acre-feet							252,100	430,000

(169) Essex Creek at Essex, Mont

(Miscellaneous site)

Location --Lat 48°16', long 113°37', in W½ sec 15, T 29 N , R 16 W , 300 ft upstream from Great Northern Railroad bridge, half a mile southwest of Essex, and 1 mile upstream from mouth

Drainage area --10 5 sq mi

Maximum --June 1964 Discharge, 2,760 cfs June 8, from slope-area measurement

(170) Park Creek near Essex, Mont

(Miscellaneous site)

Location --Lat 48°18'50", long 113°36'20", in SW¼ sec 35, T 30 N , R 16 W , half a mile upstream from mouth and 2½ miles north of Essex

Drainage area --39 4 sq mi

Maximum --June 1964 Discharge, 7,180 cfs June 8, from slope-area measurement

(171) Wahoo Creek near West Glacier, Mont

(Miscellaneous site)

Location --Lat 48°25'30", long 113°47'15", in SE¼ sec 20, T 31 N , R 17 W , at culvert on old U S Highway 2, 10 miles southeast of West Glacier and 13 miles northwest of Essex

Drainage area --105 sq mi

Maximum --June 1964 Discharge, 161 cfs June 8, from flow-through-culvert measurement

(172) 12-3573 Moccasin Creek near West Glacier, Mont

(Crest-stage station)

Location --Lat 48°29', long 113°51', in SE¼ sec 35, T 32 N , R 18 W , at culvert on U S Highway 2, 6½ miles east of West Glacier

Drainage area --1 97 sq mi

Gage-height record --Crest stages only

Discharge record --Stage-discharge relation defined by current-meter measurements below 70 cfs

Maxima.--June 1964 Discharge unknown, but evidence indicates the flow to be more than 10,000 cfs
1959 to May 1964 Discharge, 120 cfs June 3, 1960 (gage height, 1 29 ft), gage height, 1 43 ft May 27, 1961

(173) Ousel Creek near West Glacier, Mont

(Miscellaneous site)

Location --Lat 48°29'50", long 113°53'10", in NW¼ sec 34, T 32 N , R 18 W , about 1,000 ft upstream from U S Highway 2, 4½ miles east of West Glacier

Drainage area --2 92 sq mi

Maximum --June 1964 Discharge, 4,160 cfs June 8, from slope-area measurement

(174) 12-3574 Middle Fork Flathead River tributary at West Glacier, Mont

(Crest-stage station)

Location --Lat 48°30', long 113°58', in NE¼ sec 36, T 32 N , R 19 W , at culvert on U S Highway 2, 0 9 mile east of West Glacier

Drainage area --0 10 sq mi

Gage-height record --Crest stages only

Discharge record --Stage-discharge relation defined by area-velocity estimate

Maxima --June 1964 Discharge, about 8 cfs June 8 (gage height, 0 32 ft)
1960 to May 1964 Discharge, 3 cfs Apr 3, 1960 (gage height, 0 27 ft)

(175) McDonald Creek above Lake McDonald, near West Glacier, Mont

(Miscellaneous site)

Location --Lat 48°38'10", long 113°52'00", in NE¼NE¼ sec 11, T 33 N , R 18 W , at mouth of canyon, downstream from McDonald Falls, and 10 miles north of West Glacier

Drainage area --109 sq mi

Maximum --June 1964 Discharge, 21,200 cfs June 8, from slope-area measurement

(176) 12-3585 Middle Fork Flathead River near West Glacier, Mont

Location --Lat 48°29'50", long 114°00'30", in SW¼NE¼ sec 34, T 32 N , R 19 W , on left bank three-quarters of a mile downstream from McDonald Creek, 1¼ miles west of West Glacier (formerly Belton), and 3½ miles upstream from mouth

Drainage area --1,128 sq mi

Gage-height record --Water-stage recorder graph except 1500 hours June 8 to 1900 hours June 12, for which graph was reconstructed on basis of floodmarks for peak and several observed stage readings Altitude of gage is 3,130 ft (from river-profile map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 35,000 cfs and extended above on basis of flood-volume hydrographic comparison

Maxima --June 1964 Discharge, about 140,000 cfs 0030 hours June 9 (gage height, 36 46 ft, from floodmarks)
1939 to May 1964 Discharge, 34,500 cfs May 20, 1954 (gage height, 13 01 ft)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	3,810	15,400	11	6,730	26,400	21	19,400	11,100
2	3,850	15,900	12	6,700	21,000	22	16,000	10,700
3	3,880	16,900	13	7,490	19,600	23	12,100	11,100
4	3,880	19,200	14	8,080	18,800	24	9,860	13,300
5	5,050	17,600	15	7,840	18,000	25	8,630	14,200
6	4,830	18,000	16	8,260	17,500	26	8,230	12,300
7	4,510	17,500	17	10,900	17,000	27	8,690	11,600
8	4,420	50,300	18	13,500	14,800	28	12,300	10,700
9	4,730	92,700	19	14,300	13,100	29	15,600	9,280
10	5,820	41,600	20	17,100	12,000	30	15,500	8,470
						31	14,800	- - - - -
Monthly mean discharge, in cubic feet per second							9,251	19,870
Runoff, in inches							9 46	19 65
Runoff, in acre-feet							568,800	1,182,000

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	7 97	17,400	June 8	2000	27 1	96,500	June 10	0600	17 2	47,200
	0600	7 96	17,400		2200	31 8	119,000		1200	15 3	40,400
	1200	8 00	17,500		2400	36 1	139,000		1800	13 5	34,800
	1800	8 00	17,500						2400	11 9	30,800
	2400	8 15	18,000	9	0030	36 46	140,000				
					0200	35 5	136,000	11	1200	10 3	26,000
8	0600	8 94	20,900		0600	30 2	112,000		2400	9 5	23,000
	1000	10 50	26,700		1200	25 3	87,400				
	1200	12 54	32,400		1800	21 9	70,000	12	1200	9 0	21,200
	1500	16 44	44,400		2400	19 4	57,000		2400	8 33	18,700
	1800	22 7	74,100								

(177) Bruce Creek near Hungry Horse, Mont

(Miscellaneous site)

Location --Lat 47°54'40", long 113°32'30", in NE¼SW¼SE¼ sec 19, T 25 N , R 15 W , 0 4 mile downstream from Addition Creek, 1½ miles upstream from mouth, and 41 miles southeast of Hungry Horse

Drainage area --16 0 sq mi

Maximum --June 1964 Discharge, 988 cfs June 8, from slope-area measurement

(178) 12-3590 South Fork Flathead River at Spotted Bear ranger station, near Hungry Horse, Mont

Location --Lat 47°55'20", long 113°31'25", in SE¼SW¼ sec 17, T 25 N , R 15 W , on left bank 600 ft south of Spotted Bear ranger station, 1,000 ft upstream from Spotted Bear River, and 40 miles southeast of Hungry Horse

Drainage area --958 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 3,670 ft (from river-profile map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 18,000 cfs and by slope-area measurement at 36,700 cfs

Maxima --June 1964 Discharge, 36,700 cfs 2200 hours June 8 (gage height, 18 96 ft, in gage well, 19 5 ft, from outside floodmarks)
1948-57, 1959 to May 1964 Discharge, 21,200 cfs June 2, 1956 (gage height, 12 52 ft), gage height, 12 75 ft May 20, 1954
Flood of about May 22, 1948, reached a stage of 14 00 ft, from outside floodmarks (discharge, 22,000 cfs, by slope-area measurement of peak flow)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	2,960	9,000	11	2,860	12,700	21	13,600	7,660
2	2,970	9,990	12	3,100	10,800	22	10,100	7,060
3	2,690	11,500	13	3,860	10,800	23	7,310	7,640
4	2,420	13,000	14	4,250	11,200	24	6,090	9,380
5	2,270	11,400	15	4,460	11,500	25	5,590	10,500
6	2,130	11,800	16	5,460	12,100	26	5,540	9,620
7	1,980	11,800	17	8,030	12,300	27	6,070	8,870
8	1,960	25,000	18	8,980	11,300	28	8,560	8,280
9	2,080	29,500	19	9,930	9,860	29	9,290	6,660
10	2,490	18,400	20	12,200	8,650	30	8,690	5,850
						31	8,410	- - - - -
Monthly mean discharge, in cubic feet per second							5,688	11,470
Runoff, in inches.							6 85	13 36
Runoff, in acre-feet							349,700	682,600

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	8 58	11,500	June 8	2400	18 80	36,500	June 10	1200	11 31	18,200
	1200	8 66	11,700						1800	10 54	16,200
	2400	8 90	12,200	9	0200	18 28	35,400		2400	9 87	14,600
					0500	17 46	33,700				
8	0400	9 40	13,400		0800	16 79	32,100	11	0600	9 42	13,500
	0800	10 68	16,600		1200	15 81	29,700		1200	9 24	13,000
	1200	14 05	25,200		1600	14 69	26,900		2400	8 19	10,600
	1500	16 69	31,900		2000	13 71	24,300				
	1800	18 22	35,300		2400	13 06	22,700	12	1200	8 34	10,900
	2000	18 80	36,500						2400	8 27	10,800
	2200	a18 96	36,700	10	0600	12 18	20,400				

a 19 5 ft, from floodmark

(179) 12-3595 Spotted Bear River near Hungry Horse, Mont

(Gaging station, discontinued 1956)

Location --Lat 47°55'40", long 113°31'10", near center of sec 17, T 25 N , R 15 W , on left bank a third of a mile upstream from mouth and 40 miles southeast of Hungry Horse

Drainage area --184 sq mi

Gage-height record --High-water marks at gage site Altitude of gage is 3,690 ft (from river-profile map)

Discharge record --Peak discharge by slope-area measurement

Maxima --June 1964 Discharge, 20,200 cfs June 8 (gage height, 14 29 ft, from high-water mark in well, 14 47 ft, from high-water profile)
1948-56 Discharge, 5,480 cfs May 20, 1954 (gage height, 7 40 ft)

(180) 12-3598 South Fork Flathead River above Twin Creek, near Hungry Horse, Mont

(Miscellaneous site, gaging station since October 1964)

Location --Lat 47°58'45", long 113°33'50", in SE¼SW¼SE¼ sec 25, T 26 N , R 16 W , on left bank 1,000 ft downstream from Tin Creek, a quarter of a mile upstream from Twin Creek, and 36 miles southeast of Hungry Horse

Drainage area --1,160 sq mi

Gage-height record --High-water marks at gage site Altitude of gage is 3,580 ft (from river-profile map)

Discharge record --Peak discharge by slope-area measurement

Maximum --June 1964 Discharge, 50,900 cfs June 8 (gage height, 20 87 ft, from high-water profile, at gage established in October 1964)

(181) 12-3600 Twin Creek near Hungry Horse, Mont

(Gaging station, reestablished September 1964)

Location --Lat 47°59'10", long 113°33'30", in E½ sec 25, T 26 N , R 16 W , on left bank 300 ft upstream from road bridge, 0 1 mile upstream from mouth, and 36 miles southeast of Hungry Horse

Drainage area --47 6 sq mi (revised)

Gage-height record --High-water marks at gage site Altitude of gage is 3,610 ft (from river-profile map)

Discharge record --Peak discharge by slope-area measurement

Maxima --June 1964 Discharge, 5,830 cfs June 8 (gage height, 12 34 ft, from high-water mark in well, 13 1 ft, from high-water profile, at gage reactivated in September 1964)
1948-56 Discharge, 2,790 cfs May 19, 1954 (gage height, 8 33 ft), from rating curve extended above 1,000 cfs on basis of slope-area measurements at gage height of 8 1 ft

(182) 12-3605 Lower Twin Creek near Hungry Horse, Mont

(Gaging station, discontinued 1956)

Location --Lat 47°59'40", long 113°33'20", in SE¼ sec 24, T 26 N , R 16 W , on left bank half a mile upstream from mouth and 35 miles southeast of Hungry Horse Gaging station destroyed by flood Altitude of gage was 3,630 ft (from river-profile map)

Drainage area --22 2 sq mi (revised)

Maxima --June 1964 Discharge, 5,110 cfs June 8, from slope-area measurement
1948-56 Discharge, 1,200 cfs about May 22, 1948 (gage height, 5 25 ft, from floodmark), from slope-area measurement

(183) 12-3606 Soldier Creek near Hungry Horse, Mont

(Miscellaneous site, gaging station since September 1964)

Location --Lat 47°59'30", long 113°34'55", in NE¼ sec 26, T 26 N , R 16 W , on left bank 200 ft upstream from culverts on west shore road and 35 miles southeast of Hungry Horse

Drainage area --4 77 sq mi

Gage-height record --High-water marks at gage site Altitude of gage is 3,640 ft (from river-profile map)

Discharge record --Peak discharge by flow-through-culvert measurement

Maximum --June 1964 Discharge, 206 cfs June 8 (gage height, 5 7 ft, from high-water profile at gage established in September 1964)

(184) 12-3610 Sullivan Creek near Hungry Horse, Mont

Location --Lat 48°01'45", long 113°42'10", in W½ sec 12, T 26 N , R 17 W , on left bank a quarter of a mile downstream from Quintonkon Creek, 1 mile upstream from Hungry Horse Reservoir flow line, and 30 miles southeast of Hungry Horse

Drainage area --71 3 sq mi

Gage-height record --Water-stage recorder graph Altitude of gage is 3,740 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 1,300 cfs and by slope-area measurement at 5,020 cfs

Maxima --June 1964 Discharge, 5,020 cfs 1830 hours June 8 (gage height, 7 21 ft in gage well, 8 3 ft from outside floodmarks)
1948-56, 1959 to May 1964 Discharge, 2,750 cfs May 19, 1954 (gage height, 5 29 ft)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	470	1,220	11	640	1,200	21	1,430	716
2	426	1,260	12	658	1,060	22	980	716
3	356	1,340	13	752	1,080	23	726	788
4	329	1,310	14	688	1,120	24	634	910
5	375	1,220	15	726	1,070	25	598	847
6	338	1,260	16	876	1,080	26	634	704
7	316	1,230	17	1,190	1,030	27	778	626
8	347	3,260	18	1,290	875	28	1,170	540
9	442	2,780	19	1,340	808	29	1,220	475
10	640	1,580	20	1,470	756	30	1,110	445
						31	1,100	- - - - -
Monthly mean discharge, in cubic feet per second							776	1,110
Runoff, in inches							12 54	17 37
Runoff, in acre-feet							47,700	66,060

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	3 96	1,250	June 8	1600	6 90	4,600	June 9	2400	5.10	2,030
	1200	3 87	1,180		1830	a 7 21	5,020				
	2400	4 04	1,310		2000	6 98	4,650	10	1200	4 57	1,470
					2400	6 63	4,120		2400	4 44	1,350
8	0600	4 38	1,630								
	0900	5 35	2,690	9	0600	5 98	3,170	11	1200	4 26	1,190
	1200	6 12	3,640		1200	5 52	2,550		2400	4 13	1,080
	1400	54	4,160		1800	5 33	2,310				

a 8 3 ft from floodmark

(185) Logan Creek near Hungry Horse, Mont

(Miscellaneous site)

Location --Lat 48°08'35", long 113°42'35", in SW¼NE¼SE¼ sec 35, T 28 N , R 17 W , downstream from culvert on east shore road, a third of a mile upstream from Hungry Horse Reservoir flow line, and 23 miles southeast of Hungry Horse

Drainage area --5 18 sq mi

Maximum --June 1964 Discharge, 2,310 cfs June 8, from slope-area measurement

(186) 12-3615 Graves Creek near Hungry Horse, Mont

(Gaging station, reestablished October 1964)

Location --Lat 48°07'30", long 113°49'10", in SE¼ sec 1, T 27 N , R 18 W , on left bank 500 ft upstream from Hungry Horse Reservoir flow line and 22 miles southeast of Hungry Horse

Drainage area --27 0 sq mi

Gage-height record --High-water marks at gage site Altitude of gage is 3,600 ft (from topographic map)

Discharge record --Peak discharge by slope-area measurement

Maxima --June 1964 Discharge, 2,710 cfs June 8 (gage height, 5 83 ft, from high-water mark in well, 7 0 ft, from high-water profile, at gage reactivated October 1964)
1948-56 Discharge, 1,520 cfs June 22, 1950 (gage height, 5 70 ft, at site 2½ miles downstream and at datum then in use)

(187) 12-3618 8 Wounded Buck Creek near Hungry Horse, Mont

(Miscellaneous site, gaging station since October 1964)

Location --Lat 48°16'40", long 113°56'10", in SW¼SW¼NW¼ sec 17, T 29 N , R 18 W , on right bank 50 ft upstream from culvert on west shore road, 800 ft upstream from Hungry Horse Reservoir flow line, and 9 miles southeast of Hungry Horse

Drainage area --13 6 sq mi

Gage-height record --High-water marks at gage site Altitude of gage is 3,580 ft (from topographic map)

Discharge record --Peak discharge defined by flow-through-culvert measurement

Maximum --June 1964 Discharge, 706 cfs June 8 (gage height, 10 8 ft, from high-water marks, at gage established in October 1964)

(188) 12-3619 6 Emery Creek near Hungry Horse, Mont

(Miscellaneous site, gaging station since September 1964)

Location --Lat 48°21'30", long 113°55'35", in NE¼SE¼SW¼ sec 17, T 30 N , R 18 W , on left bank on east shore road, 500 ft upstream from Hungry Horse Reservoir flow line and 6 miles southeast of Hungry Horse

Drainage area --26 4 sq mi

Gage-height record --High-water marks at gage site Altitude of gage is 3,580 ft (from topographic map)

Discharge record --Stage-discharge relation defined by slope-area measurement

Maximum --June 1964 Discharge, 832 cfs June 8 (gage height, 3 39 ft from high-water profile, at gage established September 1964)

(189) 12-3620 Hungry Horse Reservoir near Hungry Horse, Mont

Location --Lat 48°20'30", long 114°00'50", in NE¼NE¼NW¼ sec 27, T 30 N , R 19 W , in block 14 of Hungry Horse Dam, 3 miles southeast of Hungry Horse

Drainage area --1,654 sq mi

Gage-height record --Water-stage recorder graph Midnight readings only, except June 8-10, when hourly readings were furnished Datum of gage is at mean sea level (levels by Bureau of Reclamation)

Discharge record --Inflow computed from change in contents corrected for outflow, for the times indicated

Maxima --June 1964 Contents observed, 3,429,000 acre-ft 2400 hours June 30 (elevation, 3,560 03 ft) Rate of inflow, 78,000 cfs 2100 hours June 8
1951 to May 1964 Contents observed, 3,461,000 acre-ft July 3, 4, 1955 (elevation, 3,561 40 ft)

Remarks --Reservoir formed by concrete dam, construction began in 1948, completed in 1952 Storage began Sept 21, 1951 Usable capacity, 3,428,000 acre-ft between elevations 3,560 (controlled spillway elevation) and 3,196 ft Dead storage, 40,140 acre-ft below elevation 3,196 ft Minimum operating level, 3,336 ft for on-site power generation (usable contents, 445,900 acre-ft) Water is stored for power production, flood control, irrigation, and recreation Figures given herein represent usable contents

Cooperation --Elevations furnished by Bureau of Reclamation

Elevation, in feet, and contents, in acre-feet, at 2400 hours and daily computed inflow, in cubic feet per second, on indicated day, 1964

Day	May			June		
	Elevation	Contents	Inflow	Elevation	Contents	Inflow
1	3,489 62	2,011,000	7,350	3,520 85	2,577,000	17,900
2	3,490 05	2,018,000	8,170	3,522 48	2,609,000	19,200
3	3,490 32	2,022,000	6,970	3,524 27	2,645,000	20,900
4	3,490 53	2,026,000	6,460	3,526 24	2,685,000	23,200
5	3,490 75	2,030,000	6,540	3,527 95	2,719,000	20,300
6	3,490 89	2,032,000	5,850	3,529 70	2,756,000	21,500
7	3,491 03	2,034,000	5,470	3,531 45	2,792,000	21,600
8	3,491 30	2,039,000	5,560	3,536 37	2,896,000	55,400
9	3,491 49	2,042,000	6,030	3,541 34	3,003,000	55,600
10	3,491 85	2,048,000	7,460	3,544 27	3,067,000	32,800
11	3,492 30	2,055,000	8,370	3,546 43	3,115,000	24,700
12	3,493 03	2,067,000	8,580	3,548.22	3,155,000	20,800
13	3,493 98	2,083,000	9,410	3,549 98	3,196,000	20,900
14	3,494 92	2,099,000	9,800	3,551 76	3,236,000	21,200
15	3,495 89	2,115,000	10,100	3,553 53	3,277,000	21,000
16	3,497 10	2,136,000	12,200	3,555 28	3,318,000	21,900
17	3,498 78	2,165,000	16,600	3,556 85	3,355,000	21,100
18	3,500 63	2,197,000	17,800	3,557 88	3,378,000	18,000
19	3,502 62	2,232,000	19,700	3,558 53	3,394,000	16,200
20	3,504 96	2,274,000	23,400	3,558 95	3,404,000	14,700
21	3,507 40	2,319,000	25,600	3,559 13	3,408,000	13,700
22	3,509 09	2,351,000	18,800	3,559 20	3,410,000	12,900
23	3,510 22	2,372,000	13,800	3,559 33	3,413,000	13,600
24	3,511 10	2,389,000	11,400	3,559 72	3,422,000	16,600
25	3,511 87	2,404,000	10,400	3,560 00	3,428,000	18,000
26	3,512 65	2,418,000	10,500	3,559 90	3,426,000	15,800
27	3,513 55	2,435,000	11,600	3,559 88	3,425,000	14,400
28	3,515 00	2,463,000	16,900	3,559 92	3,426,000	13,700
29	3,516 56	2,493,000	18,300	3,559.87	3,425,000	11,100
30	3,517 98	2,521,000	16,800	3,560 03	3,429,000	9,770
31	3,519 37	2,547,000	16,500	-	-	-
Change in contents	-	+544,000	-	-	+882,000	-

Elevation, in feet, and computed inflow, in cubic feet per second, at indicated time, 1964, of Hungry Horse Reservoir near Hungry Horse, Mont

Date	Hour	Elevation	Inflow	Date	Hour	Elevation	Inflow
June 8	0000	3,531 45	23,000	June 9	0900	3,538 53	58,000
	0300	3,531 68	27,000		1200	3,539 17	55,300
	0600	3,532 01	34,500		1500	3,539 79	51,000
	0900	3,532 45	48,000		1800	3,540 31	47,500
	1200	3,533 06	60,300		2100	3,540 81	43,000
	1500	3,533 77	69,200		2400	3,541 34	40,500
	1800	3,534 60	76,500				
	2100	3,535 44	78,000	10	0600	3,542 18	34,500
	2400	3,536 37	76,300		1200	3,542 92	30,000
					1800	3,543 62	29,500
9	0300	3,537 15	70,500		2400	3,544 27	28,000
	0600	3,537 87	61,000				

(190) 12-3625 South Fork Flathead River near Columbia, Falls, Mont

Location --Lat 48°21'30", long 114°02'15", in SW¼SE¼SW¼ sec 16, T 30 N , R 19 W , on right bank 1½ miles downstream from Hungry Horse Dam, 3½ miles upstream from mouth, and 7 miles east of Columbia Falls

Drainage area --1,663 sq mi

Gage-height record --Digital-recorder tape punched at 15-minute intervals Datum of gage is 3,040 0 ft above mean sea level (levels by Bureau of Reclamation)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 18,000 cfs 2345 hours June 25 and 0915 hours June 26 (gage height, 13 34 ft)
1910-16, 1923 to May 1964 Discharge observed, 46,200 cfs June 19, 1916 (gage height, 16 6 ft, at site 3 miles downstream and at datum then in use), from rating curve extended above 20,000 cfs

Remarks --Flow regulated since Sept 21, 1951, by Hungry Horse Reservoir (see station 189)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	3,560	3,000	11	4,590	498	21	2,940	11,600
2	4,680	2,990	12	2,340	508	22	2,960	12,100
3	4,660	3,000	13	1,750	509	23	2,990	12,100
4	4,660	3,010	14	1,760	514	24	2,970	12,100
5	4,660	3,020	15	1,770	506	25	2,990	14,800
6	4,650	3,030	16	1,770	1,080	26	2,980	17,000
7	4,290	3,040	17	1,790	2,880	27	3,010	14,600
8	3,390	3,120	18	1,810	6,010	28	3,030	13,200
9	4,500	1,640	19	1,820	8,380	29	3,030	11,700
10	4,560	641	20	2,180	9,660	30	3,020	7,900
						31	3,040	- - - - -
Monthly mean discharge, in cubic feet per second							3,166	6,138
Runoff, in acre-feet							194,700	365,200

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Dis-charge	Date	Hour	Gage height	Dis-charge	Date	Hour	Gage height	Dis-charge
June 7	0000	6 25	2,980	June 8	2400	6 41	3,180	June 10	1200	3 50	500
	1200	6 28	3,020						2400	3 48	492
	2400	6 30	3,040	9	1000	6 32	3,070				
8	1200	6 36	3,120		1200	3 60	542	11	1200	3 47	488
					2400	3 57	529		2400	3 52	508

(191) 12-3630 Flathead River at Columbia Falls, Mont

Location --Lat 48°21'50", long 114°11'10", in NW¼SE¼ sec 17, T 30 N , R 20 W , on right bank 200 ft downstream from county bridge at Columbia Falls and 5 miles downstream from South Fork

Drainage area --4,464 sq mi

Gage-height record --Digital-recorder tape punched at 15-minute intervals except 2320 hours June 8 to 2030 hours June 9, for which partly estimated graph was drawn Datum of gage is 2,977 67 ft above mean sea level, datum of 1929, supplementary adjustment of 1947 (levels by Corps of Engineers)

Discharge record --Stage-discharge relation defined by current-meter measurements below 95,000 cfs and by slope-area measurement at 176,000 cfs

Maxima --June 1964 Discharge, 176,000 cfs 0500 hours June 9 (gage height, 25 58 ft, from floodmarks in gage house)
1922-23, 1928 to May 1964 Discharge, 102,000 cfs May 23, 1948 (gage height, 19 08 ft)
Flood of June 1894 reached a stage of 22 7 ft, from floodmarks (discharge, 142,000 cfs, revised, from rating curve extended above 95,000 cfs on basis of slope-area measurement of peak flow in 1964)

Remarks --South Fork Flathead River, which contributes about one-third of flow, completely regulated by Hungry Horse Reservoir since Sept 21, 1951 (see station 189)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	10,700	33,700	11	21,800	56,600	21	42,600	36,800
2	13,700	35,200	12	19,400	46,500	22	39,100	36,300
3	14,800	36,700	13	20,000	43,300	23	29,800	36,500
4	17,800	40,700	14	21,800	40,900	24	24,200	39,200
5	18,600	39,400	15	20,900	39,600	25	21,100	42,900
6	18,300	39,500	16	20,700	38,600	26	20,500	43,200
7	17,000	39,100	17	24,200	39,000	27	20,000	39,800
8	15,800	64,400	18	29,300	38,600	28	25,700	36,600
9	17,000	158,000	19	31,800	37,600	29	31,800	32,800
10	19,600	90,100	20	36,500	36,800	30	32,700	26,900
						31	32,300	- - - - -
Monthly mean discharge, in cubic feet per second							23,530	45,510
Runoff, in acre-feet							1,447,000	2,708,000

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	11 70	39,800	June 9	0300	25 00	169,000	June 10	1800	16 43	77,100
	1200	11 56	38,800		0500	25 58	176,000		2400	15 30	66,400
	1800	11 58	39,000		0700	25 50	175,000				
	2400	11 70	39,800		1000	25 20	171,000	11	0800	14 38	58,600
					1300	24 80	166,000		1600	13 70	53,400
8	0400	11 94	41,300		1600	24 10	158,000		2400	13 15	49,400
	0800	12 49	44,900		2000	22 60	141,000				
	1200	13 52	52,000		2400	20 95	128,000	12	1200	12 63	45,800
	1500	14 77	61,800						2400	12 50	45,000
	1800	16 53	78,100	10	0400	19 50	108,000				
	2100	19 20	105,000		0800	18 40	96,800				
	2400	22 20	137,000		1200	17 45	87,300				

(192) 12-3639 Rock Creek near Olney, Mont

(Crest-stage station)

Location --Lat 48°37', long 114°39', in NW¼ sec 24, T 33 N , R 24 W , at culvert on U S Highway 93, 6 miles northwest of Olney

Drainage area --6 18 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,240 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 11 cfs June 8 (gage height, 0 81 ft)
1961 to May 1964 Discharge, 25 cfs May 2, 1964 (gage height, 1 29 ft)

(193) 12-3650 Stillwater River near Whitefish, Mont

(Gaging station, discontinued 1950)

Location --Lat 48°19'10", long 114°23'00", in NE¼SW¼ sec 34, T 30 N , R 22 W , on right bank 600 ft downstream from highway bridge, 7 miles southwest of Whitefish, and 10 miles upstream from Whitefish Creek

Drainage area --524 sq mi

Gage-height record --High-water marks at gage site Altitude of gage is 2,950 ft (by barometer)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 1,480 cfs about June 9 (gage height, 10 98 ft, from floodmarks)
1930-50 Discharge, 4,330 cfs May 26, 1948 (gage height, 20 90 ft, from floodmark)

(194) 12-3660 Whitefish River near Kalispell, Mont

(Gaging station, discontinued 1950, formerly published as Whitefish Creek)

Location --Lat 48°19'10", long 114°16'30", in SE¼NW¼ sec 34, T 30 N , R 21 W , on left bank 8 miles upstream from mouth and 8 miles north of Kalispell

Drainage area --170 sq mi

Gage-height record --High-water marks at gage site Datum of gage is 2,969 52 ft above mean sea level, datum of 1929, supplementary adjustment of 1947 (levels by Corps of Engineers)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 1,400 cfs about June 9 (gage height, 3 68 ft, from floodmarks)
1928-50 Discharge, 1,290 cfs May 30, 1948 (gage height, 4 41 ft), gage height, 4 45 ft June 26, 1950

(195) Swan River at Stroms Store, near Condon, Mont

(Miscellaneous site, published as "at Rumble Creek" in 1948)

Location --Lat 47°31', long 113°42', near center of sec 1, T 20 N , R 17 W , half a mile downstream from Cooney Creek, three-quarters of a mile upstream from Glacier Creek, three-quarters of a mile southeast of Stroms Store, and 3½ miles southeast of Condon

Drainage area --146 sq mi

Maxima --June 1964 Discharge, 1,670 cfs June 8, from slope-area measurement
1948 Discharge, 1,350 cfs May 24, from slope-area measurement

(196) 12-3700 Swan River near Bigfork, Mont

Location --Lat 48°01'30", long 113°58'40", in SE¼SW¼ sec 11, T 26 N , R 19 W , on left bank at outlet of Swan Lake, 1,000 ft downstream from Johnson Creek and 5 miles southeast of Bigfork

Drainage area --671 sq mi

Gage-height record --Water-stage recorder graph, except 1800 hours June 9 to 1900 hours June 11, for which graph was reconstructed on basis of high-water marks Datum of gage is 3,062 6 ft above mean sea level, datum of 1929 (from river-profile survey)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 8,100 cfs about 1200 hours June 10 (gage height, 6 98 ft, from floodmarks)
1922 to May 1964 Discharge, 8,400 cfs May 24, 1948 (gage height, 7 12 ft, from graph based on gage readings)

Mean discharge, in cubic feet per second, 1964, of Swan River near Bigfork, Mont

Day	May	June	Day	May	June	Day	May	June
1	1,300	3,410	11	1,930	7,560	21	3,770	3,980
2	1,560	3,500	12	2,000	6,560	22	4,290	3,680
3	1,770	3,700	13	2,040	5,760	23	4,270	3,460
4	1,900	4,080	14	2,110	5,280	24	3,810	3,430
5	2,000	4,480	15	2,170	5,060	25	3,280	3,610
6	2,000	4,610	16	2,230	4,900	26	2,910	3,930
7	1,970	4,690	17	2,350	4,880	27	2,620	4,040
8	1,900	5,220	18	2,630	4,840	28	2,600	4,000
9	1,860	6,860	19	2,980	4,650	29	2,860	3,850
10	1,860	8,020	20	3,340	4,320	30	3,190	3,610
						31	3,350	- - - - -
Monthly mean discharge, in cubic feet per second							2,544	4,666
Runoff, in inches							4 37	7 76
Runoff, in acre-feet							156,400	277,600

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 8	0000	5 38	4,760	June 9	1200	6 37	6,890	June 10	2400	6 89	7,900
	0600	5 47	4,940		1800	6 72	7,520				
	1200	5 61	5,220		2400	6 88	7,880	11	1200	6 75	7,590
	1800	5 74	5,480						1800	6 68	7,440
	2400	5 88	5,760	10	0600	6 96	8,050		2400	6 42	7,000
					1200	6 98	8,100				
9	0600	6 06	6,220		1800	6 95	8,030	12	1200	6 26	6,560
									2400	6 05	6,120

(197) 12-3705 Dayton Creek near Proctor, Mont
(Crest-stage station)

Location --Lat 47°55', long 114°20', in NW¼ sec 20, T 25 N , R 21 W , at culvert on county road, 2½ miles northwest of Proctor

Drainage area --20 9 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,350 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 30 cfs and by flow-through-culvert measurements at 51 cfs and 93 cfs

Maxima --June 1964 Discharge, 29 cfs June 8 (gage height, 1 06 ft)
1959 to May 1964 Discharge, 93 cfs May 27, 1961 (gage height, 3 00 ft)

(198) 12-3709 Teepee Creek near Polson, Mont
(Crest-stage station)

Location --Lat 47°49', long 114°01', in SW¼ sec 23, T 24 N , R 19 W , at culvert on State Highway 35, and 11 miles northeast of Polson

Drainage area --2 55 sq mi

Gage-height record --Crest stages only Altitude of gage is 2,920 ft (from topographic map)

Discharge record --Peak discharge by flow-through-culvert measurement

Maxima --June 1964 Discharge, 44 cfs June 8 (gage height, 2 15 ft)
1960 to May 1964 Discharge, 22 cfs June 2, 1961 (gage height, 0 90 ft)

(199) 12-3711 Hell Roaring Creek near Polson, Mont
(Gaging station, discontinued 1932, crest-stage station beginning 1960)

Location --Lat 47°42', long 114°03', in NW¼ sec 4, T 22 N , R 19 W , at powerhouse, 5½ miles east of Polson

Drainage area --6 41 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,150 ft (by barometer)

Discharge record --Peak discharge defined by slope-area measurement

Maxima --June 1964 Discharge, 98 cfs June 8 (gage height, 1 73 ft)
1917-32, 1948, 1960 to May 1964 Discharge observed, 104 cfs June 9, 1917 (gage height, 2 4 ft, site and datum then in use)

(200) 12-3715 Flathead Lake at Somers, Mont
(Previously published as 12-3710)

Location --Lat 48°04'30", long 114°13'30", in SE¼NE¼ sec 26, T 27 N , R 21 W , at steamboat dock at Somers

Drainage area --7,086 sq mi

Gage-height record --Water-stage recorder graph adjusted to compensate for changes in elevation indicated by the lake gage at outlet at Polson Datum of gage is at mean sea level (Somers datum) Subtract 1 00 ft to convert Somers datum to datum of 1929, supplemental adjustment of 1947

Discharge record --Inflow determined from change in contents adjusted for outflow at Polson

Maxima --June 1964 Contents, 1,952,000 acre-ft 1230 hours June 12 (elevation, 2,894 27 ft) Rate of inflow, 128,000 cfs 0600 hours June 10
1909 to May 1964 Contents, 2,208,000 acre-ft June 19, 1933 (elevation, 2,896 26 ft)
Lake reached an elevation of 2,900 ft during flood in June 1894

Remarks --Natural storage in Flathead Lake increased by construction of Kerr Dam 4 miles downstream from natural lake outlet, storage began Apr 11, 1938 Usable capacity, 1,791,000 acre-ft at controlled spillway elevation (2,893 ft) Dead storage unknown below 2,878 ft (elevation of natural outlet) Minimum operating level, 2,883 ft for on-site power generation (usable contents, 572,300 acre-ft) Water is used for power production, flood control, recreation, and irrigation Figures given herein represent usable contents

Elevation, in feet, at 2400 hours, adjusted change in contents, in equivalent cubic feet per second, and computed inflow, in cubic feet per second, on indicated day, 1964

Day	May			June		
	Elevation	Adjusted change in contents	Inflow	Elevation	Adjusted change in contents	Inflow
1	2,884 78	+3,900	13,900	2,891 22	+5,600	38,900
2	2,884 97	+7,300	17,100	2,891 40	+10,000	44,300
3	2,885 12	+10,800	17,400	2,891 48	+6,300	43,000
4	2,885 25	+7,900	20,000	2,891 58	+5,600	47,800
5	2,885 37	+9,100	21,200	2,891 67	+5,600	50,100
6	2,885 53	+9,100	21,600	2,891 77	+6,300	49,800
7	2,885 63	+7,300	20,600	2,891 88	+7,500	51,500
8	2,885 77	+8,500	20,800	2,892 10	+15,100	64,800
9	2,885 91	+8,500	19,300	2,892 81	+43,800	97,200
10	2,886 11	+14,000	21,900	2,893 78	+60,300	119,000
11	2,886 30	+11,600	24,500	2,894 19	+26,800	89,500
12	2,886 48	+11,000	24,000	2,894 23	+3,200	67,500
13	2,886 67	+11,600	23,500	2,894 12	-7,100	57,000
14	2,886 87	+12,100	24,500	2,893 97	-10,300	52,800
15	2,887 11	+14,100	26,500	2,893 78	-10,800	51,600
16	2,887 33	+12,600	24,000	2,893 64	-9,500	51,800
17	2,887 65	+20,100	27,400	2,893 47	-12,100	48,100
18	2,887 98	+20,700	31,700	2,893 30	-10,200	48,700
19	2,888 46	+29,200	38,200	2,893 15	-9,500	48,500
20	2,888 98	+31,300	40,300	2,892 96	-12,100	44,900
21	2,889 42	+27,300	43,500	2,892 80	-10,800	45,100
22	2,889 74	+19,800	49,500	2,892 71	-5,700	42,200
23	2,889 83	+5,600	41,100	2,892 93	+14,000	41,300
24	2,889 80	-1,000	33,300	2,893 06	+8,300	45,100
25	2,889 85	+3,000	29,400	2,892 97	-4,400	48,900
26	2,890 01	+11,100	27,900	2,892 95	-1,900	50,000
27	2,890 18	+10,600	24,600	2,892 94	0	49,700
28	2,890 43	+16,600	29,200	2,892 98	+2,500	42,500
29	2,890 74	+18,100	35,200	2,892 96	-1,900	41,000
30	2,891 00	+16,600	38,300	2,892 93	-700	35,000
31	2,891 12	+7,500	39,000	-	-	-
Change in contents	-	+395,900	-	-	+113,900	-

Elevation, in feet, and computed inflow, in cubic feet per second, at indicated time, 1964, of Flathead Lake at Somers, Mont

Date	Hour	Elevation	Inflow	Date	Hour	Elevation	Inflow
June 8	0000	2,891 88	58,000	June 10	1200	2,893 33	123,000
	0600	2,891 94	62,000		1800	2,893 60	113,000
	1200	2,891 99	65,000		2400	2,893 78	102,000
	1800	2,892 06	67,000				
	2400	2,892 10	72,000	11	0600	2,893 94	96,000
					1200	2,894 07	89,000
9	0600	2,892 20	83,000		1800	2,894 14	83,000
	1200	2,892 34	96,000		2400	2,894 19	78,000
	1800	2,892 58	112,000				
	2400	2,892 81	124,000	12	1230	2,894 27	66,000
					2400	2,894 23	60,000
10	0600	2,893 09	128,000				

(201) 12-3720 Flathead River near Polson, Mont

Location --Lat 47°40'50", long 114°15'10", in NW¼SE¼ sec 11, T 22 N , R 21 W , on left bank half a mile downstream from Kerr Dam, 4 miles west of Polson, and 5 miles downstream from Flathead Lake

Drainage area --7,096 sq mi

Gage-height record --Water-stage recorder punch tape Datum of gage is 2,693 70 ft above mean sea level (levels by The Montana Power Co)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 66,800 0815 hours June 12 (gage height, 17 99 ft)
1907 to May 1964 Discharge, 82,800 cfs May 29, 1928 (gage height, 17 2 ft, at site 6 miles downstream and datum of 2,629 20 ft above mean sea level (river-profile survey)
Flood in June 1894 reached a stage of about 21 ft, present datum (discharge, about 110,000 cfs) from lake elevation-discharge study

Remarks --Flow regulated by Hungry Horse Reservoir since September 1951 (see station 189), and by Flathead Lake (Kerr Dam) since April 1938 (see station 199)

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	10,000	33,300	11	12,900	62,700	21	16,200	55,900
2	9,820	34,300	12	13,000	64,300	22	29,700	47,900
3	6,580	36,700	13	11,900	64,100	23	35,500	27,300
4	12,100	42,200	14	12,400	63,100	24	34,300	36,800
5	12,100	44,500	15	12,400	62,400	25	26,400	53,300
6	12,500	43,500	16	11,400	61,300	26	16,800	51,900
7	13,300	44,000	17	7,320	60,200	27	14,000	49,700
8	12,300	49,700	18	11,000	58,900	28	12,600	39,900
9	10,800	53,400	19	9,020	58,000	29	17,100	42,900
10	7,860	58,800	20	8,990	57,000	30	21,700	35,700
						31	31,500	- - - -
Monthly mean discharge, in cubic feet per second							15,270	49,790
Runoff, in acre-feet							939,200	2,963,000

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964

Date	Hour	Gage height	Dis-charge	Date	Hour	Gage height	Dis-charge	Date	Hour	Gage height	Dis-charge
June 8	0000	14 19	43,300	June 10	0400	16 59	57,700	June 12	1000	17 67	64,800
	0600	14 57	45,600		0800	16 66	58,200		1200	17 62	64,400
	1000	16 04	54,400		1600	16 99	60,300		1600	17 71	65,000
	1200	15 42	50,700		2000	17 00	60,400		2000	17 74	65,200
	1400	15 47	51,000		2400	17 13	61,200		2400	17 49	63,600
	1600	16 69	58,400								
	1800	15 66	52,200	11	0600	17 26	62,100	13	0600	17 71	65,000
	2400	15 37	50,400		1200	17 34	62,600		1200	17 63	64,500
					1600	17 44	63,300		1800	17 59	64,200
9	0600	15 78	52,900		2200	17 57	64,100		2400	17 42	63,100
	0800	16 09	54,700		2400	17 33	62,500				
	1000	15 78	52,900					14	0600	17 48	63,500
	1600	15 94	53,800	12	0400	17 43	63,200		1200	17 47	63,500
	2200	16 20	55,400		0800	17 70	65,000		1600	17 33	62,500
	2400	15 83	53,200		0815	17 99	66,800		1800	17 57	64,100
									2400	17 05	60,700

(202) 12-3743 Mill Creek near Niarada, Mont

(Crest-stage station)

Location --Lat 47°50', long 114°41', in NE¼ sec 20, T 24 N , R 24 W , at bridge on county road, 3½ miles northwest of Niarada

Drainage area --28 0 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,000 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 80 cfs

Maxima --June 1964 Discharge, 24 cfs June 8 (gage height, 0 62 ft)
1959 to May 1964 Discharge, 140 cfs May 1, 1961 (gage height, 1 42 ft)

(203) 12-3757 South Fork Garden Creek near Hot Springs, Mont

(Crest-stage station)

Location --Lat 47°39', long 114°43', in SW¼ sec 20, T 22 N , R 24 W , at bridge on county road, 3 miles north of Hot Springs

Drainage area --3 29 sq mi

Gage-height record --Crest stages only Altitude of gage is 3,300 ft (from topographic map)

Discharge record --Stage-discharge relation defined by current-meter measurements below 20 cfs

Maxima --June 1964 Discharge, about 40 cfs June 8 (gage height, 0 93 ft)
1959 to May 1964 Discharge, about 45 cfs May 27, 1964 (gage height, 1 02 ft)

(204) 12-3890 Clark Fork near Plains, Mont

Location --Lat 47°25'50", long 114°51'20", in SW¼ sec 1, T 19 N , R 26 W , on right bank 2 miles southeast of Plains and 6 miles downstream from Flathead River

Drainage area --19,958 sq mi

Gage-height record --Water-stage recorder graph Datum of gage is 2,449 34 ft above mean sea level, datum of 1929 (levels by Corps of Engineers)

Discharge record --Stage-discharge relation defined by current-meter measurements

Maxima --June 1964 Discharge, 128,000 cfs 2100 hours June 11 (gage height, 17 48 ft)
1910 to May 1964 Discharge, 134,000 cfs June 5, 1948 (gage height, 19 17 ft)

Remarks --Flow partly regulated by Hungry Horse Reservoir and Flathead Lake (see stations 189, 200) Many diversions above stations

Mean discharge, in cubic feet per second, 1964

Day	May	June	Day	May	June	Day	May	June
1	13,800	69,000	11	20,200	127,000	21	46,000	93,000
2	19,700	69,100	12	26,200	124,000	22	57,700	89,400
3	21,400	72,600	13	26,900	116,000	23	69,700	74,800
4	18,700	77,900	14	27,400	109,000	24	67,000	53,800
5	23,000	82,900	15	29,000	106,000	25	61,800	73,900
6	22,700	84,300	16	30,700	105,000	26	47,400	85,600
7	23,200	84,800	17	32,200	104,000	27	39,900	82,600
8	22,900	93,500	18	33,200	103,000	28	38,400	81,100
9	22,600	111,000	19	39,900	100,000	29	41,500	67,900
10	21,600	120,000	20	41,100	95,500	30	53,600	69,000
						31	58,200	- - - - -
Monthly mean discharge, in cubic feet per second							35,410	90,860
Runoff, in acre-feet							2,177,000	5,406,000

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1964, of Clark Fork near Plains, Mont

Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge	Date	Hour	Gage height	Discharge
June 7	0000	13 90	83,600	June 9	1800	16 42	113,000	June 11	2100	17 48	128,000
	1200	14 00	84,700		2400	16 58	116,000		2400	17 47	128,000
	2400	14 13	86,100								
				10	0600	16 72	118,000	12	0600	17 36	127,000
8	0600	14 35	88,600		1200	16 95	121,000		1200	17 20	124,000
	1200	14 70	92,400		1800	17 06	122,000		1800	16 98	121,000
	1800	15 15	97,500		2400	17 20	124,000		2400	16 91	120,000
	2400	15 77	105,000								
				11	0600	17 32	126,000	13	1200	16 64	117,000
9	0600	16 18	110,000		1200	17 40	127,000		2400	16 32	112,000
	1200	16 34	112,000		1800	17 47	128,000				

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