Floods of 1950 in the Upper Mississippi River and Lake Superior Basins in Minnesota

Prepared under the direction of C. G. PAULSEN, *Chief Hydraulic Engineer*

FLOODS OF 1950

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1137-G

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PREFACE

This report on the floods of 1950 on the upper Mississippi River and tributaries and on streams in Minnesota tributary to Lake Superior was prepared by the U. S. Geological Survey, Water Resources Division, under the general direction of C. G. Paulsen, chief, Water Resources Division, and J. V. B. Wells, chief, Surface Water Branch.

The collection of basic records of stage and discharge in the area described in this report is a part of a continuous cooperative program with the Minnesota Conservation Department, Division of Waters; the Minnesota Iron Range and Rehabilitation Commission; the Corps of Engineers, Department of the Army; and the Department of State.

The gaging station on Pigeon River at Middle Falls, below International Bridge, Minn., is maintained jointly by the United States and Canada under terms of the Boundary Waters Treaty of 1909 or under subsequent agreement between the two countries. Full cooperation exists between the United States Geological Survey and the Water Resources Division, Department of Resources and Development, Canada, in the maintenance of these international gaging stations.

Acknowledgment is made to the following agencies for data furnished: The Corps of Engineers; the Bureau of Public Roads; the Weather Bureau; the Great Northern Railway; the Northern Pacific Railway; the Chicago, Milwawkee, St. Paul and Pacific R. R.; and the Minneapolis, St. Paul & Sault Ste. Marie R. R. Co. Acknowledgment is made to the Minnesota Department of Conservation for the services of survey parties to assist in the collection of field data.

The data presented in this report were collected and prepared for publication under the supervision of Paul R. Speer, district engineer, St. Paul, Minn., except for the brief section on ground water, which was prepared by P. D. Akin, district engineer, Ground Water Branch, Grand Forks, N. Dak. Several engineers of the Water Resources Division, detailed to the St. Paul district from other parts of the United States, assisted in the field and office work.

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FLOODS OF 1950

FLOODS OF 1950 IN THE UPPER MISSISSIPPI RIVER AND LAKE SUPERIOR BASINS IN MINNESOTA

Prepared under the direction of C. G. PAULSEN
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ABSTRACT

Floods of great magnitude occurred on the Mississippi River and tributaries, and on streams in Minnesota tributary to Lake Superior, during the months of April to June 1950. They were caused by an unusual combination of hydrologic conditions. These were: high soil-moisture content, very heavy snow cover, delayed snow melt, and heavy precipitation.

An outstanding feature of the floods in the upper portions of the Mississippi River basin in Minnesota was the prolonged period that the streams remained above flood stage. For example, at Fort Ripley the average duration of floods since 1907 has been 7 days; but in 1950 the river remained above flood stage for periods of 13 and 34 days with a very short interval of in-the-bank flow between.

Snow surveys by the Corps of Engineers in mid-March indicated an exceptionally high water content in the vicinity of the Mississippi River headwaters. This survey showed a moisture content of more than 4 inches as far downstream as the Gull Lake Reservoir; in the Crow Wing River basin near Brainerd, the maximum was 5.09 inches.

Information regarding the water content of the snow pack in river basins tributary to Lake Superior is not available. The Weather Bureau reported that 72.5 inches of snow lay on the ground on April 11 at International Bridge north of Grand Marais. At Duluth, Minn., new records were established for April snowfall and for the depth of snow on the ground so late in the season. Conditions in the northern portion of the Lake Superior basin were not as extreme as in the southern portion; therefore, outstanding floods were mostly confined to the St. Louis River basin. The crests at gaging stations near the headwaters of this basin were the highest since records began in 1942. The Minnesota Power & Light Co. reported that the flow at their Thompson plant near Carlton was the highest since the start of the record in 1908 and about 50 percent greater than the previous peak flow in 1948.

In the Mississippi River basin new record-high discharges occurred at gaging stations on tributary streams down to the Crow Wing River, where the 1950 crest was slightly less than that of 1943. On the main stem, there were record-high discharges down to Anoka, Minn., and at Prescott, Wis., just below the St. Croix River.

In the St. Croix River basin, record-high discharges occurred at gaging stations on the main stem; the discharge at St. Croix Falls, Wis., was the maximum since records began in 1908.

The area of most spectacular flooding was in the vicinity of Aitkin, Minn., on the Mississippi River, where the stage was computed by the Corps of Engineers as being 2.46 feet higher than the previous maximum of 1888. The region was designated as a disaster area by the Governor of Minnesota. The Red Cross, National Guard, Coast Guard, and Corps of Engineers were the principals in relief work.

The damage in the headwater area was estimated by the Corps of Engineers at more than $2,675,000. Estimates by the Corps of Engineers and the Weather Bureau indicate that the total damage in the area covered by this report may have exceeded $5,000,000. Only one life is known to have been lost as a direct result of the floods.

During the last days of March, discharge on the Root River reached within 400 cfs of the maximum of record, which occurred in March 1933--these two peaks probably were the highest since 1899. During the same period, the Zumbro River at Theilman reached a discharge of 20,900 cfs--this figure was slightly less than the highest discharge observed since records began in 1938.

In May, the discharge from the melting snow reached the Mississippi River below the St. Croix, and flood conditions existed from Prescott, Wis., to La Crosse, Wis. At La Crosse, the highest stages since 1943 were reached.

On June 12 and 13, excessive rains on basins tributary to the Mississippi River between Hastings, Minn., and La Crosse, Wis., resulted in flash floods on the Zumbro, Whitewater, and Root Rivers. Previous maximum flows were exceeded at Theilman, on the Zumbro River, and at Beaver, on the Whitewater River.

This report contains records of stage and discharge at 46 gaging stations and records of storage or elevation at 6 reservoirs. A summary table shows crest stages and discharges at 72 points during the floods of April-June, and similar data are shown for former record floods where it is available. A discussion of concurrent meteorology and references to some outstanding past floods are also included.

INTRODUCTION

The floods of 1950 on the upper Mississippi River and tributaries, and on tributaries to Lake Superior, were for the most part the result of very unusual combinations of the following hydrologic and meteorologic phenomena: High soil-moisture content at the time of the freeze-up in the fall; unusually heavy snowfall during the winter with little or no melting; prolonged cold weather in the spring, which held the accumulated snow on the ground long past normal melting time; and last and most important, excessive precipitation in the form of rain when the snow was still on the ground and the ground still frozen.

The floods in the Mississippi River basin can be divided into two general classifications: those caused by the snow-melt, and those caused by exceptionally heavy local rains. Above the Crow Wing River, the flooding was attributed to the snow-melt which was accelerated and aided by precipitation at critical times. Flooding in this area included both the main stem of the river and the tributaries. Below the Crow Wing River and on the St. Croix River, flooding from the snow-melt was confined mostly to the main stem; damage was not excessive, although some damage was reported to summer cottages on Lake St. Croix. Below St. Paul, flooding occurred at times on the tributary streams during April, May, and June and was entirely due to excessive local precipitation; the outstanding floods were on the Root, Whitewater, and Zumbro Rivers. In the Lake Superior basin, the flood was caused by a combination of snow-melt and precipitation.

In the headwater area of the Mississippi and in and near the St. Louis River, floods were the greatest of record, and an outstanding feature was the prolonged period of above flood-stage discharge. At Aitkin, Minn., the stages exceeded any known prior to this time.

This report is supplemental to the annual Geological Survey water-supply papers and is intended to give detailed information not included in the regular publications. The data herein presented is for the purpose of satisfying the needs of those engaged in the planning and designing of projects which are of such a nature that flood flows must be taken into consideration. The information obtained at gaging stations regarding stage and discharge enables flood hydrographs to be accurately reproduced. Also included in these data are: peak stages and discharges observed at miscellaneous points; data on flood damage to cities, highways, and agricultural lands; and a description of special features of the floods.

Figure 99 is a map showing the area covered by this report and the areas in which flooding was most severe.

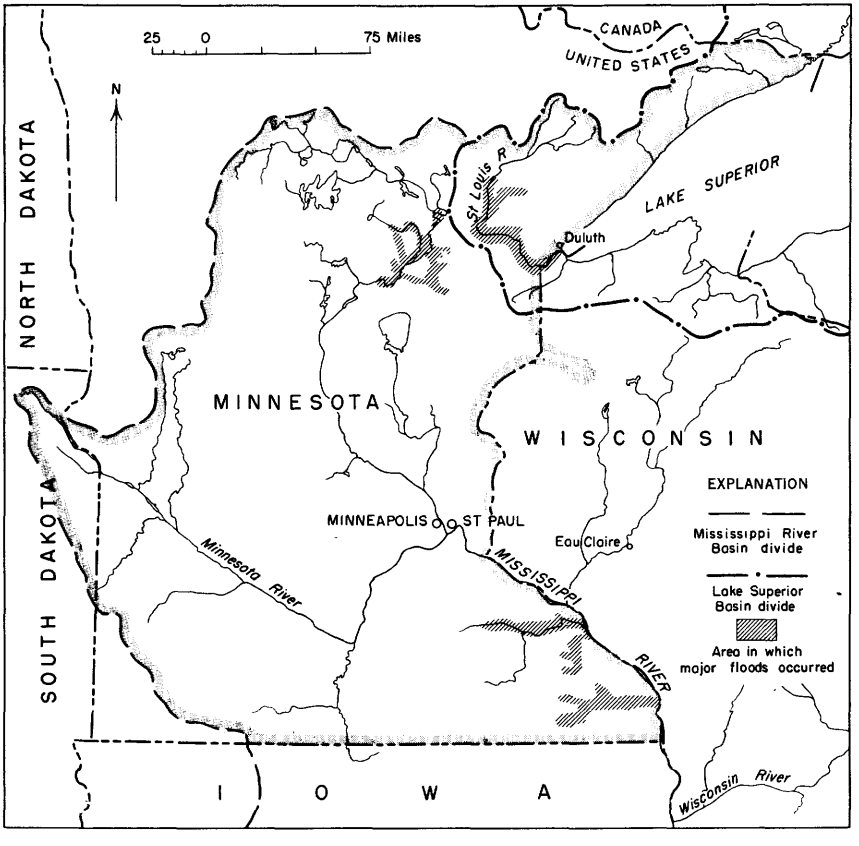

Figure 99.--Map showing location of area covered by this report.

GENERAL DESCRIPTION OF THE FLOODS

The floods described in this report occurred in two drainage basins, the upper Mississippi River basin and the Lake Superior basin. The most damaging and spectacular flooding occurred in the Mississippi River basin between the Itasca County line and Pine Knoll, a few miles downstream from Aitkin, where channel slopes are relatively flat and the relief is relatively low.

Mississippi River basin

Mississippi River headwaters

At Aitkin, there was practically no increase in stage until April 15, when a rise of about one foot above that of the previous day was noted. By April 19, the flood stage of 12.0 feet had been exceeded, and a steady rise continued to May 20, when the peak stage of 19.49 feet and a corresponding discharge of 20,000 cfs was reached. According to the Corps of Engineers, the highest previous stage was 17.0 feet, which occurred in 1888. Their records also show that in 1905 a stage of 16.36 feet was recorded. There was no loss of life in urban areas because the rise in stage was relatively slow; damage to personal property was prevented by moving goods to locations above the reach of floodwaters.

The region was declared a disaster area by the Governor of Minnesota, and a National Guard unit composed of 147 officers and men was mobilized and assigned to the area to help with rescue and rehabilitation work. Coast Guard units and equipment and the Red Cross were also present in the area. The St. Paul District of the Corps of Engineers furnished a DUKW (an amphibious truck commonly called a "Duck"), boats, outboard motors, and other equipment to the Red Cross to assist in flood rescue operations. Transportation of livestock to high points, and their subsequent feeding, were major problems requiring a great amount of time and effort. The prolonged period during which the river was above flood stage contributed greatly to the cost and discomfort. The river at Aitkin was above the flood stage of 12.0 feet from April 19 to June 15, or 58 days--apparently an all-time record of flood duration. Figure 100 is an aerial view in the vicinity of Aitkin.

From the news accounts describing the flood in Aitkin County, the following chronological report was obtained. Stages, except that of the crest, are the mean for the day.

Date	River stage at Aitkin	Event
April 18	10.81	Flood warnings received from Corps of Engineers.
April 19	12.14	
April 20	12.84	Local Disaster Chairman warned farmers to locate high lands for stock and to evacuate low farms.
April 23	15.02	Estimate by local residents that 30,000 acres flooded.
April 24-25	15.56	$13\frac{1}{4}$ inches snow with 1.59 inches water content.
April 26	15.58	Local estimate of 50,000 acres flooded. Thirteen families evacuated from homes. Many families isolated with Coast Guard bringing food, mail, etc.
May 6	16.00	National Guard company called out to assist with flood emergency work. Headquarters established at Aitkin and Palisade .
May 10	16.89	Twenty-five families evacuated, and much livestock moved.
May 11	17.31	Red Cross appealed for volunteers to help with relief work.
May 14	18.64	Total of 310 head of cattle moved to date.
May 16	19.09	0.7 inch rain at Aitkin with slightly more upstream.
May 18	19.40	FHA declared Aitkin County a disaster area.
May 20	19.49	Crest stage reached.

Record stages were reported by the Weather Bureau at the station near Fort Ripley where the flood crest was 13.3 feet, which was 0.5 foot higher than the former record of July 8, 1905. The duration of the flood at this station covered two periods of 13 and 34 days; the river was within its banks for only a short interval

Figure 100.--Aerial view at north edge of Aitkin, Minn., near crest of flood. Note highway in upper right, and freight cars standing on inundated tracks in left foreground. Photo by Brownie's Photo Shop, Hibbing, Minn.

between these periods. The total duration of this flood was 47 days --this may be compared with an average of only 7 days for the eleven previous floods since 1907.

This long duration was in direct contrast with those of the floods on the Zumbro, Whitewater, and Root Rivers, where the slopes of the river beds are relatively steep (especially on the minor tributaries). Examples of the short duration of flood in that area were noted by observers of the Weather Bureau, who reported that streams which were out of the banks in the forenoon of June 13, had returned almost to normal by evening.

Mississippi River main stem below Brainerd

Record discharges were noted down to and including the station at Anoka, Minn. There were no exceptionally high discharges on the Minnesota River and tributaries, and the increased flow of the Mississippi River at St. Paul was not outstanding. At Prescott, just below the mouth of the St. Croix River, the discharge in May reached a maximum for the period of record because of the snow melt; it was the highest since 1916. Flood stages prevailed from Prescott to La Crosse, Wis.

Mississippi River tributaries in Minnesota below Hastings

During the period March 7-9, a warm spell of weather caused rapid melting of snow in the Root and Zumbro Rivers and resulted in high discharges. Later in the month, during the period March 26-28, heavy rains (Spring Valley, 2.03 inches; Winona, 1.20 inches; Zumbrota, 1.08 inches) fell on the last of the snow still on the ground and caused flash floods in the Zumbro and Root River basins. The entire Root River valley, according to the Weather Bureau, was flooded from Rushford to Hokah, a distance of 25 miles. The Root River near Houston reached within 400 cfs of the 1933 record flow of 26,600 cfs. These two peaks are believed to be the highest since 1899. The towns of Lanesboro, Rushford, and Houston were most affected.

During the period June 12, 13, heavy rains fell on the tributary streams in Minnesota. The greatest concentration was near Red Wing, where a 24-hour fall of 7.60 inches was reported; at Dam no. 3, just upstream, 6.08 inches were reported. These rains caused flooding in the basins of the Root, Whitewater, and Zumbro Rivers. These were truly "flash floods" and the rise and fall was exceedingly rapid. It was noted that some streams were at overbank stage before noon on June 13 and were almost back to normal flow by evening. An example of this is the South Fork Whitewater River near Altura; the flow was 13 cfs on June 12, 2,340 cfs at 4 a.m. June 13, and 39 cfs at 8 p.m. June 13.

St. Croix River basin

The upper St. Croix River basin was in the region of high spring flows. New records of stage and discharge were established at gaging stations near Danbury, Grantsburg, Rush City, and St. Croix Falls. Some flooding was reported on the upper tributaries in Minnesota, but throughout most of the basin, banks are high and little damage resulted. On May 9, the Lake St. Croix gage at Stillwater, Minn., indicated a peak water-surface elevation of 687.53 feet above mean sea level (adjustment of 1912). This was the highest elevation since 1881, when 687.87 feet was recorded. It has been reported, but not confirmed, that in the year 1850 an elevation of 689.47 feet was reached.

Lake Superior basin

In Minnesota, most of the streams tributary to Lake Superior are located in a very sparsely settled portion of the State and have fairly high banks and stream beds with steep slopes. Little or no flood damage was reported on streams outside of the St. Louis River basin. Slopes in the St. Louis River basin are, in comparison with other streams along the north shore, relatively flat except for the last few miles along the main stem where it descends to the lake. Most of the basin was affected by the same meteorological conditions that affected the headwater area of the Mississippi River; as a result, some areas in the basin were flooded.

A reconnaissance survey made by the Milwaukee District of the Corps of Engineers found that, during the week of April 24, the St. Louis River and tributaries were at flood stage because of ice jams, warm rain, and melted snow cover. During the following week, cold weather moved into the area and brought an additional 8 to 10 inches of snowfall. On May 5, about 3 inches of rain fell on the area, and river stages rose well above the April peaks. According to information collected by the Corps of Engineers, the stages during this rise equaled those of 1898, when the highest previously known stage occurred.

The Minnesota Power & Light Co. reported that the flow at their Thompson Station during the period May 7-11 was the highest of record--these records have been continuous since 1908.

The Village of Floodwood, population 500, located at the junction of the St. Louis, Savannah, and Floodwood Rivers, had its most severe flood since 1898. See figure 101.

Figure 101.--Aerial view of St. Louis River at Floodwood, Minn., at mouths of Savanna and Floodwood Rivers, showing inundation near crest of flood in May. Photo by Brownie's Photo Shop, Hibbing, Minnesota.

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HYDROLOGIC AND METEOROLOGIC FEATURES

Causes of floods

The spring floods were the result of a most unusual combination of hydrologic factors; individually, none could cause floods of comparable magnitude. The following four factors were the greatest contributors: High soil-moisture content prior to the spring breakup; unusual accumulation of snow during the winter; unseasonable continuation of cold weather into the spring; and last, and probably most important, heavy precipitation during the snow-melt.

In the headwater region of the Mississippi River and along Lake Superior, the soil-moisture at the time of the freeze-up in the fall was well above normal. For the State as a whole, the average precipitation during October 1949 was 1.39 inches above normal; Duluth and Park Rapids reported 3.07 inches and 1.77 inches above normal, respectively. As a result of this precipitation, lake levels, pond levels, and stream-flows were above normal for this time of year. These conditions were fixed at their high levels by the fall freeze-up, which began about November 20, and was well established by December 11. Stream flow, ground water levels, lake and pond levels, and soil-moisture content remained well above normal during the winter freeze-up and contributed greatly to runoff during the spring floods.

Snowfall during the winter period was unusually heavy with very little melting to relieve the potential spring flood possibilities. Table 1, furnished by the Weather Bureau, shows precipitation departure, snowfall, and snow-on-ground data for Duluth and the northern division of the State during the period December 1949 to April 1950. The results of a survey by the Corps of Engineers in mid-March to determine the water content of snow on the ground are shown on figure 102.

Generally, temperatures were below normal over the headwater flood areas during the winter and spring. The average temperature for weather stations in the northern area was below normal for each month from December through May, except for February when the average temperature was only 0.2 degree above normal. The average temperature for April at Minneapolis was the lowest on record since 1874. As a result of the prolonged low temperatures, the snow-cover remained heavy until the time of the spring breakup. At International Bridge, Minn., 72.5 inches of snow was on the ground on April 11. At Duluth, new records were established for the amount of snow on the ground at this time of the year. Figure 103 shows the range of temperatures at Itasca State Park and Duluth from December 1, 1949 to May 31, 1950. Temperatures at these two locations are taken to be fairly representative of the area.

Table 1. --Snowfall at Duluth and in northern division of Minnesota December 1949 to April 1950

[Records by U. S. Weather Bureau]

Month	Departure from normal precipitation, in inches	Snowfall during month, in inches	Snow on ground near end of month, in inches
Duluth			
December	-0.02	12.4	2.0
January	-1.22	23.8	22
February	- .55	5.0	20
March	- .35	12.0	15
April	- .97	19.1	10
Northern Div.			
December	- .36	7.0	-
January	-1.04	23.7	-
February	- .37	3.8	-
March	- .60	13.4	-
April	- .78	24.2	-

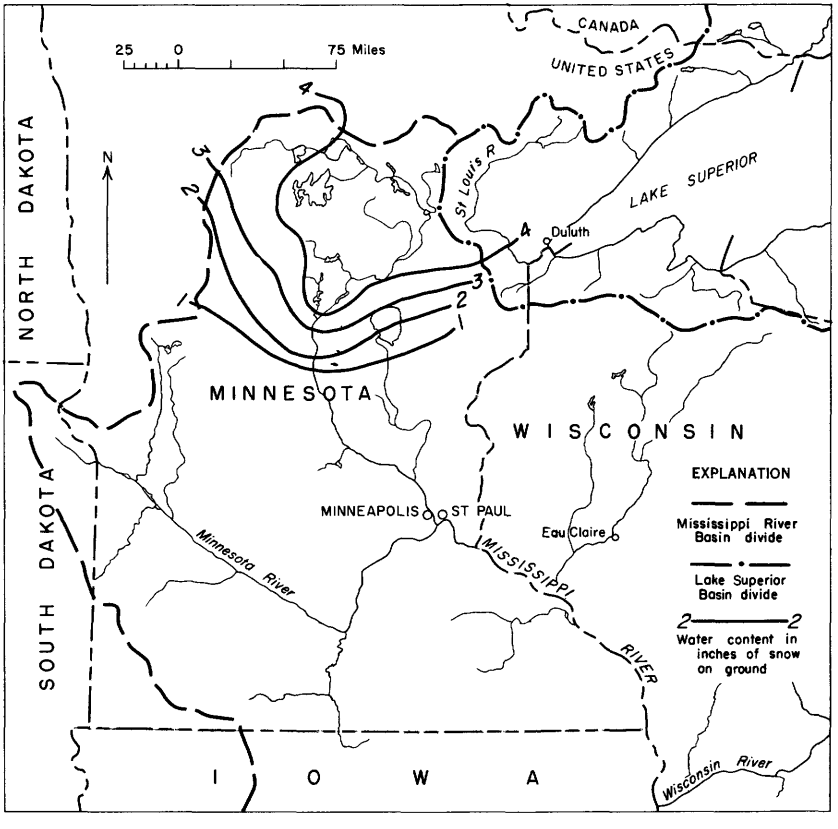

Figure 102. --Map of Minnesota showing results of mid-March snow survey by Corps of Engineers. Isograms are lines of equal water content of snow on ground.

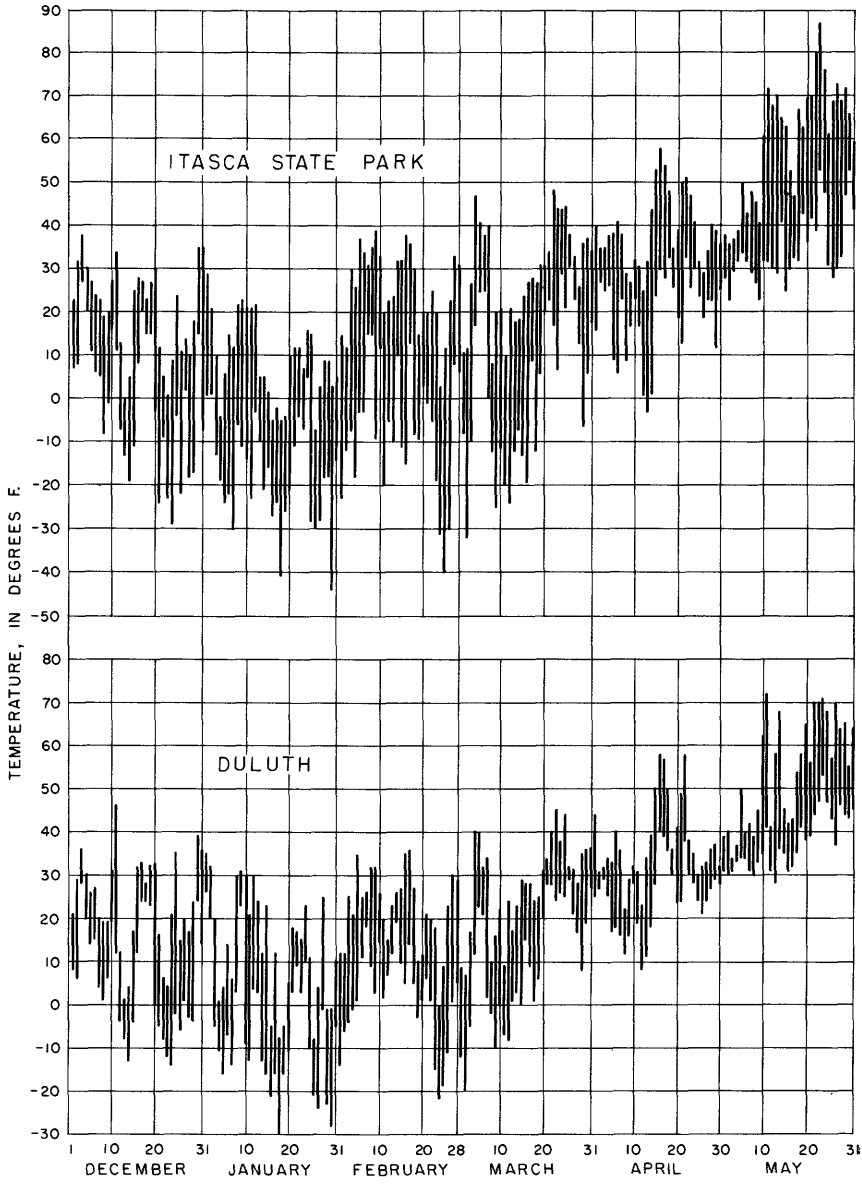

Figure 103. --Graph showing daily range in temperature at Itasca State Park and at Duluth, Minn., December 1949 to May 1950.

Cold weather in April had caused precipitation to be held in the form of snow. With excessive snow on the ground late in the season and the ground well saturated with moisture, heavy precipitation during the snow-melt was the only factor necessary to cause record floods. On May 5, heavy general rains covered the State: 2.25 inches fell at Duluth, 4.38 inches at Two Harbors, 2.78 inches at Grand Marais, 1.53 inches at Grand Rapids, and 1.62 inches at Sandy Lake Dam at Libby. Rains continued intermittently during the remainder of May, with enough snow added to give a maximum snowfall for the month since 1924.

Meteorology

[Prepared by the staff of the United States Weather Bureau]

The average annual precipitation in Minnesota ranges from 32 inches in the southeastern corner to 19 inches in the northwestern part. Fifty-five percent of the annual rainfall normally occurs from May to August, principally during thunderstorms, and June usually is the peak month. In spite of the concentration of a great part of the annual precipitation in a few months, the State is not particularly subject to floods. The long, flat slopes of prairie lands and forests do not gather water quickly into great volumes nor do they run it off readily.

The floods which occurred during the period from April through June were caused primarily by the late spring and the abnormal accumulation of snow. March had been considerably colder than usual, and the monthly average snowfall was about 4.2 inches more than normal. At the end of the month a period of severe glaze, sleet, snow and wind storms occurred--this storm period was one of the worst on record at Duluth.

Except for a short mild spell, one polar outbreak after another was experienced in Minnesota during April and the first 10 days of May (see fig. 104). It was the coldest April since the beginning of State-wide records in 1891.

On the evening of April 7, a strong cold front from Canada started moving across the northwest corner of Minnesota. Some light precipitation accompanied its passage there, but the front moved across the rest of the State within the next 24 hours with no precipitation at all. The great polar High behind the cold front remained north of the Canadian border as it moved rapidly eastward. On the afternoon of the 9th, the High was centered just northeast of James Bay and caused a flow of air over Minnesota from the southeast. However, at 700 millibars (approximate altitude, 10,000 feet) the flow was from the southwest. The warm air brought by this circulation aloft was moist, and as it was lifted

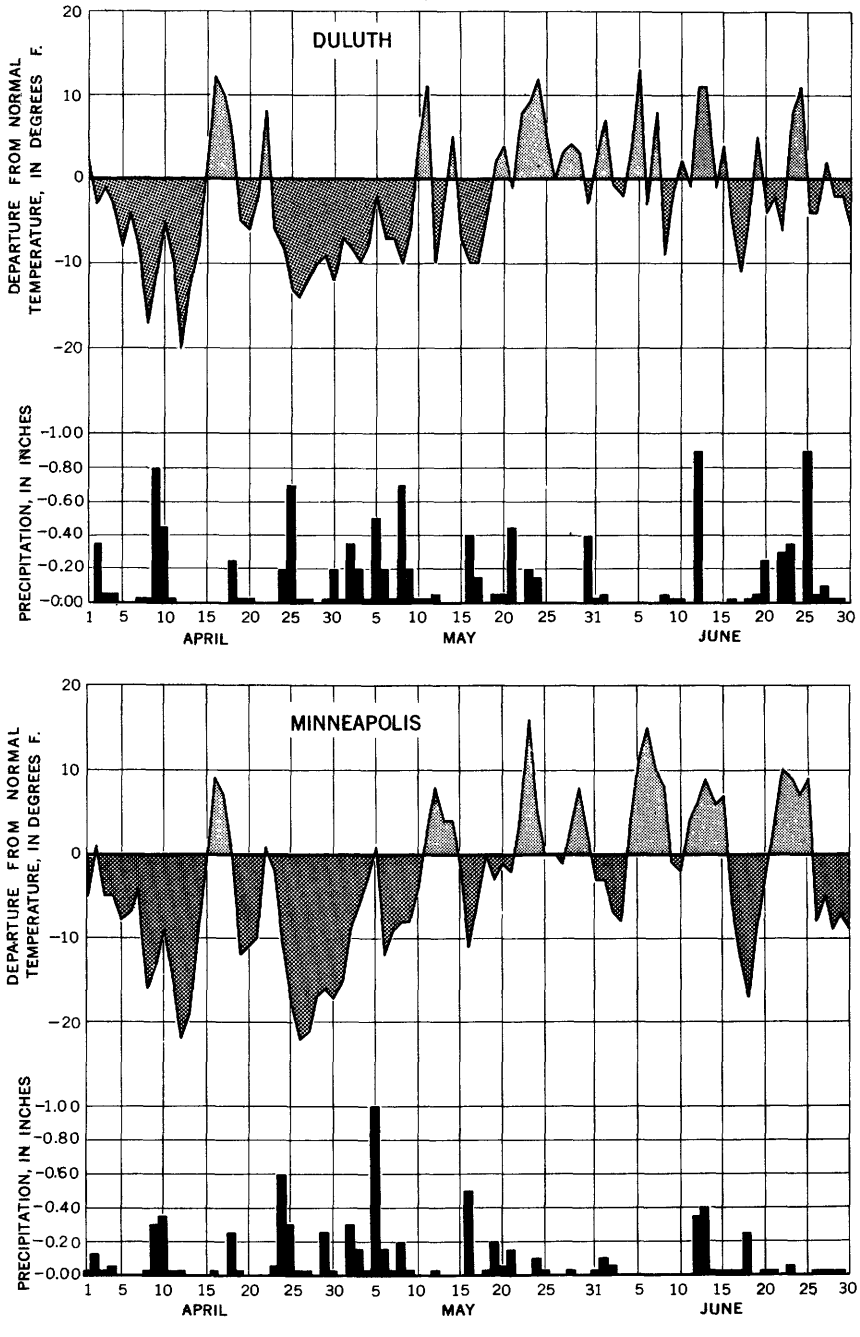

Figure 104. --Precipitation and departure of average temperature from normal at Duluth and Minneapolis, Minn., April-June 1950.

over the wedge of cold dense air at land surface, a great amount of precipitation in the form of snow, rain, and glaze was released. On the 11th, 72.5 inches of snow covered the ground at Pigeon River Bridge. Worst hit, however, was the southern part of Minnesota. Near-record low temperatures occurred on the 12th, and record low temperatures for so late in the season occurred on the 13th.

Temperatures rose as high as 72° F on April 16, and in the next few days ice finally went out of lakes in the southern part of the State--this date was the latest in 15 years. Then, on the 18th, another cold front surged across Minnesota. Temperatures fell until, on the 21st, a hard freeze gripped the entire State. Tempertures rose briefly and plunged again as polar air once more invaded Minnesota on the 23rd. Thus, April ended. At Duluth, new records were established for April snowfall and for depth of snow on the ground at end of April. It was the coldest April since 1874 at Minneapolis. Average snowfall for the State was the second greatest of record for April.

The first 10 days in May were wet; some stations reported rain every day. As in April, the precipitation was caused by the lifting of warm moist air over cold. From the afternoon of May 2 through the morning of the 5th, a wedge of polar air lay over Minnesota, and winds at the surface were from an easterly direction. Aloft, however, the flow over Minnesota during this period was from the southwest--bringing in warm moist air. The condition was intensified by a Low which developed in southern New Mexico on the afternoon of the 4th and moved northeastward into Nebraska during the next 12 hours. By the afternoon of the 5th (see fig. 105) the Low had deepened rapidly and moved almost directly north. The tremendous area of precipitation associated with this intense system covered the entire State of Minnesota. Duluth received 2.25 inches of rain on the 5th, and Two Harbors, northeast of Duluth, received 4.38 inches. During this storm Minneapolis experienced a sea-level pressure of 28.00 inches (948.2 millibars), the second lowest of record for the city.

In the wake of the storm came another siege of cold weather and more rain. There was a rapid rally, however, and as shown on figure 104, temperatures rose to normal and above, with comparatively little precipitation.

A new polar front swept across Minnesota on May 15, and again, as the Canadian High continued to move eastward and the flow of air over the State came from the southeast, rain and snow fell. Temperatures remained slightly below normal for the next several days as another minor cold front crossed Minnesota and again produced precipitation.

On the 22d, a low pressure system to the northwest of Minnesota created a flow of warm air from the southwest over the State. This circulation persisted through the 23d, when maximum temperatures rose as high as 96° F. The passage of still another cold front during the last week in May brought State-wide temperatures down to near normal during the period, May 25-27, but they rose again on the next two days. Two more polar outbreaks occurred during the last two days in May, thus presaging unseasonable weather for June.

May was cooler and wetter than usual and produced the greatest May snowfall since 1924. Floods in the extreme upper Mississippi River, which continued throughout the month, were the result of rain and the melting of the great quantity of snow. April flood crests were exceeded, and the Mississippi reached new record discharges. At Fort Ripley and Aitkin, both on the upper Mississippi, flood crests and duration of flood established new all-time records.

As June began, a strong Low in Canada (north of Minnesota) created a flow of cold air from the northwest over the State, and for three days temperatures fell progressively lower. Then, a well-developed high-pressure area moved eastward across the United States. As the circulation over Minnesota was dominated by the western side of the High, warm air flowed up from the south and raised temperatures even more rapidly than they had fallen.

Except for a brief drop in temperatures on the 9th and 10th when a minor cold front crossed the State, temperatures remained high through June 15. On that day a Low was developing in North Dakota. By the following morning the Low had moved into eastern Minnesota, and the circulation around it pulled a cold front down into the State. An extensive polar High, which had built up in Canada, came down behind the front. On June 19 the temperature at Minneapolis fell to 41° F--the lowest temperature ever recorded that late in the season.

A weak low pressure center formed in Canada just north of Montana on the afternoon of June 21. It moved eastward very slowly and deepened 9 millibars in 24 hours. For the next 24 hours the Low continued to deepen, and the pressure gradient became steeper. A strong flow of air from the southwest was created in the southeastern quadrant of the Low--Minnesota was included in this area. As a result of this great influx of warm air, temperatures rose sharply throughout the State and reached as high as 99° F on the 22d. By the morning of the 23d the central pressure of the Low had fallen to less than 981 millibars. In the course of the next 2 days, the Low moved to the northeast, and another Low developed in Utah. The new Low rapidly moved northeastward,

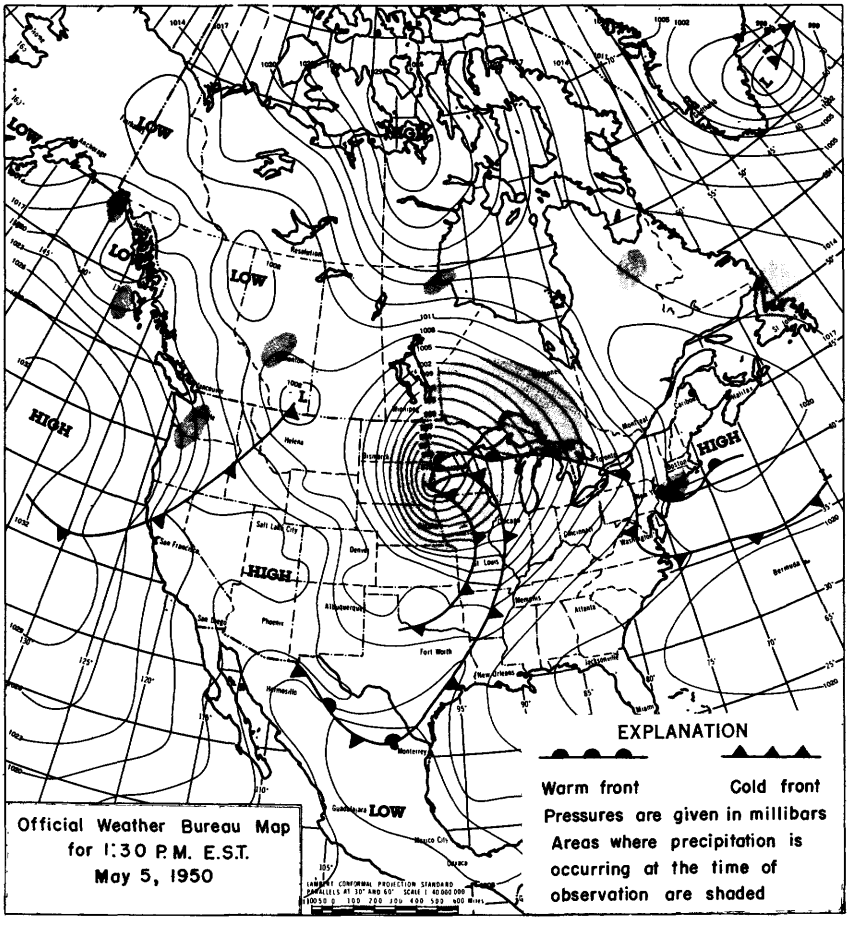

Figure 105. --Surface weather chart for May 5, 1950. Note area of extremely low barometric pressure centered in western Minnesota.

and on the morning of June 26 it lay north of Minnesota. The circulation quickly shifted; polar air was pulled down into the State, and temperatures plunged from above normal to well below normal. During the last four days of June, two more polar fronts crossed Minnesota in rapid succession. The month ended as it had begun--with temperatures well below the norm.

In spite of the frontal activity throughout the month there was little overrunning such as occurred during April and May. As a result, throughout the State the June precipitation was definitely low. There were a few exceptions among the extreme southeastern stations. At these stations, excessive rains fell on June 12 and 13 as a result of thunderstorms in warm air. The bulk of the month's total rainfall occurred in this short period and resulted in several flash floods on the 13th. At Red Wing, a total of 7.60 inches fell on June 12 and 13 and set a new record at that station for all months of the year.

Spring 1950 was one of the most unusual of record. The April-June flood in the headwaters of the Mississippi River was the greatest of record; new records of high stages, duration of flood, and total damages were established.

Ground Water

Because of lack of records throughout Minnesota, the effect of the spring floods on ground-water levels could not be shown with any degree of certainty.

The small amount of data available, shown in table 2, indicates a correlation between high river stages and increases in ground-water storage. However, before definite conclusions can be drawn, a systematic network of observation wells must be established, and the data obtained must be studied in order to evaluate the storage changes and to determine which wells reflect regional changes in ground water and not merely local changes in response to changes in levels of adjacent surface water bodies.

It is interesting to note that the two wells at Cloquet, Minn., indicate that recovery occurs more rapidly in shallow stratum.

Table 2. --Readings on observation wells in Minnesota during 1950

Location	Depth of well (feet)	Date	a/ Depth to water (feet)	Date	a/ Depth to water (feet)	Recovery (feet)
Winnibigoshish Dam	30	Mar. 6	20.69	Aug. 7	16.23	b/4.46
Cloquet	14	Mar.19	9.22	May 28	5.35	3.87
Cloquet	85	Apr. 8	38.17	Sept. 16	34.17	4.00
Camp Ripley	59	Feb. 1	16.38	c/May12	13.91	2.47
Near Eveleth	10	Mar.12	7.6	May 21	4.32	3.28

a Depth to water below reference point.
b Affected by changes of elevation in Winnibigoshish Reservoir.
c Last reading available during year.

FLOOD DAMAGE

Flood damage to highways and bridges in Minnesota counties covered by this report is shown in table 3. This table, prepared by the Federal Bureau of Public Roads, includes damages during the entire period of the floods.

Table 3. --Flood damage to highways and bridges in Mississippi River and Lake Superior basins in Minnesota, during floods of 1950.

County	Federal aid systems a/	Non-federal aid systems b/	Total
Aitkin	$62,420	$133,806	$196,226
Beltrami c/	-	51,438	51,438
Carlton	21,775	70,417	92,192
Cass	600	33,216	33,816
Cook	4,650	57,630	62,280
Crow Wing	-	39,000	39,000
Douglas	1,400	3,350	4,750
Grant c/	1,000	6,900	7,900
Hubbard	3,000	19,776	22,776
Itasca c/	9,896	134,852	144,748
Kanabec	509	46,207	46,716
Mille Lacs	1,000	24,250	25,250
Morrison	1,000	4,237	5,237
Ottertail c/	7,000	13,000	20,000
Pine	-	60,570	60,570
St. Louis	8,500	192,045	200,545
Todd	23,500	90,900	114,400
Wadena	12,600	115,505	128,105
Total	$158,850	$1,097,099	$1,255,949

a Based on cost of replacement to adequate standards.

b Excludes damage to those washed out bridges which were to be replaced by adequate structures.

c Part of county drains outside Mississippi River or Lake Superior basins.

Mississippi River basin

Mississippi River headwaters

The Corps of Engineers reported that in Aitkin there were 88 homes flooded (which were not damaged during the first flood), and that the basements of approximately 100 additional homes and 44 business establishments were flooded. Roads, streets, and lumber yards were also flooded. The total damage at Aitkin was estimated as $180,000.

By far, the largest farm damage was in this area. It was estimated that 57,000 acres of cropland and pasture were inundated. One life was lost as a direct result of the flood when a raft, used to transport cream was overturned. Indirect damages--such as loss of business by merchants and grain elevator operators--were estimated at $143,700. Damages to farm buildings, fences, machinery, livestock, stored grain and feed, and incidental items were estimated at $659,000.

The Aitkin County Relief Committee made the following estimates regarding flood damage in the county:

Public roads, bridges, and culverts	$ 207,000
Township roads	126,000
Aitkin Village roads and culverts	56,300
Private roads, bridges, and culverts	96,000
Private property, bridges, fences, equipment, and crops.	1,200,000
Public property	20,000
Total	$1,705,300

The County Relief Committee estimated that 160 families, 1,325 livestock, and 5,000 fowl were evaculated, and that 20,800 acres of cropland were flooded.

Damage at Brainerd resulted from flooding of the sewage disposal plant; structural damage occurred at the dam of the Northwest Paper Co. Some damage was done to streets, sewer mains, and residences. Here, the damage was estimated by the Corps of Engineers at $210,000.

At Palisade, road and street damage was estimated at $5,000.

Excessive stages in the headwater reservoirs resulted in damage to lakeshore property and access roads, and resort operators reported a loss of business. At Sandy Lake Reservoir, flood costs, emergency protection measures and subsequent clean-up activities amounted to $45,000. This reservoir reached a stage of 17.51 feet on May 19--6.5 feet higher than the normal maximum operating limit.

An estimate by the Corps of Engineers of the flood damage in headwater reservoirs and immediate vicinity is shown in table 4. In addition, the following damages and costs were estimated: damage to roads, bridges, and culverts, $356,000; damage to public utilities, $8,000; and cost of Red Cross, Coast Guard, National Guard, Corps of Engineers, $75,000. The total loss of the 1950 flood in the headwaters area has been summarized by the Corps of Engineers, and is shown in table 5.

Known losses on minor lakes have not been evaluated; however, these losses and unreported losses probably were considerable.

Table 4.--Damage in headwater reservoirs and immediate vicinity
[Estimated by Corps of Engineers]

Winnibigoshish Reservoir	$25,000
Cass Lake and connecting lakes	90,000
Leech Lake Reservoir	40,000
Pokegama Reservoir	20,000
Ball Club Lake and vicinity	40,000
Sandy Lake Reservoir	125,000
Emergency protection work	45,000
Total	$385,000

Table 5.--Flood damage in the Mississippi River headwaters area
[Summarized by the Corps of Engineers]

Urban	$395,000
Crop losses (direct)	653,300
Crop losses (indirect)	143,700
Other farm losses	659,000
Headwater reservoirs	385,000
Roads, bridges, and culverts	356,000
Public utilities	8,000
Rescue evacuation and rehabilitation	75,000
Total	$2,675,000

Flood control in headwaters area

There are no projects in the area operated solely for the purpose of flood control in the Mississippi River basin above Aitkin. However, six reservoirs are operated in the headwater region primarily in the interest of navigation at points downstream from St. Paul. Operations at these reservoirs result in benefit to recreation, water power, water supplies, and flood control. Four of the six reservoirs are located on the main stem or on tributaries above Aitkin. The Corps of Engineers has estimated that the operation of headwater reservoirs resulted in a reduction of flood damages. See table 6.

Table 6. --Reduction of flood damage by reservoir operation
[Estimated by Corps of Engineers]

Urban	$76,000
Crop	97,000
Miscellaneous farm loss	117,000
Sandy Lake Reservoir	30,000
Roads, bridges, and culverts	70,000
Public utilities	2,000
Rescue, evacuation, and rehabilitation	12,000
Total	$404,000

Mississippi River main stem below Brainerd

There was no flood damage reported on the Mississippi River between Brainerd, Minn. and Prescott, Wis., although discharges were record-high as far downstream as the gaging station at Anoka (upstream from the Twin Cities). Weather Bureau estimates of the damage between Hastings (upstream from the mouth of the St. Croix River), and La Crosse, Wis., are shown in table 7. Of the total amount, the greatest single item was damage to the roadbed of the Chicago, Burlington & Quincy Railroad, which was caused by high stages and wave action along Lake Pepin.

Table 7. --Flood damage between Hastings, Minn. and La Crosse, Wis., during May, 1950
[Estimated by U. S. Weather Bureau]

Urban damage:	
Dwellings and movable property	$21,000
Private and industrial property	13,000
Streets and bridges	500
Rural damage:	
Growing crops	20,000
Other property damage	100,000
Loss of income and wages	10,000
Emergency protection and evacuation	15,000
Total	$179,500

Mississippi River tributaries in Minnesota below Hastings

The high discharges in the Root and Zumbro River basins resulting from the warm weather of March 7-9 caused damage that was confined mainly to fences--total damage as estimated by the Weather Bureau was $25,000. The flash floods resulting from the heavy rains of March 26-28 caused damage in the Root River valley estimated by the Weather Bureau at $200,000--a total of $225,000 for the month in this area.

Flash floods in the Root, Zumbro, and Whitewater River basins resulted from the heavy rains of June 12 and 13. An estimate of damages in these three tributary basins as calculated by the Weather Bureau is shown in table 8. Damage to growing crops accounted for most of the losses; highway damage (confined for the most part to the Zumbro and Whitewater valleys) was second largest. Because of the rapid rise and fall of many of the streams, some crops were not a total loss; this is especially true with regard to corn, which is usually considered a total loss if submerged longer than about 24 hours.

Table 8.--Flood damage in Root Whitewater, and Zumbro River basins, June 12 and 13, 1950
[Estimates by U. S. Weather Bureau]

Urban damage	$15,000
Rural damage (1,800 acres inundated):	
Crops in fields	91,000
Buildings and fences	2,000
Movable property and machinery	2,100
Railroad, highways, and bridges	20,200
Suspension of business	2,000
Emergency protection	5,000
Total	$137,300

St. Croix River basin

Flood damage was confined mainly to the immediate vicinity of Lake St. Croix. Flood damage at Stillwater was confined to waterfront property; a lumber yard received the most serious damage. Flood damage resulted to summer homes along the shores of Lake St. Croix, but no evaluation of the damage was made. At Nevers Dam, six of the eight generators were put out of operation.

Lake Superior basin

About one-third of the village of Floodwood was inundated by the high water of early May, and 30 families were forced to evacuate their homes. The Corps of Engineers estimated that direct damage to buildings and contents amounted to $100,000; other losses were estimated at $36,000.

At Cloquet, the bridge of the Duluth & Northeastern R. R. Co. was destroyed, and a portion of the industrial area was inundated. Direct damage to buildings, contents of buildings, and railroad property was estimated at $172,000; indirect damages were estimated at $300,000.

At Fond du Lac, Minn., about 30 homes and 8 commercial establishments were damaged. Total direct and indirect damages were estimated at $120,000.

No estimate was made of the damage to farm lands, which were inundated along the entire length of the St. Louis River.

MEASUREMENT OF FLOOD DISCHARGES

The operation of a stream-gaging station consists principally of the development of a relationship between stage and discharge, from which the discharge can be calculated when the stage is known. The development of a stage-discharge relationship is based upon current-meter measurements over the range of stage experienced, or over a sufficient part of the range to enable the discharge corresponding to the maximum stage to be obtained by an extension of the stage-discharge relationship, or rating curve.

Because of the adverse conditions caused by the floods, it was not possible to obtain current-meter measurements at all points where measurement of peak discharge was desired. At gaging stations where the flood greatly exceeded the stage defined by current-meter measurements, and at other points where measurement of the flood discharge was desired, the maximum discharge usually was computed by these indirect methods: computation of flow over dams, computation of flow through contracted openings, and computation of flow from slope-area observations.

At some locations where indirect methods were used, snow drifts had made floodmarks indefinite. In order to avoid the use of erroneous floodmarks, careful studies and comparisons were made.

A general description of these indirect methods can be found in Water-Supply Paper 888. More detailed description of the slope-area method, with illustrated examples, can be found in certain flood reports--particularly in Water-Supply Papers 773-E, 796-G, and 816. Water-Supply Paper 816 contains illustrative examples of all three indirect methods.

STAGES AND DISCHARGES AT STREAM-GAGING STATIONS

Explanation of Data

The basic data systematically collected at stream-gaging stations consist of records of stage, measurements of discharge, and general information useful in determining the daily flow from the records of gage heights and discharge measurements. The records of stage are obtained either by periodic readings on a non-recording gage or by a water-stage recorder that provides a continuous graph of stage. Measurements of discharge are generally made by a current-meter. Occasionally, the determination of extraordinary peak flows must be made by indirect methods referred to in the preceding section of this report.

The data presented in the following tables for each stream-gaging station comprise, in general, a description of the gaging station, a table showing the daily discharges during the flood period (April to June 1950 for most stations), and a table showing the stage and discharge during major flood periods at intervals short enough to permit reliable definition of the flood hydrograph.

The description of the station gives information concerning the location, datum, and type of gage, area of drainage basin, details of gage-height and discharge records, details of maxima, and miscellaneous remarks helpful to a better understanding of the records. The statement regarding the discharge record briefly explains the methods used in the definition of the stage-discharge relationship over the ranges of stage that occurred during the floods of April-June 1950, as well as of the previous maximum flood of record. The description also includes information about auxiliary methods used in obtaining the discharge and describes conditions that may have affected the stage-discharge relation. The maximum stage and discharge at each gaging station are given for the floods of April-June 1950 and for the period of record prior to that time; additional information is included at some stations for floods antedating the period of record.

The table of daily mean discharge usually presents data for April to June 1950 and covers not only the periods of major flood but also covers a sufficient length of time to show antecedent and

recession discharges. The table shows the monthly mean discharge, in cubic feet per second, and the volume of runoff, in acre-feet and depth in inches over the drainage area. Figure 106 shows graphs of elevation of water surface at gaging stations on the Mississippi River main stem. Figure 107 shows hydrographs at gaging stations on the main stem of the Mississippi River, and Figure 108 shows hydrographs at selected gaging stations on tributaries of the Mississippi River.

A table that follows the tabulation of mean discharges gives (for each station where such detailed definition is necessary) the stages and discharges at indicated times of each day during the period of rapid change in stage and discharge. The time interval for selecting momentary data was chosen to offer adequate hydrograph definition without including unnecessary information. Data for each station are listed from the beginning of the flood until the recession is adequately defined by the daily mean discharges.

The gage heights were obtained from records of continuous water-stage recorders, where such records were available. For a station with an incomplete record, or where the records of stage consisted of only one or more manual-gage readings a day, graphs were constructed on the basis of available gage readings, high-water marks, and other pertinent evidence, and the stages at indicated time were picked from the graph. Departures from this general procedure are noted in the description under the paragraph entitled "Gage-height record".

Records are presented in downstream order, the Mississippi River basin first. Within each river basin, records for stations on the main stream are presented first, in downstream order, followed by records for stations on the tributaries in similar order beginning with the uppermost. The streams tributary to Lake Superior, which begin with records for Pigeon River, are listed after those in the Mississippi basin.

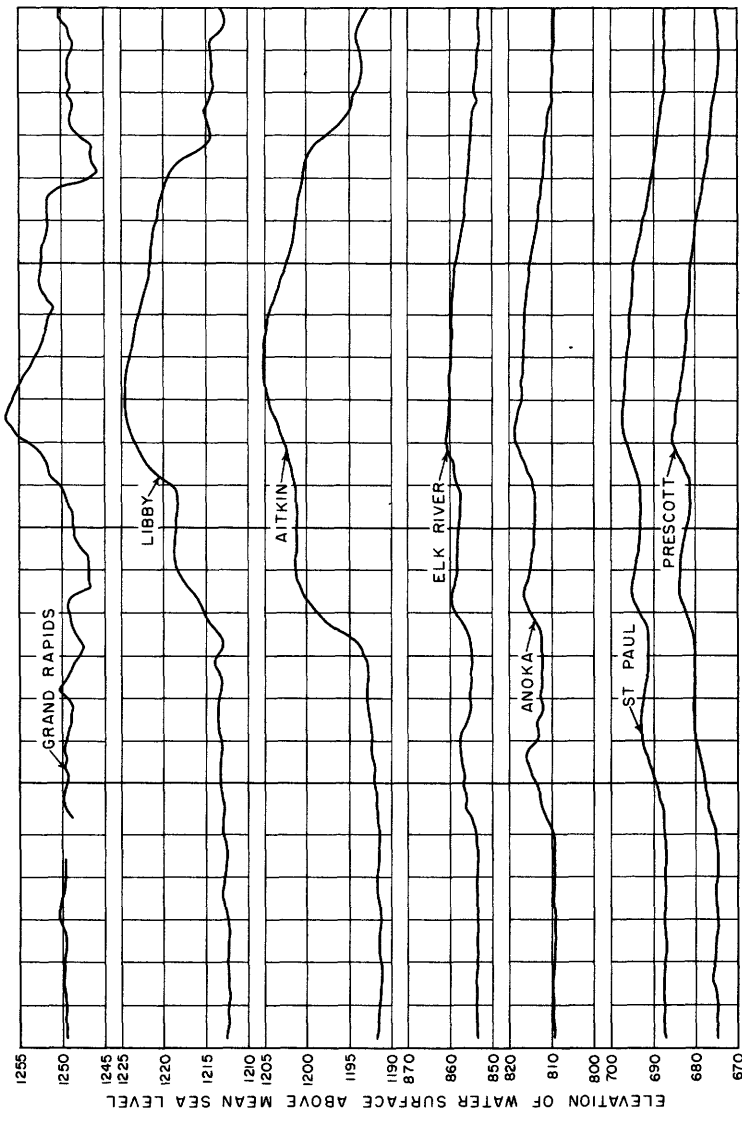

Figure 106.--Graphs of elevation of water surface at Mississippi River main stem gaging stations, March-June 1950

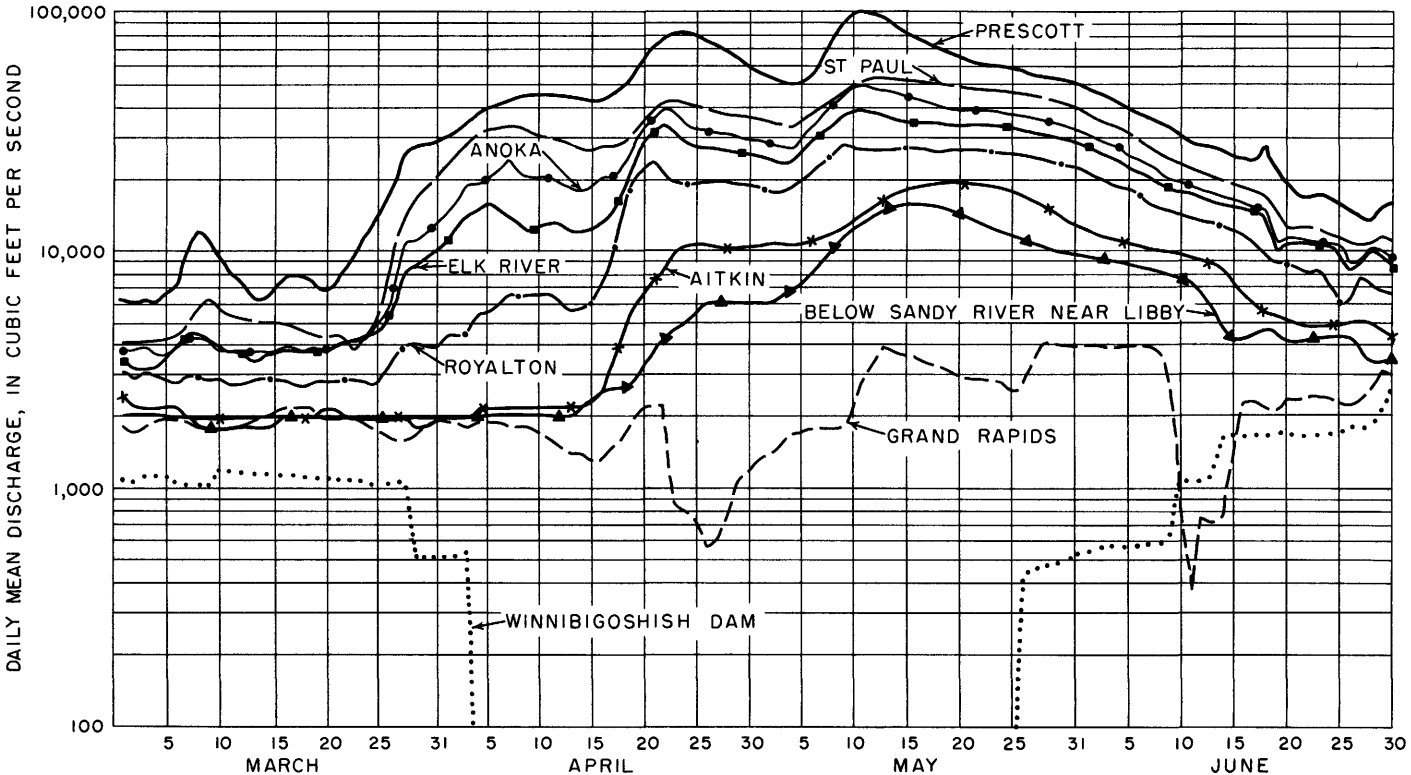

Figure 107. --Graphs of daily discharge at Mississippi River main stem gaging stations, March-June 1950.

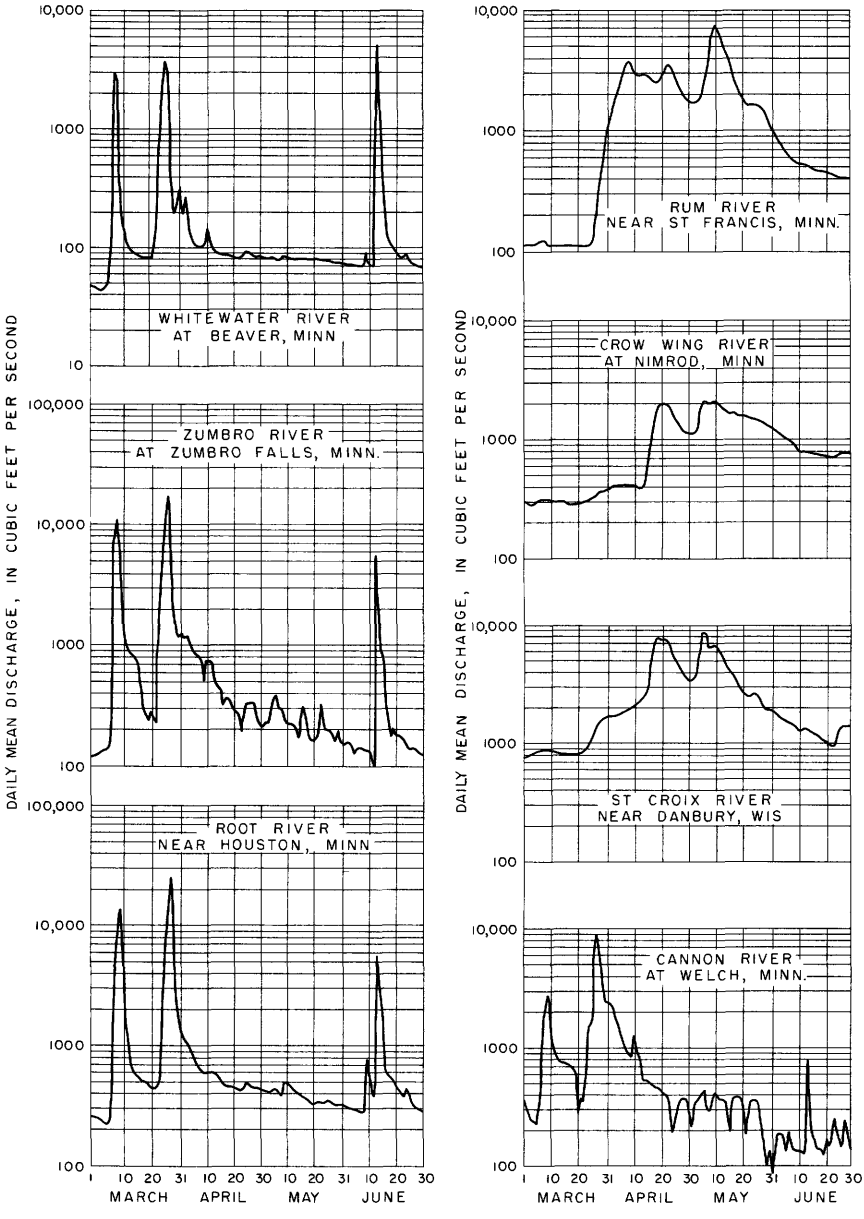

Figure 108. --Graphs of daily discharge at selected gaging stations on tributaries of Mississippi River, March-June 1950.

Mississippi River main stem

Winnibigoshish Reservoir near Deer River, Minn.

Location.--Lat 47°25'42", long. 94°03'00", in sec. 25, T. 146 N., R. 27 W., at dam on Mississippi River, 1 mile northwest of Little Winnibigoshish Lake and 14 miles northwest of town of Deer River. Datum of gage is 1,289.47 ft above mean sea level, adjustment of 1912.
Drainage area.--1,442 sq mi.
Gage-height record.--Water-stage recorder graph read twice daily.
Maxima.--April-September 1950: Gage height observed, 14.23 ft June 26.
1884 to March 1950: Gage height observed, 14.42 ft July 31, 1905.
Remarks.--Reservoir is formed by natural lake completely controlled by concrete and timber dam with stoplogs between concrete piers. Dead storage, 314,360 acre-ft. Water is used to benefit navigation on Mississippi River below Minneapolis. Records furnished by Corps of Engineers, in terms of cfs-days, and converted to acre-feet by Geological Survey.

Gage height, in feet, and contents, in acre-feet, at 6 p.m. of indicated day, 1950

Day	April		May		June		July		August		September	
	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents
10	9.19	511,870	10.97	634,470	13.67	908,270	13.80	922,690	12.60	790,830	10.85	624,990
20	9.40	525,660	12.12	742,670	13.86	929,340	13.53	892,750	12.03	733,650	11.13	649,070
30-1	9.94	561,180	13.20	856,170	13.96	940,560	13.02	836,210	11.50	682,850	10.96	633,540

Mississippi River at Winnibigoshish Dam, near Deer River, Minn.

Location.--Lat 47°25'42", long. 94°03'00", in SW¼ sec. 25, T. 146 N., R. 27 W., at dam, 1 mile northwest of Little Winnibigoshish Lake and 14 miles northwest of town of Deer River. Datum of gages is 1,289.47 ft above mean sea level, adjustment of 1912.
Drainage area.--1,442 sq mi.
Gage-height record.--Water stage recorder graph read twice daily.
Discharge record.--Discharge computed on basis of head over dam using modified weir formula and adjusted to conform with current-meter measurements. Gage height used to hundredths.
Maxima.--April-June 1950: Daily discharge, 2,670 cfs June 30.
1941 to March 1950: Daily discharge, 1,706 cfs Mar. 3, 1945.
Daily discharge known, 4,370 cfs Aug. 6, 1905.
Remarks.--Flow regulated by Winnibigoshish Reservoir (see preceding station). Figures of monthly mean discharge, and monthly runoff in acre-feet and inches are adjusted for change in reservoir contents. Records furnished by Corps of Engineers.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	523	60	539	11	50	56	1,086	21	58	44	1,683
2	523	62	559	12	50	36	1,091	22	60	48	1,683
3	543	44	569	13	50	42	1,146	23	62	54	1,713
4	38	48	569	14	50	48	1,693	24	64	62	1,713
5	40	54	574	15	50	52	1,693	25	48	48	1,713
6	40	50	579	16	52	56	1,698	26	52	444	1,873
7	40	54	584	17	54	60	1,693	27	54	459	1,833
8	40	60	599	18	54	50	1,683	28	56	474	1,848
9	42	44	629	19	56	54	1,708	29	56	484	2,066
10	46	52	1,101	20	58	60	1,713	30	58	499	2,670
								31	-	529	-
Monthly mean discharge, in cfs(adjusted)									1,237	4,932	2,761
Runoff, in acre-feet(adjusted)									73,610	303,300	164,300
Runoff, in inches(adjusted)									0.96	3.94	2.13

Mississippi River near Deer River, Minn.

Location.--Lat 47°15'10", long. 93°48'00", in NE¼NW¼ sec. 35, T. 144 N., R. 25 W., at Day's Highlanding Bridge, 5½ miles south of Deer River and 20 miles downstream from Leech Lake River. Datum of gage is 1,264.31 ft above mean sea level, adjustment of 1912. Auxiliary gage at Collinge Bridge, 7½ miles downstream, at same datum.
Drainage area.--3,190 sq mi.
Gage-height record.--Base and auxiliary staff gages read twice daily.
Discharge record.--Stage-fall-discharge relation defined by current-meter measurements. Discharge except for period of ice effect computed by using fall between gages as a factor. Discharge for period of ice effect, Apr. 1-25, computed on basis of backwater corrections to gage heights without regard to fall between gages, one discharge measurement, gage height, weather records, engineers' notes, and outflow records for Leech Lake and Winnibigoshish Reservoirs.
Maxima.--April-June 1950: Daily discharge, 3,070 cfs May 10; gage height observed, 14.30 ft May 13.
1945 to March 1950: Daily discharge, 4,200 cfs Mar. 17, 19, 1945; gage height observed, 14.86 ft Mar. 17, 1945, affected by ice.
Remarks.--Flow regulated by Winnibigoshish and Leech Lake Reservoirs, and Ball Club and White Oak Lakes. No diversions above station. Gage heights for station and outflow records for Winnibigoshish and Leech Lake Reservoirs furnished by Corps of Engineers.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	1,700	1,180	1,990	11	1,100	2,940	989	21	1,300	2,160	1,530
2	1,700	919	1,850	12	1,000	2,960	1,050	22	1,400	1,810	1,560
3	1,700	818	1,970	13	850	2,980	943	23	1,600	1,520	1,580
4	1,700	1,260	1,920	14	800	2,890	892	24	1,700	1,360	1,640
5	1,600	1,130	1,910	15	750	2,890	918	25	1,800	1,490	1,890
6	1,500	1,690	1,880	16	850	2,700	1,200	26	1,880	1,230	1,880
7	1,400	2,710	1,860	17	1,010	2,550	1,030	27	1,810	1,450	1,890
8	1,400	3,000	1,860	18	1,100	2,310	1,270	28	1,810	1,670	2,000
9	1,300	2,750	1,710	19	1,200	2,220	1,540	29	1,540	2,060	2,110
10	1,200	3,070	1,380	20	1,200	2,390	1,510	30	1,450	1,750	2,120
								31	-	1,880	-
Monthly mean discharge, in cfs									1,378	2,056	1,596
Runoff, in acre-feet									82,000	126,400	94,970
Runoff, in inches									0.48	0.74	0.56

Pokegama Reservoir near Grand Rapids, Minn.

Location.--Lat 47°10'00", long. 93°33'20", in NW¼ sec. 17, T. 54 N., R. 25 W., at narrows on Highway 169, 4 miles south of Grand Rapids. Datum of gage is 1,264.89 ft above mean sea level, adjustment of 1912.
Drainage area.--3,265 sq mi.
Gage-height record.--Water-stage recorder graph from which gage readings are taken on the 10th, 20th, and last of the month or oftener as required to compute storage except those for Aug. 20, Sept. 10, which are estimated.
Maxima.--April-September 1950: Gage height observed, 12.97 ft May 14.
1941 to March 1950: Gage height observed, 13.47 ft Apr. 29, 1948.
A stage of 13.50 ft was observed May 8, 1897.
Remarks.--Reservoir is formed by natural lakes controlled by concrete dam. Dead storage, 18,370 acre-feet. Water used to benefit navigation below Minneapolis. Records furnished by Corps of Engineers in terms of cfs-days and converted to acre-feet by Geological Survey.

Gage height, in feet, and contents, in acre-feet, on indicated day, 1950

Day	April		May		June		July		August		September	
	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents
10	7.02	31,950	12.48	131,700	8.83	58,310	9.16	63,510	9.15	63,350	9.16	63,510
20	6.46	24,480	12.85	140,150	9.53	69,720	9.13	63,010	9.19	64,030	9.26	65,200
30-1	9.87	75,410	11.46	108,480	9.29	65,690	9.10	62,520	9.24	64,860	9.61	71,050

Mississippi River at Grand Rapids, Minn.

Location.--Lat 47°14'00", long. 93°31'40", in SW¼NW¼ sec. 21, T. 55 N., R. 25 W., in machine room of Blandin Paper Mill in Grand Rapids, and 2.5 miles upstream from Prairie River. Datum of gage is 1,242.00 ft above mean sea level, adjustment of 1912.
Drainage area.--3,370 sq mi.
Gage-height record.--Average of twice-daily float-tape gage readings used except for periods, Apr. 10-14, 22-24, 28, 29, May 5 to June 16, when graph was drawn on basis of two or more gage readings daily and observation of crest gage height.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-25. Discharge for period of backwater from Prairie River, Apr. 26 to June 15, computed on basis of five discharge measurements and records for Prairie River and Pokegama Dam.
Maxima.--April-June 1950: Daily discharge observed, 4,160 cfs May 29; gage height observed, 14.76 ft May 13, affected by backwater.
1941 to March 1950: Discharge, 12,500 cfs Sept. 3, 1948 (gage height, 15.2 ft, from floodmark) caused by dam failure, from rating curve extended above 4,500 cfs by logarithmic plotting.
Remarks.--Flow completely regulated by Pokegama Reservoir (see p.821). Records for Prairie River (unpublished) and Pokegama Dam furnished by Corps of Engineers.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	1,900	1,330	4,050	11	1,600	2,960	378	21	2,200	2,950	2,370
2	1,900	1,380	4,060	12	1,500	3,430	766	22	2,200	2,900	2,490
3	1,800	1,590	3,980	13	1,400	4,060	732	23	850	2,880	2,430
4	1,900	1,700	3,910	14	1,400	3,820	766	24	800	2,810	2,430
5	1,900	1,710	4,060	15	1,300	3,720	1,440	25	750	2,640	2,250
6	1,900	1,810	4,070	16	1,300	3,640	2,310	26	568	2,640	2,250
7	1,800	1,800	4,000	17	1,500	3,490	2,310	27	600	3,450	2,370
8	1,800	1,790	3,880	18	1,600	3,320	2,190	28	766	4,150	2,550
9	1,800	1,810	2,800	19	2,000	3,150	2,130	29	1,100	4,160	3,150
10	1,700	2,090	889	20	2,200	3,030	2,430	30	1,160	4,080	3,000
								31	-	4,040	-
Monthly mean discharge, in cfs									1,506	2,849	2,548
Runoff, in acre-feet									89,610	175,200	151,600
Runoff, in inches									0.50	0.97	0.84

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 5			May 15			May 26			June 4	
6	7.47	1,620	8	13.87	3,730	6	8.88	2,500	6	9.63	3,850
N	7.80	1,700	4	13.72	3,720	N	8.89	2,580	N	9.66	3,890
6	8.22	1,810	12	13.54	3,690	6	8.91	2,690	6	9.70	3,960
12	8.73	1,780		May 16		12	9.34	3,080	12	9.71	4,030
	May 6		8	13.38	3,660		May 27			June 5	
6	9.13	1,860	4	13.23	3,640	6	9.64	3,400	6	9.68	4,070
N	9.22	1,810	12	13.00	3,580	N	9.63	3,450	N	9.63	4,070
6	9.26	1,790		May 17		6	9.62	3,480	6	9.60	4,050
12	9.34	1,810	8	12.72	3,500	12	10.03	3,860	12	9.62	4,070
	May 7		4	12.52	3,460		May 28			June 6	
6	9.44	1,830	12	12.37	3,420	6	10.39	4,190	6	9.65	4,100
N	9.44	1,810		May 18		N	10.40	4,210	N	9.65	4,080
6	9.44	1,780	8	12.20	3,360	6	10.40	4,190	6	9.63	4,060
12	9.47	1,750	4	11.91	3,250	12	10.41	4,190	12	9.60	4,030
	May 8		12	11.77	3,250		May 29			June 7	
8	9.60	1,760		May 19		6	10.42	4,180	6	9.56	3,990
4	9.86	1,820	8	11.60	3,210	N	10.41	4,160	N	9.56	3,990
12	10.13	1,810	4	11.32	3,070	6	10.40	4,140	6	9.58	4,010
	May 9		12	11.22	3,070	12	10.39	4,130	12	9.60	4,030
8	10.40	1,800		May 20			May 30			June 8	
4	10.67	1,800	8	11.12	3,040	6	10.38	4,110	6	9.55	3,970
12	10.95	1,830	4	10.98	3,010	N	10.37	4,080	N	9.53	3,900
	May 10		12	10.91	3,020	6	10.33	4,060	6	9.50	3,810
8	11.27	1,930		May 21		12	10.32	4,050	12	9.44	3,670
4	11.68	2,130	8	10.84	3,030		May 31			June 9	
12	12.44	2,580	4	10.52	2,880	6	10.31	4,050	6	9.29	3,430
	May 11		12	10.33	2,840	N	10.27	4,020	N	8.80	2,990
8	13.03	2,940		May 22		6	10.25	4,010	6	7.62	2,210
4	13.32	3,100	8	10.23	2,870	12	10.33	4,120	12	6.27	1,480
12	13.54	3,100	4	10.20	2,950		June 1			June 10	
	May 12		12	10.09	2,940	N	10.42	4,220	6	5.13	868
6	13.64	3,140		May 23		N	10.19	4,050	N	4.97	861
N	13.83	3,280	8	9.93	2,900	6	10.00	3,920	6	4.73	786
6	14.35	3,720	4	9.82	2,860	12	10.01	3,960	12	4.29	600
12	14.67	4,050	12	9.71	2,820		June 2			June 11	
	May 13			May 24		6	10.05	4,020	6	3.81	392
6	14.76	4,320	8	9.63	2,800	N	10.07	4,070	N	3.62	343
N	14.42	4,040	4	9.55	2,800	6	10.05	4,100	6	3.54	303
6	14.22	3,890	12	9.48	2,840	12	10.01	4,110	12	3.63	343
12	14.23	3,900		May 25			June 3				
	May 14		6	9.38	2,830	6	9.89	4,040			
8	14.20	3,870	N	8.93	2,590	N	9.77	3,960			
4	14.06	3,780	6	8.85	2,490	6	9.69	3,910			
12	13.98	3,750	12	8.85	2,480	12	9.67	3,880			

Mississippi River below Sandy River, near Libby, Minn.

Location.--Lat 46°47', long. 93°20', in sec. 25, T. 50 N., R. 24 W., 600 ft downstream from Sandy River and three-quarters of a mile northwest of Libby. Datum of gage is 1,204.55 ft above mean sea level, adjustment of 1912.
Drainage area.--5,060 sq mi.
Gage-height record.--Water-stage recorder graph except periods, 8:25 a.m. Apr. 7 to 1 p.m. Apr. 14, 5 a.m. Apr. 25 to 6:30 a.m. May 2, 8 p.m. May 7 to 4 p.m. June 28, for which once or twice-daily staff-gage readings were obtained, and Apr. 8-11, 13, 25-27, May 8, 10, 12, June 27, when no gage readings were obtained. Graph was drawn for period May 9 to June 14, based on once or twice-daily staff-gage readings.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1 to May 3. Discharge for periods of no gage-height record computed on basis of records for stations at Grand Rapids and Aitkin. Gage heights used to hundredths.
Maxima.--April-June 1950: Discharge observed, 16,000 cfs 5:30 a.m. May 17 (gage height, 20.02 ft).
1930 to March 1950: Discharge, 8,060 cfs Apr. 28, 1948 (gage height, 15.70 ft).
Remarks.--Flow regulated by power plants and Winnibigoshish, Leech Lake, Pokegama, and Sandy Lake Reservoirs. No diversions.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	2,000	6,000	9,690	11	2,000	13,400	7,320	21	3,800	14,000	4,160
2	2,000	6,000	9,560	12	2,000	14,200	6,700	22	4,400	13,400	4,250
3	2,000	6,500	9,370	13	2,000	15,000	5,770	23	4,800	12,900	4,290
4	2,000	6,820	9,140	14	2,200	15,600	4,650	24	5,000	12,300	4,290
5	2,000	7,220	8,900	15	2,200	15,800	4,280	25	5,500	11,800	4,350
6	2,000	8,090	8,660	16	2,600	15,900	4,310	26	6,000	11,300	4,330
7	2,000	9,210	8,430	17	2,600	15,900	4,530	27	6,000	10,900	3,850
8	2,000	9,730	8,200	18	2,600	15,600	4,740	28	6,000	10,400	3,420
9	2,000	11,800	7,950	19	2,800	15,200	4,600	29	6,000	10,100	3,420
10	2,000	12,700	7,690	20	3,200	14,600	4,190	30	6,000	9,960	3,580
								31	-	9,820	-
Monthly mean discharge, in cfs									3,257	11,680	5,954
Runoff, in acre-feet									193,800	718,200	354,300
Runoff, in inches									0.72	2.66	1.31

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 9			May 20			May 29			June 7	
8	18.16	11,600	8	19.52	14,700	8	17.28	10,100	8	15.88	8,470
4	18.42	12,100	4	19.44	14,500	4	17.24	10,100	4	15.79	8,380
12	18.57	12,400	12	19.35	14,300	12	17.21	10,000	12	15.72	8,320
	May 11			May 21			May 30			June 8	
8	18.93	13,300	8	19.27	14,100	8	17.17	10,000	8	15.63	8,240
4	18.99	13,400	4	19.20	13,900	4	17.14	9,930	4	15.53	8,150
12	19.10	13,700	12	19.12	13,700	12	17.12	9,900	12	15.45	8,080
	May 13			May 22			May 31			June 9	
8	19.62	15,000	8	19.04	13,500	8	17.07	9,830	8	15.35	7,990
4	19.64	15,000	4	18.98	13,400	4	17.04	9,790	4	15.25	7,910
12	19.80	15,400	12	18.90	13,200	12	17.02	9,760	12	15.14	7,820
	May 14			May 23			June 1			June 10	
8	19.85	15,600	8	18.81	13,000	8	16.98	9,700	8	15.03	7,730
4	19.85	15,600	4	18.72	12,800	4	16.95	9,660	4	14.94	7,670
12	19.88	15,600	12	18.64	12,600	12	16.93	9,640	12	14.76	7,540
	May 15			May 24			June 2			June 11	
8	19.95	15,800	8	18.57	12,400	8	16.90	9,600	8	14.57	7,410
4	19.98	15,900	4	18.48	12,200	4	16.84	9,520	4	14.36	7,260
12	19.98	15,900	12	18.39	12,100	12	16.78	9,450	12	14.05	7,040
	May 16			May 25			June 3			June 12	
8	19.99	15,900	8	18.30	11,900	8	16.73	9,390	8	13.70	6,820
4	20.00	15,900	4	18.23	11,700	4	16.70	9,350	4	13.37	6,600
12	20.01	16,000	12	18.15	11,600	12	16.64	9,280	12	12.95	6,330
	May 17			May 26			June 4			June 13	
8	20.02	16,000	8	18.03	11,400	8	16.53	9,150	8	12.38	5,960
4	19.99	15,900	4	17.95	11,200	4	16.48	9,100	4	11.75	5,550
12	19.96	15,800	12	17.86	11,100	12	16.42	9,030	12	11.33	5,270
	May 18			May 27			June 5			June 14	
8	19.91	15,700	8	17.78	10,900	8	16.32	8,920	8	10.93	5,010
4	19.86	15,600	4	17.72	10,800	4	16.26	8,860	4	9.70	4,240
12	19.79	15,400	12	17.63	10,700	12	16.20	8,790	12	9.60	4,180
	May 19			May 28			June 6				
8	19.73	15,200	8	17.54	10,500	8	16.09	8,680			
4	19.68	15,100	4	17.45	10,400	4	16.03	8,620			
12	19.61	14,900	12	17.35	10,200	12	15.96	8,550			

Mississippi River at Aitkin, Minn.

Location.--Lat 46°32'30", long. 93°42'20", in W½ sec. 24, T. 47 N., R. 27 W., at highway bridge at north edge of Aitkin. Datum of gage is 1,185.72 ft above mean sea level, adjustment of 1912.
Drainage area.--6,140 sq mi.
Gage-height record.--Graph drawn on basis of twice-daily gage readings Apr. 15 to June 22. Average of once or twice-daily readings used Apr. 1-14, June 23-30.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-22.
Maxima.--April-June 1950: Discharge, 20,000 cfs 4-12 p.m. May 20 (gage height, 19.49 ft, from graph based on gage readings).
1945 to March 1950: Discharge, 12,000 cfs Apr. 27, 28, 1948 (gage height, 15.77 ft).
Remarks.--Flow partly regulated by Government reservoirs (see "Remarks" for station near Libby on preceding page). Gage-height record furnished by Corps of Engineers.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	2,000	10,500	12,300	11	2,200	14,300	9,320	21	7,500	19,800	4,890
2	2,000	10,600	11,800	12	2,200	15,500	9,060	22	8,000	19,600	4,820
3	2,000	10,800	11,400	13	2,200	16,600	8,800	23	9,820	19,100	4,810
4	2,200	10,600	11,300	14	2,200	17,700	8,220	24	10,300	18,800	4,810
5	2,200	10,800	10,800	15	2,400	18,300	7,310	25	10,600	18,200	4,860
6	2,200	11,400	10,500	16	2,600	18,900	6,480	26	10,600	17,400	4,980
7	2,200	11,700	10,300	17	3,600	19,400	5,870	27	10,400	16,400	5,040
8	2,200	12,000	10,100	18	4,800	19,700	5,550	28	10,400	15,600	4,860
9	2,200	12,600	9,870	19	6,000	19,800	5,380	29	10,400	14,600	4,540
10	2,200	13,300	9,620	20	6,500	19,900	5,140	30	10,400	13,700	4,260
								31	-	13,100	-
Monthly mean discharge, in cfs									5,151	15,510	7,566
Runoff, in acre-feet									306,500	953,700	450,200
Runoff, in inches									0.94	2.91	1.37

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 15			Apr. 26			May 7			May 18	
8	7.45		8	15.60	10,700	8	16.17	11,700	8	19.39	19,700
4	7.56		4	15.57	10,600	4	16.18	11,700	4	19.41	19,800
12	7.68		12	15.51	10,500	12	16.21	11,800	12	19.42	19,800
	Apr. 16			Apr. 27			May 8			May 19	
8	7.84		8	15.45	10,400	8	16.26	11,900	8	19.42	19,800
4	7.99		4	15.43	10,400	4	16.31	12,000	4	19.43	19,800
12	8.18		12	15.42	10,400	12	16.39	12,200	12	19.43	19,800
	Apr. 17			Apr. 28			May 9			May 20	
8	8.54		8	15.41	10,400	8	16.50	12,400	8	19.46	19,900
4	9.20		4	15.41	10,400	4	16.64	12,700	4	19.49	20,000
12	9.90		12	15.39	10,400	12	16.73	12,900	12	19.49	20,000
	Apr. 18			Apr. 29			May 10			May 21	
8	10.55		8	15.38	10,300	8	16.83	13,200	8	19.46	19,900
4	11.13		4	15.41	10,400	4	16.95	13,400	4	19.40	19,700
12	11.60		12	15.43	10,400	12	17.07	13,700	12	19.39	19,700
	Apr. 19			Apr. 30			May 11			May 22	
8	12.00		8	15.45	10,400	8	17.23	14,100	8	19.37	19,700
4	12.33		4	15.46	10,500	4	17.39	14,500	4	19.33	19,600
12	12.59		12	15.47	10,500	12	17.55	14,900	12	19.27	19,400
	Apr. 20			May 1			May 12			May 23	
8	12.66		8	15.48	10,500	8	17.69	15,300	8	19.21	19,200
4	12.94		4	15.48	10,500	4	17.85	15,700	4	19.11	19,000
12	13.24		12	15.49	10,500	12	17.98	16,000	12	19.09	18,900
	Apr. 21			May 2			May 13			May 24	
8	13.50		8	15.52	10,600	8	18.12	16,400	8	19.08	18,900
4	13.76		4	15.57	10,600	4	18.29	16,800	4	19.03	18,700
12	14.00		12	15.63	10,700	12	18.49	17,300	12	18.96	18,600
	Apr. 22			May 3			May 14			May 25	
8	14.30		8	15.66	10,800	8	18.59	17,600	8	18.87	18,300
4	14.60		4	15.66	10,800	4	18.68	17,800	4	18.79	18,100
12	14.84		12	15.63	10,700	12	18.78	18,100	12	18.71	17,900
	Apr. 23			May 4			May 15			May 26	
8	14.98	9,760	8	15.58	10,700	8	18.81	18,100	8	18.61	17,600
4	15.08	9,900	4	15.54	10,600	4	18.90	18,400	4	18.47	17,300
12	15.18	10,000	12	15.55	10,600	12	19.01	18,700	12	18.33	16,900
	Apr. 24			May 5			May 16			May 27	
8	15.33	10,300	8	15.61	10,700	8	19.05	18,800	8	18.21	16,600
4	15.43	10,400	4	15.68	10,800	4	19.11	19,000	4	18.10	16,300
12	15.50	10,500	12	15.81	11,000	12	19.19	19,200	12	18.00	16,000
	Apr. 25			May 6			May 17			May 28	
8	15.55	10,600	8	15.98	11,400	8	19.25	19,300	8	17.88	15,700
4	15.57	10,600	4	16.07	11,500	4	19.31	19,500	4	17.76	15,400
12	15.60	10,700	12	16.12	11,600	12	19.36	19,600	12	17.63	15,100

Mississippi River at Aitkin, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 29			June 4			June 10			June 16	
8	17.51	14,800	8	15.98	11,400	8	14.91	9,670	8	11.00	6,630
4	17.38	14,500	4	15.87	11,200	4	14.81	9,540	4	10.55	6,340
12	17.25	14,200	12	15.80	11,000	12	14.78	9,510	12	10.25	6,150
	May 30			June 5			June 11			June 17	
8	17.12	13,800	8	15.73	10,900	8	14.70	9,410	8	10.00	6,000
4	17.02	13,600	4	15.68	10,800	4	14.54	9,230	4	9.55	5,730
12	16.93	13,400	12	15.60	10,700	12	14.44	9,130	12	9.38	5,630
	May 31			June 6			June 12			June 18	
8	16.84	13,200	8	15.50	10,500	8	14.40	9,090	8	9.30	5,580
4	16.75	13,000	4	15.45	10,400	4	14.37	9,060	4	9.22	5,530
12	16.60	12,600	12	15.42	10,400	12	14.26	8,960	12	9.12	5,470
	June 1			June 7			June 13			June 19	
8	16.43	12,300	8	15.40	10,400	8	14.10	8,830	8	9.00	5,400
4	16.39	12,200	4	15.34	10,300	4	14.02	8,770	4	8.91	5,350
12	16.32	12,000	12	15.30	10,200	12	13.82	8,620	12	8.88	5,330
	June 2			June 8			June 14			June 20	
8	16.24	11,900	8	15.25	10,100	8	13.52	8,390	8	8.80	5,280
4	16.19	11,800	4	15.21	10,100	4	13.10	8,080	4	8.36	5,020
12	16.11	11,600	12	15.14	9,990	12	12.72	7,790	12	8.20	4,920
	June 3			June 9			June 15			June 21	
8	16.03	11,400	8	15.08	9,000	8	12.40	7,560	8	8.20	4,920
4	15.99	11,400	4	15.03	9,830	4	11.70	7,080	4	8.12	4,880
12	16.00	11,400	12	14.99	9,780	12	11.28	6,810	12	8.06	4,840
										June 22	
									8	8.04	4,830
									4	8.01	4,820
									12	8.00	4,810

Mississippi River near Royalton, Minn.

Location.--Lat 45°52', long. 94°22', in lot 2, sec. 20, T. 39 N., R. 32 W., at plant of Minnesota Power & Light Co., 5 miles northwest of Royalton and 5 miles downstream from Swan River.
Drainage area.--11,600 sq mi.
Gage-height record.--Headwater and tailwater gages read hourly.
Discharge record.--Discharge computed from power-plant records by Minnesota Power & Light Co. and checked occasionally by discharge measurements.
Maxima.--April-June 1950: Daily discharge, 28,000 cfs May 9.
1924 to March 1950: Daily discharge, 24,000 cfs Apr. 5, 1943.
Remarks.--No Diversions. Flow regulated by Government reservoirs on headwaters. Records collected by Minnesota Power & Light Co.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	4,480	18,200	21,500	11	6,490	26,600	13,500	21	23,200	27,200	8,610
2	4,430	17,300	20,500	12	6,070	26,300	13,300	22	21,000	27,000	8,180
3	4,440	17,300	19,600	13	5,520	26,900	13,100	23	19,600	26,900	8,340
4	5,360	18,300	18,900	14	5,640	27,000	12,600	24	18,900	26,500	7,260
5	5,420	19,700	18,000	15	5,900	27,200	12,200	25	19,000	26,200	5,980
6	5,800	21,800	17,700	16	7,130	27,200	11,700	26	19,500	25,900	6,360
7	6,510	22,800	15,600	17	9,330	27,000	10,600	27	19,400	24,800	7,780
8	6,280	24,800	15,100	18	13,800	26,800	9,590	28	19,200	24,400	7,090
9	6,500	28,000	14,600	19	19,800	26,900	8,820	29	18,900	23,800	6,700
10	6,440	26,900	14,400	20	21,900	27,200	8,840	30	18,500	23,400	6,780
								31	-	22,300	-
Monthly mean discharge, in cfs									11,820	24,600	12,110
Runoff, in thousands of acre-feet									703.3	1,513	720.6
Runoff, in inches									1.14	2.44	1.16

Mississippi River at Elk River, Minn.

Location.--Lat 45°18', long. 93°34', in SE¼ sec. 34, T. 33 N., R. 26 W., fourth principal meridian, in town of Elk River, 2,500 ft downstream from Elk River. Datum of gage is 847.92 ft above mean sea level, adjustment of 1912.
Drainage area.--14,500 sq mi.
Gage-height record.--Water-stage recorder graph.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-16. Gage heights used to hundredths.
Maxima.--April-June 1950: Discharge, 39,000 cfs 3 p.m. May 10 (gage height, 13.00 ft).
1915 to March 1950: Discharge, 37,700 cfs Apr. 6, 1943 (gage height, 12.63 ft).
Remarks.--Flow partly regulated by six Government reservoirs on headwaters; total usable capacity, 1,640,610 acre-ft; total normal operating capacity, 948,900 acre-ft. No diversion.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	11,000	24,400	26,900	11	13,000	38,100	17,200	21	32,000	34,000	10,900
2	13,000	23,900	26,200	12	13,000	37,200	16,400	22	33,700	34,000	10,800
3	14,000	23,300	25,300	13	12,000	36,100	16,300	23	30,500	34,000	10,400
4	15,000	23,200	23,900	14	12,000	35,900	15,900	24	27,600	33,700	10,600
5	16,000	25,900	22,100	15	12,000	35,400	15,400	25	26,800	33,200	9,490
6	15,000	29,100	21,500	16	13,000	35,200	14,900	26	26,600	32,300	8,010
7	14,000	31,100	20,800	17	14,700	34,900	14,700	27	26,200	31,700	8,550
8	13,000	33,200	18,900	18	17,300	34,300	13,800	28	25,900	31,300	10,100
9	12,000	37,200	18,400	19	23,000	33,800	10,000	29	25,400	30,000	9,240
10	13,000	38,800	17,500	20	28,800	33,700	10,800	30	25,000	29,300	8,490
								31	-	28,400	-
Monthly mean discharge, in cfs									19,150	32,150	15,450
Runoff, in thousands of acre-feet									1,140	1,977	919.3
Runoff, in inches									1.47	2.56	1.19

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 18			Apr. 24 (Con.)			May 3			May 10 (Con.)	
4	7.82	16,300	N	10.60	27,600	6	9.70	23,600	12	12.94	38,700
8	8.06	17,200	4	10.54	27,300	N	9.62	23,300		May 11	
N	8.18	17,600	8	10.43	26,800	6	9.53	22,900	2	12.93	38,700
4	8.25	17,800	12	10.39	26,600	12	9.45	22,600	4	12.90	38,500
8	8.33	18,100		Apr. 25			May 4		6	12.88	38,400
12	8.49	19,700	6	10.44	26,800	6	9.47	22,600	8	12.87	38,400
	Apr. 19		N	10.48	27,000	N	9.60	23,200	10	12.87	37,300
4	8.90	20,300	6	10.45	26,900	6	9.68	23,500	N	12.85	37,300
8	9.35	22,100	12	10.41	26,700	12	9.80	24,000	2	12.72	37,600
N	9.68	23,500		Apr. 26			May 5		4	12.68	37,400
4	9.91	24,500	6	10.42	26,800	6	10.08	25,300	6	12.67	37,400
8	10.10	25,300	N	10.44	26,800	N	10.32	26,300	8	12.68	37,400
12	10.31	26,300	6	10.35	26,400	6	10.37	26,800	10	12.76	37,800
	Apr. 20		12	10.26	26,000	12	10.57	27,400	12	12.76	37,800
4	10.45	26,900		Apr. 27			May 6			May 12	
8	10.61	27,600	6	10.25	26,000	6	10.81	28,500	4	12.71	37,600
N	10.88	28,880	N	10.30	26,200	N	11.01	29,400	8	12.67	37,400
4	11.16	30,100	6	10.30	26,200	6	11.08	29,700	N	12.64	37,200
8	11.29	30,700	12	10.29	26,100	12	11.18	30,200	4	12.61	37,100
12	11.32	30,800		Apr. 28			May 7		8	12.56	36,800
	Apr. 21		6	10.26	26,000	6	11.28	30,700	12	12.51	36,600
4	11.34	30,900	N	10.23	25,900	N	11.38	31,100		May 13	
8	11.44	31,400	6	10.19	25,700	6	11.46	31,500	4	12.48	36,500
N	11.57	32,000	12	10.16	25,600	12	11.51	31,700	8	12.45	36,300
4	11.69	32,600		Apr. 29			May 8		N	12.35	35,800
8	11.77	33,000	6	10.13	25,500	4	11.58	32,100	4	12.37	35,900
12	11.88	33,500	N	10.12	25,400	8	11.67	32,500	8	12.39	36,000
	Apr. 22		6	10.10	25,300	N	11.73	32,800	12	12.39	36,000
4	11.98	34,000	12	10.11	25,400	4	11.91	33,700		May 14	
8	12.03	34,200		Apr. 30		8	12.07	34,400	4	12.39	36,000
N	12.00	34,100	6	10.05	25,100	12	12.38	36,000	8	12.38	36,000
4	11.92	33,700	N	10.04	25,100		May 9		N	12.37	35,900
8	11.78	33,000	6	10.00	24,900	4	12.45	36,300	4	12.37	35,900
12	11.66	32,500	12	9.98	24,800	8	12.53	36,700	8	12.35	35,800
	Apr. 23			May 1		N	12.66	37,300	12	12.31	35,600
4	11.54	31,900	6	9.94	24,600	4	12.75	37,800		May 15	
8	11.39	31,200	N	9.93	24,600	8	12.80	38,000	4	12.30	35,600
N	11.24	30,500	6	9.85	24,200	12	12.86	38,300	8	12.28	35,500
4	11.10	29,800	12	9.76	23,900		May 10		N	12.27	35,400
8	10.97	29,200		May 2		4	12.92	38,600	4	12.25	35,300
12	10.87	28,800	6	9.74	23,800	8	12.95	38,800	8	12.24	35,300
	Apr. 24		N	9.77	23,900	N	12.98	38,900	12	12.23	35,200
4	10.78	28,400	6	9.80	24,000	4	12.98	38,900		May 16	
8	10.68	27,900	12	9.76	23,900	8	12.97	38,800	4	12.23	35,200

Mississippi River at Elk River, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 16 (Con.)			May 23 (Con.)			May 31			June 8	
8	12.23	35,200	N	12.01	34,100	6	10.85	28,700	6	8.62	19,200
N	12.22	35,200	6	11.99	34,100	N	10.80	28,500	N	8.54	18,900
4	12.23	35,200	12	11.94	33,800	6	10.71	28,100	6	8.47	18,600
8	12.25	35,300		May 24		12	10.51	27,200	12	8.47	18,600
12	12.24	35,300	6	11.92	33,700		June 1			June 9	
	May 17		N	11.91	33,700	6	10.48	27,000	6	8.46	18,600
4	12.24	35,300	6	11.89	33,600	N	10.49	27,100	N	8.45	18,600
8	12.21	35,100	12	11.89	33,600	6	10.44	26,800	6	8.37	18,300
N	12.11	34,600		May 25		12	10.40	26,700	12	8.23	17,700
4	12.12	34,700	6	11.83	33,300		June 2			June 10	
8	12.12	34,700	N	11.81	33,200	6	10.33	26,400	6	8.20	17,600
12	12.11	34,600	6	11.77	33,000	N	10.28	26,100	N	8.17	17,500
	May 18		12	11.74	32,800	6	10.23	25,900	6	8.14	17,400
6	12.09	34,500		May 26		12	10.18	25,700	12	8.11	17,300
N	12.06	34,400	6	11.67	32,500		June 3			June 11	
6	11.99	34,100	N	11.63	32,300	6	10.10	25,300	6	8.10	17,300
12	11.95	33,800	6	11.59	32,100	N	10.12	25,400	N	8.09	17,300
	May 19		12	11.56	32,000	6	10.04	25,100	6	8.04	17,100
6	11.93	33,800		May 27		12	9.99	24,900	12	7.91	16,600
N	11.93	33,800	6	11.54	31,900		June 4			June 12	
6	11.95	33,800	N	11.51	31,700	6	9.93	24,600	6	7.86	16,500
12	11.92	33,700	6	11.46	31,500	N	9.74	23,800	N	7.83	16,400
	May 20		12	11.43	31,400	6	9.63	23,300	6	7.82	16,300
6	11.91	33,700		May 28		12	9.46	22,600	12	7.83	16,400
N	11.92	33,700	6	11.36	31,000		June 5			June 13	
6	11.92	33,700	N	11.30	30,800	6	9.40	22,300	6	7.80	16,300
12	11.95	33,800	6	11.24	30,400	N	9.36	22,200	N	7.82	16,300
	May 21		12	11.20	30,300	6	9.24	21,700	6	7.81	16,300
6	11.97	34,000		May 29		12	9.23	21,600	12	7.74	16,100
N	11.98	34,000	6	11.15	30,000		June 6			June 14	
6	12.00	34,100	N	11.13	30,000	6	9.25	21,700	6	7.72	16,000
12	12.00	34,100	6	11.10	29,800	N	9.22	21,600	N	7.72	16,000
	May 22		12	11.07	29,700	6	9.15	21,300	6	7.67	15,800
6	11.99	34,100		May 30		12	9.14	21,300	12	7.60	15,600
N	11.99	34,100	6	11.00	29,400		June 7			June 15	
6	11.98	34,000	N	10.98	29,300	6	9.10	21,100	6	7.57	15,500
12	11.99	34,100	6	10.94	29,100	N	9.09	21,100	N	7.58	15,500
	May 23		12	10.91	29,000	6	8.99	20,700	6	7.51	15,300
6	11.98	34,000				12	8.71	19,600	12	7.47	15,200

Mississippi River near Anoka, Minn.

Location.--Lat 45°07'36", long. 93°17'48", in SW¼ sec. 12, T. 119 N., R. 21 W., half a mile downstream from Coon Creek, 1½ miles downstream from hydro-electric plant of Northern States Power Co. at Coon Rapids, and 6½ miles downstream from Anoka. Datum of gage is 805.02 ft above mean sea level, adjustment of 1912.
Drainage area.--19,100 sq mi.
Gage-height record.--Water-stage recorder graph except period 11 a.m. Apr. 12 to 2:15 p.m. Apr. 13, for which partly estimated graph was drawn.
Stage-discharge relation.--Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-7. Gage heights used to hundredths.
Maxima.--April-June 1950: Discharge, 50,700 cfs noon May 11 (gage height, 13.82 ft).
1931 to March 1950: Discharge, 47,000 cfs Apr. 6, 1943 (gage height, 14.11 ft).
Remarks.--Flow partly regulated by six Government reservoirs on headwaters and by power plants above station. No diversion above station.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	14,000	28,200	30,700	11	20,000	50,300	18,800	21	36,600	39,600	11,500
2	16,000	27,500	29,700	12	19,000	49,200	17,800	22	39,100	39,600	10,800
3	19,000	27,100	28,700	13	18,200	47,300	17,600	23	37,000	39,400	10,700
4	19,000	26,500	27,200	14	17,800	46,000	17,000	24	33,700	38,900	11,000
5	20,000	29,300	25,000	15	18,300	44,600	16,300	25	32,400	38,300	10,400
6	22,000	33,400	24,100	16	20,600	43,300	15,700	26	31,800	37,400	8,700
7	24,000	36,800	23,400	17	20,200	42,500	15,200	27	30,700	36,600	9,000
8	21,100	39,400	21,200	18	22,100	41,200	15,000	28	30,300	35,700	10,400
9	20,000	45,100	20,400	19	27,000	40,000	10,900	29	29,500	34,700	9,840
10	20,200	49,400	19,300	20	33,000	39,500	11,400	30	29,000	33,700	9,090
								31	-	32,700	-
Monthly mean discharge, in cfs									24,720	38,490	16,890
Runoff, in thousands of acre-feet									1,471	2,367	1,005
Runoff, in inches									1.44	2.32	0.99

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 15			Apr. 18 (Con.)			Apr. 21 (Con.)			Apr. 25 (Con.)	
2	6.89	17,800	N	7.96	22,400	10	11.28	37,800	6	10.12	32,300
4	6.80	17,500	2	8.11	23,100	12	11.31	38,000	8	10.15	32,400
6	6.71	17,100	4	8.11	23,100		Apr. 22		10	10.15	32,400
8	6.58	16,500	6	8.11	23,100	2	11.38	38,300	N	10.16	32,500
10	6.59	16,600	8	8.13	23,200	4	11.45	38,700	2	10.17	32,500
N	6.60	16,600	10	8.14	23,200	6	11.50	38,900	4	10.18	32,600
2	6.65	16,800	12	8.21	23,500	8	11.55	39,200	6	10.18	32,600
4	6.93	18,000		Apr. 19		10	11.62	39,500	8	10.16	32,500
6	7.56	20,700	2	8.25	23,700	N	11.65	39,600	10	10.15	32,400
8	7.94	22,300	4	8.33	24,100	2	11.62	39,500	12	10.10	32,200
10	7.41	20,000	6	8.45	24,600	4	11.66	39,700		Apr. 26	
12	7.67	21,100	8	8.67	25,600	6	11.64	39,600	2	10.07	32,000
	Apr. 16		10	8.86	26,500	8	11.57	39,200	4	10.06	32,000
2	7.58	20,800	N	9.01	27,100	10	11.53	39,000	6	10.02	31,800
4	7.59	20,800	2	9.25	28,200	12	11.44	38,600	8	10.03	31,800
6	7.51	20,400	4	9.33	28,600		Apr. 23		10	10.08	32,100
8	7.55	20,600	6	9.37	28,800	2	11.35	38,200	N	10.04	31,900
10	7.58	20,800	8	9.52	29,500	4	11.35	38,200	2	10.02	31,800
N	7.74	21,500	10	9.67	30,200	6	11.32	38,000	4	10.02	31,800
2	7.72	21,400	12	9.72	30,400	8	11.25	37,700	6	10.02	31,800
4	7.71	21,300		Apr. 20		10	11.16	37,300	8	10.01	31,700
6	7.56	20,700	2	9.83	30,900	N	11.12	37,100	10	9.95	31,500
8	7.31	19,600	4	9.89	31,200	2	11.11	37,000	12	9.89	31,200
10	7.23	19,300	6	10.02	31,800	4	10.97	36,400		Apr. 27	
12	7.35	19,800	8	10.08	32,100	6	10.93	36,200	2	9.84	31,000
	Apr. 17		10	10.15	32,400	8	10.83	35,700	4	9.81	30,800
2	7.39	19,900	N	10.23	32,800	10	10.79	35,500	6	9.78	30,700
4	7.37	19,900	2	10.30	33,100	12	10.69	35,000	8	9.77	30,600
6	7.35	19,800	4	10.45	33,900		Apr. 24		10	9.77	30,600
8	7.34	19,700	6	10.59	34,500	2	10.63	34,700	N	9.77	30,600
10	7.36	19,800	8	10.68	35,000	4	10.61	34,600	2	9.78	30,700
N	7.42	20,100	10	10.79	35,500	6	10.54	34,300	4	9.78	30,700
2	7.53	20,500	12	10.90	36,000	8	10.52	34,200	6	9.78	30,700
4	7.57	20,700		Apr. 21		10	10.46	33,900	8	9.78	30,700
6	7.59	20,800	2	10.91	36,100	N	10.40	33,600	10	9.78	30,700
8	7.52	20,500	4	10.91	36,100	2	10.38	33,500	12	9.77	30,600
10	7.50	20,400	6	10.91	36,100	4	10.36	33,400		Apr. 28	
12	7.49	20,400	8	10.92	36,100	6	10.31	33,200	2	9.77	30,600
	Apr. 18		10	10.92	36,100	8	10.29	33,100	4	9.75	30,600
2	7.47	20,300	N	10.96	36,300	10	10.23	32,800	6	9.75	30,600
4	7.45	20,200	2	11.01	36,500	12	10.13	32,300	8	9.73	30,500
6	7.59	20,800	4	11.11	37,000		Apr. 25		10	9.68	30,200
8	7.79	21,700	6	11.15	37,200	2	10.12	32,300	N	9.69	30,300
10	7.94	22,300	8	11.21	37,500	4	10.12	32,300	2	9.68	30,200

Mississippi River near Anoka, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 28 (Con.)			May 3 (Con.)			May 8			May 12 (Con.)	
4	9.67	30,200	8	9.08	27,500	2	11.35	38,200	8	13.45	48,700
6	9.65	30,100	10	9.01	27,100	4	11.37	38,300	10	13.42	48,600
8	9.64	30,000	N	9.01	27,100	6	11.39	38,400	12	13.39	48,400
10	9.62	30,000	2	9.00	27,100	8	11.47	38,800		May 13	
12	9.58	28,800	4	8.98	27,000	10	11.50	38,900	4	13.31	48,000
	Apr. 29		6	8.96	26,900	N	11.56	39,200	8	13.24	47,600
2	9.54	29,600	8	8.91	26,700	2	11.61	39,400	N	13.19	47,400
4	9.55	29,600	10	8.88	26,500	4	11.70	39,900	4	13.09	46,900
6	9.54	29,600	12	8.81	26,200	6	11.77	40,200	8	13.02	46,500
8	9.53	29,500		May 4		8	11.85	40,600	12	13.02 44	46,500
10	9.52	29,500	2	8.80	26,200	10	11.96	41,200		May 14	
N	9.52	29,500	4	8.80	26,200	12	12.08	41,800	4	13.01	46,500
2	9.51	29,400	6	8.74	25,900		May 9		8	12.97	46,200
4	9.50	29,400	8	8.76	26,000	2	12.21	42,400	N	12.94	46,100
6	9.50	29,400	10	8.79	26,100	4	12.36	43,200	4	12.89	45,800
8	9.50	29,400	N	8.83	26,300	6	12.50	43,900	8	12.86	45,700
10	9.50	29,400	2	8.87	26,500	8	12.60	44,400	12	12.80	45,400
12	9.48	29,300	4	8.93	26,800	10	12.69	44,800		May 15	
	Apr. 30		6	8.95	26,900	N	12.76	45,200	4	12.74	45,100
2	9.47	29,300	8	8.98	27,000	2	12.86	45,700	8	12.67	44,800
4	9.48	29,300	10	9.02	27,200	4	12.97	46,200	N	12.63	44,600
6	9.48	29,300	12	9.04	27,300	6	13.02	46,500	4	12.58	44,300
8	9.46	29,200		May 5		8	13.08	46,800	8	12.53	44,000
10	9.42	29,000	2	9.05	27,300	10	13.19	47,400	12	12.48	43,800
N	9.42	29,000	4	9.10	27,600	12	13.25	47,700		May 16	
2	9.41	29,000	6	9.16	27,600		May 10		4	12.42	43,500
4	9.40	28,900	8	9.28	28,400	2	13.33	48,100	8	12.38	43,300
6	9.39	28,900	10	9.39	28,900	4	13.37	48,300	N	12.36	43,200
8	9.38	28,800	N	9.52	29,500	6	13.45	48,700	4	12.36	43,200
10	9.33	28,600	2	9.65	30,100	8	13.49	48,900	8	12.37	43,200
12	9.32	28,600	4	9.73	30,500	10	13.56	49,300	12	12.35	43,200
	May 1		6	9.76	30,600	N	13.63	49,700		May 17	
2	9.32	28,600	8	9.81	30,800	2	13.66	49,800	4	12.33	43,000
4	9.31	28,500	10	9.82	30,900	4	13.57	49,400	8	12.28	42,800
6	9.30	28,500	12	9.84	31,000	6	13.72	50,100	N	12.24	42,600
8	9.29	28,400		May 6		8	13.78	50,500	4	12.14	42,100
10	9.26	28,300	2	10.01	31,700	10	13.79	50,500	8	12.09	41,800
N	9.20	28,000	4	10.03	31,800	12	13.79	50,500	12	12.06	41,700
2	9.21	28,100	6	10.13	32,300		May 11			May 18	
4	9.21	28,100	8	10.17	32,500	2	13.78	50,500	4	12.04	41,600
6	9.21	28,100	10	10.26	32,900	4	13.81	50,600	8	11.99	41,400
8	9.21	28,000	N	10.40	33,600	6	13.80	50,600	N	11.96	41,200
10	9.14	27,700	2	10.51	34,100	8	13.80	50,600	4	11.94	41,100
12	9.13	27,700	4	10.56	34,400	10	13.80	50,600	8	11.87	40,800
	May 2		6	10.65	34,800	N	13.82	50,700	12	11.80	40,400
2	9.08	27,500	8	10.67	34,900	2	13.76	50,400		May 19	
4	9.09	27,500	10	10.71	35,100	4	13.76	50,400	4	11.77	40,200
6	9.08	27,500	12	10.77	35,400	6	13.72	50,100	8	11.73	40,000
8	9.06	27,400		May 7		8	13.66	49,800	N	11.72	40,000
10	9.02	27,200	2	10.80	35,500	10	13.59	49,500	4	11.73	40,000
N	9.07	27,400	4	10.90	36,000	12	13.57	49,400	8	11.70	39,900
2	9.08	27,500	6	10.91	36,100		May 12		12	11.67	39,800
4	9.08	27,500	8	10.98	36,400	2	13.58	49,400		May 20	
6	9.10	27,600	10	11.01	36,500	4	13.60	49,500	4	11.66	39,700
8	9.10	27,600	N	11.09	36,900	6	13.61	49,600	8	11.61	39,400
10	9.09	27,500	2	11.13	37,100	8	13.61	49,600	N	11.59	39,400
12	9.15	27,800	4	11.15	37,200	10	13.56	49,300	4	11.60	39,400
	May 3		6	11.21	37,500	N	13.55	49,300	8	11.58	39,300
2	9.10	27,600	8	11.28	37,800	2	13.54	49,200	12	11.59	39,400
4	9.10	27,600	10	11.27	37,800	4	13.51	49,100			
6	9.09	27,500	12	11.35	38,200	6	13.49	48,900			

Mississippi River at St. Paul, Minn.

Location.--Lat 44°56'40", long. 93°05'20", in NE¼ sec. 6, T. 28 N., R. 22 W., in St. Paul, 6 miles downstream from Minnesota River. Datum of gage is 684.16 ft above mean sea level, adjustment of 1912. Auxiliary gage in SE¼ sec. 22, T. 28 N., R. 22 W., in South St. Paul, 7 miles downstream, at same datum.
Drainage area.--36,800 sq mi.
Gage-height record.--Water-stage recorder graphs from base and auxiliary gages.
Discharge record.--Stage-fall-discharge relation defined by current-meter measurements was used except for period, June 26-30, when discharge was obtained by taking sum of discharges of Minnesota River near Carver and Mississippi River at Ford Hydro Plant (unpublished). Gage height used to hundredths.
Maxima.--April-June 1950: 53,900 cfs 3 p.m. May 13 (elevation, 697.11 ft).
1887 to March 1950: Discharge, 80,800 cfs Apr. 6, 1897 (elevation, 702.16 ft).
Discharge known, 107,000 cfs Apr. 29, 1881 (elevation, 703.86 ft), determined by Corps of Engineers.
Remarks.--Flow partly regulated by Government reservoirs on headwaters and by power plants. Stage-discharge relation affected by backwater from Hastings Dam most of the time. Records herein do not include diversion averaging about 206 cfs during period, April to June, to sewage-disposal plant, which bypassed station. Gage readings at South St. Paul and on outside staff gage at St. Paul furnished by Corps of Engineers. Discharges of Mississippi River at Ford Hydro Plant furnished by Ford Motor Co.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	22,400	34,700	38,600	11	29,700	52,800	22,000	21	39,700	48,300	12,600
2	26,000	33,800	36,700	12	28,300	53,600	21,400	22	42,300	48,100	12,700
3	28,400	33,400	34,900	13	27,200	53,700	20,500	23	42,800	48,000	12,200
4	30,500	32,600	33,600	14	26,200	53,400	19,600	24	41,000	47,600	11,800
5	32,000	34,800	31,300	15	26,100	52,900	18,900	25	39,700	46,900	11,400
6	32,100	37,500	29,300	16	27,400	52,100	18,100	26	38,700	46,200	10,600
7	33,100	40,300	27,300	17	27,000	51,500	17,700	27	37,800	45,400	10,500
8	32,900	42,700	25,600	18	28,000	50,600	17,000	28	37,100	44,500	10,800
9	31,300	46,300	24,500	19	30,800	49,700	14,600	29	36,100	43,200	11,700
10	30,400	50,200	23,000	20	35,600	48,800	12,300	30	35,700	41,900	10,900
								31	-	40,500	-
Monthly mean discharge, in cfs									32,550	45,350	20,070
Runoff, in thousands of acre-feet									1,937	2,788	1,194
Runoff, in inches									0.99	1.42	0.61

*Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 19			Apr. 27			May 5 (Con.)			May 14	
6	691.91	29,700	8	693.88	38,000	2	693.38	35,700	8	697.04	53,500
N	692.10	30,400	4	693.80	37,600	4	693.44	36,000	4	697.01	53,400
6	692.48	31,900	12	693.75	37,400	6	693.47	36,100	12	696.98	53,200
12	692.78	33,200		Apr. 28		8	693.48	36,200		May 15	
	Apr. 20		8	693.71	37,200	10	693.51	36,300	8	696.94	53,000
6	693.07	34,400	4	693.66	37,000	12	693.55	36,500	4	696.91	52,800
N	693.36	35,700	12	693.58	36,600		May 6		12	696.84	52,400
6	693.60	36,700		Apr. 29		8	693.68	37,100		May 16	
12	693.86	37,900	8	693.49	36,200	4	693.85	37,800	8	696.78	52,100
	Apr. 21		4	693.41	35,900	12	694.06	38,800	4	696.78	52,100
6	694.12	39,000	12	693.44	36,000		May 7		12	696.75	52,000
N	694.28	39,800		Apr. 30		8	694.28	39,800		May 17	
6	694.40	40,400	8	693.39	35,800	4	694.49	40,800	8	696.68	51,600
12	694.56	41,100	4	693.35	35,600	12	694.66	41,600	4	696.64	51,400
	Apr. 22		12	693.26	35,200		May 8		12	696.56	51,000
6	694.70	41,800		May 1		8	694.80	42,200		May 18	
N	694.84	42,400	8	693.18	34,900	4	694.98	43,100	8	696.49	50,600
6	694.94	42,900	4	693.10	34,600	12	695.21	44,200	4	696.48	50,600
12	694.96	43,000	12	693.02	34,200		May 9		12	696.38	50,100
	Apr. 23			May 2		8	695.48	45,600		May 19	
6	694.98	43,100	8	692.94	33,900	4	695.77	47,000	8	696.31	49,800
N	694.95	43,000	4	692.88	33,600	12	696.05	48,400	4	696.28	49,600
6	694.86	42,500	12	692.91	33,700		May 10		12	696.20	49,200
12	694.76	42,100		May 3		8	696.28	49,600		May 20	
	Apr. 24		8	692.88	33,600	4	696.52	50,800	8	696.14	48,600
6	694.64	41,500	4	692.81	33,300	12	696.71	51,800	4	696.08	48,600
N	694.56	41,100	12	692.75	33,100		May 11		12	696.06	48,500
6	694.48	40,700		May 4		8	696.86	52,500		May 21	
12	694.42	40,400	8	692.65	32,600	4	969.98	53,200	8	696.02	48,300
	Apr. 25		4	692.58	32,300	12	697.01	53,400	4	696.02	48,300
6	694.32	40,000	12	692.60	32,400		May 12		12	696.00	48,200
N	694.26	39,700		May 5		8	697.06	53,600		May 22	
6	694.21	39,400	2	692.63	32,600	4	697.09	53,800	8	695.98	48,100
12	694.15	39,200	4	692.65	32,600	12	697.08	53,700	4	695.98	48,100
	Apr. 26		6	692.68	32,800		May 13		12	695.97	48,000
6	694.09	38,900	8	692.85	33,500	8	697.08	53,700		May 23	
N	694.05	38,700	10	693.39	35,800	4	697.10	53,800	8	695.94	47,900
6	694.00	38,500	N	693.38	35,700	12	697.06	53,600	4	695.99	48,200
12	693.96	38,300							12	695.95	48,000

*Gage heights have been converted to elevation above mean sea level.

Mississippi River at Prescott, Wis.

Location.--Lat 44°44'45", long. 92°48'00", in sec. 9, T. 26 N., R. 20 W., at Prescott, 200 ft downstream from St. Croix River. Datum of gage is 600.00 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers). Auxiliary gage in sec. 14, T. 25 N., R. 19 W., half a mile upstream from Diamond Bluff, 2 miles upstream from Trimbelle River, and 10.7 miles downstream from Prescott, at same datum.
Drainage area.--44,800 sq mi.
Gage-height record.--Water-stage recorder graphs from base and auxiliary gages.
Discharge record.--Stage-fall-discharge relation defined by current-meter measurements. Gage height used to hundredths.
Maxima.--April-June 1950: Discharge, 101,000 cfs 12 p.m. May 10 to 2 a.m. May 11 (elevation, 685.21 ft).
1928 to March 1950: Discharge, 87,500 cfs Mar. 23, 1945 (elevation 684.17 ft).
Remarks.--Flow partly regulated by reservoirs, navigation dams, and power plants above statior A small percentage of the flow is diverted into Vermilion Slough, returning to river below Dam 3.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	30,600	55,600	48,300	11	45,300	100,000	28,800	21	74,500	63,800	16,800
2	33,000	53,000	46,800	12	44,500	98,700	27,200	22	79,900	61,800	16,900
3	36,400	51,800	44,500	13	44,100	95,800	27,900	23	81,300	60,200	17,400
4	38,900	49,400	42,100	14	43,200	91,200	26,400	24	80,200	60,400	16,800
5	40,400	49,200	40,000	15	42,000	85,400	24,900	25	78,500	58,900	15,900
6	41,300	54,400	38,100	16	42,000	79,900	24,600	26	75,300	57,000	14,900
7	42,500	64,800	36,000	17	44,800	75,700	23,500	27	71,600	56,600	13,900
8	44,400	79,100	34,600	18	48,400	71,500	27,700	28	67,100	55,600	13,300
9	45,300	93,800	33,000	19	55,400	68,700	21,300	29	62,300	54,200	15,200
10	45,700	99,800	30,400	20	65,600	66,200	18,300	30	58,800	52,700	16,200
								31	-	50,300	-
Monthly mean discharge, in cfs									53,440	68,240	26,720
Runoff, in thousands of acre-feet									3,180	4,196	1,590
Runoff, in inches									1.33	1.76	0.67

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 25			May 4			May 13	
6	80.07	41,500	6	83.79	79,300	6	81.13	49,700	8	84.95	96,500
N	80.10	41,700	N	83.74	78,600	N	81.08	49,300	4	84.87	95,200
6	80.21	42,500	6	83.70	78,000	6	81.01	48,800	12	84.77	93,600
12	80.29	43,000	12	83.62	77,000	12	80.99	48,600		May 14	
	Apr. 17			Apr. 26			May 5		8	84.67	92,100
6	80.42	44,100	6	83.55	76,000	6	81.03	48,900	4	84.56	90,400
N	80.53	44,900	N	83.50	75,400	N	81.13	49,700	12	84.42	88,300
6	80.61	45,600	6	83.43	74,500	6	81.02	48,900		May 15	
12	80.68	46,100	12	83.36	73,600	12	81.27	50,900	8	84.29	86,400
	Apr. 18			Apr. 27			May 6		4	84.16	84,400
6	80.81	47,200	6	83.29	72,700	6	81.49	52,800	12	84.02	82,500
N	80.97	48,500	N	83.20	71,500	N	81.65	54,200		May 16	
6	81.11	49,600	6	83.12	70,500	6	81.83	56,000	8	83.88	80,500
12	81.28	50,900	12	83.03	69,400	12	82.03	58,000	4	83.78	79,100
	Apr. 19			Apr. 28			May 7		12	83.69	77,900
6	81.57	53,500	6	82.93	68,200	6	82.37	61,700		May 17	
N	81.76	55,300	N	82.85	67,200	N	82.62	64,400	8	83.57	76,300
6	82.00	57,700	6	82.75	66,000	6	82.95	68,400	4	83.47	75,000
12	82.19	59,700	12	82.65	64,800	12	83.20	71,500	12	83.36	73,600
	Apr. 20			Apr. 29			May 8			May 18	
6	82.47	62,800	6	82.50	63,100	6	83.47	75,000	8	83.23	71,900
N	82.74	65,900	N	82.42	62,200	N	83.75	78,700	4	83.15	70,800
6	82.95	68,400	6	82.33	61,200	6	84.06	83,000	12	83.09	70,100
12	83.13	70,600	12	82.28	60,700	12	84.37	87,600		May 19	
	Apr. 21			Apr. 30			May 9		8	83.00	69,000
6	83.29	72,700	6	82.19	59,700	6	84.62	91,300	4	82.93	68,200
N	83.45	74,800	N	82.10	58,700	N	84.82	94,400	12	82.88	67,600
6	83.58	76,400	6	82.02	57,900	6	84.95	96,500		May 20	
12	83.69	77,900	12	81.91	56,800	12	85.07	98,400	8	82.81	66,700
	Apr. 22			May 1			May 10		4	82.71	65,500
6	83.78	79,100	6	81.84	56,100	6	85.13	99,400	12	82.66	64,900
N	83.85	80,100	N	81.80	55,700	N	85.18	100,000		May 21	
6	83.89	80,700	6	81.72	54,900	6	85.18	100,000	8	82.60	64,200
12	83.93	81,200	12	81.66	54,300	12	85.21	101,000	4	82.54	63,500
	Apr. 23			May 2			May 11		12	82.46	62,700
6	83.94	81,400	6	81.56	53,400	6	85.20	100,000		May 22	
N	83.95	81,500	N	81.47	52,600	N	85.18	100,000	8	82.41	62,100
6	83.94	81,400	6	81.47	52,600	6	85.17	100,000	4	82.36	61,600
12	83.91	80,900	12	81.43	52,300	12	85.14	99,500	12	82.31	61,000
	Apr. 24			May 3			May 12			May 23	
6	83.89	80,700	6	81.42	52,200	8	85.11	99,100	6	82.29	60,800
N	83.85	80,100	N	81.40	52,000	4	85.07	98,400	N	82.19	59,700
6	83.84	80,000	6	11.35	51,600	12	85.02	97,600	6	82.20	59,800
12	83.80	79,400	12	81.27	50,900				12	82.24	60,200

Mississippi River at Prescott, Wis.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 24			May 28			June 1			June 5	
6	82.26	60,500	8	81.81	55,800	6	81.01	48,800	6	79.88	40,400
N	82.29	60,800	4	81.77	55,400	N	80.95	48,300	N	79.75	39,600
6	82.23	60,100	12	81.72	54,900	6	80.91	48,000	6	79.76	39,700
12	82.24	60,200		May 29		12	80.81	47,200	12	79.68	39,200
	May 25		8	81.67	54,400		June 2			June 6	
6	82.21	59,900	4	81.61	53,900	6	80.81	47,200	6	79.61	38,900
N	82.12	58,900	12	81.57	53,500	N	80.79	47,000	N	79.46	38,000
6	82.04	58,100		May 30		6	80.75	46,700	6	79.34	37,400
12	81.98	57,500	6	81.52	53,100	12	80.62	45,700	12	79.28	37,000
	May 26		N	81.47	52,600		June 3			June 7	
8	81.93	57,000	6	81.45	52,400	6	80.54	45,000	6	79.20	36,600
4	81.92	56,900	12	81.36	51,600	N	80.49	44,600	N	79.05	35,800
12	81.91	56,800		May 31		6	80.41	44,000	6	79.00	35,500
	May 27		6	81.25	50,700	12	80.31	43,200	12	78.95	35,200
8	81.91	56,800	N	81.20	50,300		June 4			June 8	
4	81.87	56,400	6	81.14	49,800	6	80.24	42,700	6	78.87	34,800
12	81.84	56,100	12	81.08	49,300	N	80.16	42,100	N	78.82	34,500
						6	80.06	41,500	6	78.76	34,200
						12	80.00	41,100	12	78.76	34,200

Leech Lake River basin

Leech Lake Reservoir at Federal Dam, Minn.

Location.--Lat 47°12'23", long. 94°18'31", in lot 2, sec. 14, T. 143 N., R. 29 W., at head of Leech Lake River on Waboose Bay, 5 miles southwest of town of Federal Dam. Datum of gage is 1,293.23 ft above mean sea level, adjustment of 1912.
Drainage area.--1,163 sq mi.
Gage-height record.--Water-stage recorder graph read on the 10th, 20th, and last day of the month or oftener, as required to compute storage, except those for Apr. 10, 20, 30, May 10, 20, June 10, Sept. 30, which were estimated.
Maxima.--April-September 1950: Gage height observed, 4.11 ft May 30, June 1.
1941 to March 1950: Gage height observed, 3.90 ft Aug. 19, Sept. 19, 1944.
A stage of 5.18 ft was observed June 30, 1916.
Remarks.--Reservoir is formed by natural lake and concrete and timber dam with about 10.5 ft of control by stoplogs. Dead storage, 53,550 acre-ft. Water used to benefit navigation below Minneapolis. Records furnished by Corps of Engineers in terms of cfs-days and converted to acre-feet by Geological Survey.

Gage height, in feet, and contents, in acre-feet, on indicated day, 1950

Day	April		May		June		July		August		September	
	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents
10	2.00	283,700	3.35	457,130	4.09	569,200	3.98	552,520	3.40	464,710	2.52	349,450
20	2.20	308,990	3.87	535,870	4.08	567,670	3.80	525,260	3.14	427,830	2.54	351,970
30-1	2.56	354,510	4.11	572,210	4.02	558,590	3.62	498,010	2.85	391,180	2.39	333,000

Leech Lake River at Federal Dam, Minn.

Location.--Lat 47°14'45", long. 94°13'12", in sec. 29, T. 144 N., R. 28 W., at dam on Leech Lake River at town of Federal Dam, 2 miles downstream from natural outlet of Leech Lake. Datum of gages is 1,293.23 ft above mean sea level, adjustment of 1912.
Drainage area.--1,163 sq mi.
Gage-height record.--Recording headwater gage and staff tailwater gage.
Discharge record.--Discharge computed on basis of head over dam using modified weir formula. Gage heights used to hundredths.
Maxima.--April-June 1950: Daily discharge, 1,329 cfs June 26.
1941 to March 1950: Daily discharge, 1,254 cfs Feb. 1, 1945.
A discharge of 1,530 cfs was observed during July 1904.
Remarks.--Flow regulated by Leech Lake Reservoir (see preceding station). Figures of monthly mean discharge and monthly runoff in acre-feet and inches are adjusted for change in reservoir contents. Records furnished by Corps of Engineers.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	196	111	310	11	109	103	206	21	94	97	864
2	190	91	294	12	108	103	280	22	104	101	982
3	192	99	240	13	108	103	590	23	106	104	1,056
4	104	103	246	14	106	101	619	24	106	104	1,014
5	104	108	249	15	106	106	720	25	103	91	909
6	103	99	261	16	108	106	690	26	104	215	1,329
7	102	92	233	17	98	94	690	27	107	209	1,089
8	97	103	226	18	104	95	689	28	107	215	1,068
9	103	99	305	19	127	101	751	29	95	221	1,092
10	108	94	237	20	123		759	30	101	227	1,196
								31	-	285	-
Monthly mean discharge, (adjusted)									1,686	3,666	411
Runoff, in acre-feet (adjusted)									100,300	225,400	24,460
Runoff, in inches (adjusted)									1.62	3.63	0.39

Sandy River basin

Sandy Lake Reservoir at Libby, Minn.

Location.--Lat 46°46'40", long. 93°19'20", in sec. 36, T. 50 N., R. 24 W., at Libby, 1 mile upstream from dam on Sandy River, two miles upstream from mouth, and 14 miles north of McGregor. Datum of gage 1,207.71 ft above mean sea level, adjustment of 1912.
Drainage area.--421 sq mi.
Gage-height record.--Water-stage recorder graph read on the 10th, 20th and last day of the month or oftener, as required to compute storage.
Maxima.--April-September 1950: Gage height observed, 17.51 ft May 19.
1941 to March 1950: Gage height observed, 14.26 ft June 14, 1944.
A stage of 15.05 ft occurred July 13, 1897.
Remarks.--Reservoir is formed by natural lake and concrete dam with sluice gates and stop-logs. Dead storage, 34,960 acre-ft. Water is used to benefit navigation below Minneapolis. Record furnished by Corps of Engineers in terms of cfs-days and converted to acre-feet by the Geological Survey.

Gage height, in feet, and contents, in acre-feet, on indicated day, 1950

Day	April		May		June		July		August		September	
	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents
10	7.19	36,540	16.17	145,790	13.66	103,780	9.60	58,250	9.54	57,660	9.22	54,600
20	7.57	39,730	17.45	171,170	10.82	70,610	9.46	56,890	9.40	56,310	9.29	55,260
30-1	12.70	91,740	16.13	143,010	9.54	57,660	9.54	57,660	9.34	55,740	9.26	54,980

Sandy River at Sandy Lake Dam, at Libby, Minn.

Location.--Lat 46°47'18", long. 93°19'06", in sec. 25, T. 50 N., R. 24 W., in headwater and tailwater of dam at outlet of Sandy Lake, a quarter of a mile north of Libby, and 1.4 miles upstream from mouth. Datum of gage is 1,207.71 ft above mean sea level, adjustment of 1912.
Drainage area.--421 sq mi.
Gage-height record.--Headwater and tailwater recording gages on dam read twice daily.
Discharge record.--Discharge computed on basis of head over dam using modified weir formula and adjusted to current-meter measurements. Control affected by backwater from Mississippi River most of year. Gage heights used to hundredths.
Maxima.--April-June 1950: Daily discharge, 3,400 cfs May 23.
1893-1916, 1941 to March 1950: Discharge observed, 3,738 cfs July 12, 1897.
Remarks.--Flow regulated by Sandy Lake Reservoir (see preceding station). Figures of monthly mean discharge and runoff in acre-feet and inches are adjusted for change in reservoir contents. Records furnished by Corps of Engineers.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	65	1,314	2,540	11	110	1,800	2,441	21	35	2,500	1,179
2	65	1,326	2,528	12	115	1,800	2,731	22	0	2,500	1,295
3	70	1,389	2,528	13	177	1,600	2,853	23	0	3,400	1,255
4	70	1,646	2,508	14	483	1,678	1,974	24	0	3,350	1,210
5	70	1,508	2,493	15	252	1,597	2,078	25	4	3,318	1,225
6	65	1,201	2,483	16	135	1,672	2,235	26	29	3,300	1,155
7	65	1,032	2,472	17	188	1,747	2,133	27	172	3,300	1,135
8	65	0	2,464	18	318	2,185	1,989	28	710	3,200	165
9	65	626	2,371	19	163	2,067	1,579	29	997	3,000	235
10	110	1,600	2,374	20	213	2,146	1,330	30	1,295	2,887	280
								31	-	2,900	-
Monthly mean discharge, in cfs (adjusted)									1,151	2,885	407
Runoff, in acre-feet (adjusted)									68,490	177,400	24,220
Runoff, in inches (adjusted)									3.05	7.90	1.08

Pine River basin

Pine River Reservoir at Cross Lake, Minn.

Location.--Lat 46°40'12", long. 94°06'48", at dam on Pine River in sec. 21, T. 137 N., R. 27 W., at outlet of Cross Lake at village of Cross Lake. Datum of gage is 1,218.20 ft above mean sea level (levels by Corps of Engineers). Auxiliary gage at same site and datum used for check purposes.
Drainage area.--562 sq mi.
Gage-height record.--Staff gage read daily at 6 a.m. and 6 p.m.; checked by auxiliary water-stage recorder record.
Maxima.--April-September 1950: Gage height observed, 15.09 ft May 25.
1941 to March 1950: Gage height observed, 15.66 ft June 17, 1944.
A stage of 18.24 ft was observed July 10, 1916.
Remarks.--Reservoir is formed by natural lake and timber crib dam with sluice gates and stoplogs. Water used to benefit navigation below Minneapolis. Records furnished by Corps of Engineers in terms of cfs-days and converted to acre-feet by Geological Survey.

Gage height, in feet, and contents, in acre-feet, at 6 p.m. of indicated day, 1950

Day	April		May		June		July		August		September	
	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents
10	11.50	78,250	14.50	119,070	14.25	115,580	12.92	97,230	12.35	89,550	11.87	83,150
20	11.97	84,480	14.89	124,580	13.52	105,440	12.62	93,200	12.06	85,670	12.02	85,130
30-1	13.16	100,520	14.96	125,570	13.14	100,240	12.50	91,560	12.01	85,010	12.02	85,130

Pine River at Pine River Dam, at Cross Lake, Minn.

Location.--Lat 46°40'12", long. 94°06'48", in headwater and tailwater of Pine River Dam at village of Cross Lake. Datum of gages is 1,218.20 ft above mean sea level, unadjusted.
Drainage area.--562 sq mi.
Gage-height record.--Headwater and tailwater staff gages read twice daily.
Discharge record.--Discharge computed on basis of head over dam using modified weir formula and adjusted to conform with current-meter measurements. Gage heights used to hundredths.
Maxima.--April-June 1950: Daily discharge, 1,610 cfs May 15-19.
1895-1916, 1929, 1941 to March 1950: Daily discharge, 2,246 cfs in June 1896 (does not include flow bypassing dam through crevasse).
Remarks.--Flow regulated by Pine River Reservoir (see preceding station). Figures of monthly mean discharge and runoff in acre-feet and inches are adjusted for changes in reservoir contents. Records furnished by Corps of Engineers.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	144	871	1,030	11	146	1,570	1,058	21	554	1,040	1,035
2	144	1,004	1,030	12	146	1,570	1,048	22	557	1,040	1,031
3	144	1,005	1,030	13	146	1,590	1,058	23	561	1,040	868
4	144	1,005	1,025	14	247	1,590	1,055	24	653	1,040	519
5	144	1,009	1,030	15	545	1,610	1,053	25	808	1,039	519
6	144	1,017	1,020	16	538	1,610	1,053	26	812	1,039	520
7	144	1,026	1,010	17	538	1,610	1,048	27	813	1,060	519
8	144	1,037	990	18	544	1,610	1,043	28	815	1,060	519
9	144	1,110	1,000	19	548	1,610	1,040	29	816	1,060	519
10	145	1,450	1,000	20	551	1,190	1,038	30	817	1,050	519
								31	-	1,030	-
Monthly mean discharge, in cfs (adjusted)									858	1,620	482
Runoff, in acre-feet (adjusted)									51,050	99,610	28,680
Runoff, in inches (adjusted)									1.71	3.32	0.96

Crow Wing River basin

Crow Wing River at Nimrod, Minn.

Location.--Lat 46°39', long. 94°53', in sec. 32, T. 137 N., R. 33 W., 10 ft upstream from highway bridge, a quarter of a mile north of Nimrod, and 0.7 mile upstream from Cat River.
Drainage area.--1,010 sq mi.
Gage-height record.--Water-stage recorder graph except period Apr. 9-17, when there was no gage-height record. Staff gage read once Apr. 8 and 11.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Discharge for periods of no gage-height record computed on basis of weather records and engineers' notes. Stage-discharge relation affected by ice Apr. 1-8, Apr. 11, 18-23.
Maxima.--April-June 1950: Discharge, 2,200 cfs 4 - 8 a.m. May 7 (gage height, 5.46 ft); gage height, 7.64 ft Apr. 20 (backwater from ice).
1910-14, 1930 to March 1950: Discharge observed, 2,330 cfs Apr. 7, 1943; gage height observed, 6.44 ft Apr. 8, 1947 (backwater from ice).
Remarks.--Flow regulated by several lakes. No diversions above station.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	380	1,120	1,220	11	400	2,040	776	21	2,000	1,570	712
2	400	1,120	1,170	12	380	1,960	764	22	2,000	1,530	692
3	400	1,140	1,120	13	380	1,900	783	23	1,900	1,500	705
4	400	1,210	1,080	14	400	1,790	757	24	1,730	1,500	698
5	400	1,730	1,040	15	500	1,690	750	25	1,560	1,500	738
6	400	2,070	1,010	16	700	1,630	744	26	1,400	1,460	757
7	400	2,150	982	17	1,000	1,700	744	27	1,290	1,420	764
8	400	1,990	947	18	1,500	1,640	731	28	1,200	1,380	764
9	400	2,090	884	19	1,900	1,590	731	29	1,160	1,340	757
10	400	2,110	828	20	2,000	1,610	731	30	1,140	1,310	744
								31	-	1,260	-
Monthly mean discharge, in cfs									951	1,615	837
Runoff, in acre-feet									56,590	99,300	49,800
Runoff, in inches									1.05	1.84	0.93

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 18			Apr. 22			Apr. 26 (Con.)			May 6 (Con.)	
4	6.99		2	5.66		8	4.44	1,380	2	5.32	2,080
6	7.01		4	5.63		12	4.41	1,350	4	5.34	2,100
8	6.93		6	5.61			Apr. 27		6	5.34	2,100
10	7.00		8	5.59		6	4.36	1,320	8	5.35	2,110
12	7.08		10	5.58		N	4.32	1,280	10	5.37	2,120
	Apr. 19		N	5.57		6	4.29	1,260	12	5.41	2,160
2	6.97		2	5.75		12	4.27	1,250		May 7	
4	6.95		4	5.92			Apr. 28		4	5.46	2,200
6	6.99		6	6.02		6	4.24	1,220	8	5.46	2,200
8	7.03		8	6.20		N	4.20	1,200	N	5.43	2,180
10	7.00		10	6.34		6	4.18	1,180	4	5.39	2,140
N	7.01		12	5.95		12	4.17	1,170	8	5.33	2,090
2	7.05			Apr. 23			Apr. 29		12	5.28	2,050
4	7.07		2	5.79		6	4.15	1,160		May 8	
6	7.07		4	5.59		N	4.14	1,150	4	5.22	2,000
8	7.10		6	5.45		6	4.14	1,150	8	5.20	1,980
10	7.12		8	5.34		12	4.14	1,150	N	5.17	1,950
12	7.10		10	5.25			May 4		4	5.21	1,990
	Apr. 20		N	5.24		4	4.17	1,170	8	5.23	2,010
2	7.01		2	5.23		8	4.19	1,190	12	5.27	2,040
4	6.88		4	5.19		N	4.19	1,190		May 9	
6	6.79		6	5.15		4	4.20	1,200	6	5.30	2,060
8	6.72		8	5.07		8	4.29	1,260	N	5.34	2,100
10	6.84		10	5.04		12	4.46	1,390	6	5.35	2,110
N	6.99		12	5.01			May 5		12	5.35	2,110
2	7.04			Apr. 24		2	4.54	1,450		May 10	
4	7.20		4	4.95	1,770	4	4.61	1,500	6	5.36	2,120
6	7.51		8	4.92	1,750	6	4.68	1,560	N	5.36	2,120
8	7.38		N	4.88	1,710	8	4.71	1,580	6	5.35	2,110
10	7.20		4	4.87	1,710	10	4.77	1,630	12	5.34	2,100
12	7.35		8	4.84	1,680	N	4.83	1,670		May 11	
	Apr. 21		12	4.81	1,660	2	4.99	1,810	6	5.31	2,070
2	7.15			Apr. 25		4	5.10	1,895	N	5.28	2,050
4	7.05		4	4.77	1,630	6	5.17	1,950	6	5.24	2,010
6	6.72		8	4.70	1,570	8	5.21	1,990	12	5.19	1,970
8	7.00		N	4.67	1,550	10	5.19	1,970		May 12	
10	6.79		4	4.63	1,520	12	5.26	2,030	6	5.18	1,960
N	6.94		8	4.61	1,500		May 6		N	5.16	1,950
2	6.70		12	4.57	1,470	2	5.25	2,020	6	5.16	1,950
4	6.33			Apr. 26		4	5.29	2,060	12	5.20	1,980
6	6.09		4	4.51	1,430	6	5.27	2,040		May 13	
8	5.94		8	4.49	1,410	8	5.31	2,070	6	5.13	1,920
10	5.78		N	4.46	1,390	10	5.27	2,040	N	5.09	1,890
12	5.73		4	4.45	1,380	N	5.29	2,060	6	5.06	1,860

Crow Wing River at Nimrod, Minn.--Con.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 13 (Con.)			May 16 (Con.)			May 19 (Con.)			May 22 (Con.)	
12	5.03	1,840	6	4.78	1,630	N	4.69	1,560	4	4.64	1,520
	May 14		12	4.85	1,690	6	4.74	1,600	12	4.61	1,500
6	5.01	1,820		May 17		12	4.76	1,620		May 23	
N	4.98	1,800	6	4.87	1,710		May 20		8	4.61	1,500
6	4.94	1,760	N	4.87	1,710	6	4.77	1,630	4	4.59	1,490
12	4.90	1,730	6	4.86	1,700	N	4.76	1,620	12	4.63	1,520
	May 15		12	4.83	1,670	6	4.74	1,600		May 24	
6	4.88	1,710		May 18		12	4.73	1,590	8	4.55	1,460
N	4.86	1,700	6	4.82	1,670		May 21		4	4.65	1,530
6	4.82	1,670	N	4.80	1,650	8	4.71	1,580	12	4.63	1,520
12	4.79	1,640	6	4.76	1,620	4	4.69	1,560			
	May 16		12	4.73	1,590	12	4.67	1,550			
6	4.77	1,630		May 19			May 22				
N	4.75	1,610	6	4.71	1,580	8	4.66	1,540			

Gull Lake Reservoir near Brainerd, Minn.

Location.--Lat 46°24'40", long. 94°21'26", in N½ sec. 20, T. 134 N., R. 29 W., in pool of dam on Gull River, 800 ft south of outlet of Gull Lake, a quarter of a mile upstream from Gull Lake Dam, and 8 miles northwest of Brainerd. Datum of gage is 1,188.14 ft above mean sea level, adjustment of 1912.
Drainage area.--287 sq mi.
Gage height record.--Water-stage recorder read on the 10th, 20th, and last day of the month or oftener as required to compute storage, except readings for Aug. 31, Sept. 10, 20, which were estimated.
Maxima.--April-September 1950: Gage height observed, 7.26 ft May 10, 11.
1941 to March 1950: Gage height observed, 7.20 ft June 3, 4, 1943.
A stage of 7.30 ft occurred June 30, 1914.
Remarks.--Reservoir is formed by natural lake controlled by concrete dam. Dead storage, 44,810 acre-ft. Water used to benefit navigation below Minneapolis. Records furnished by Corps of Engineers in terms of cfs-days and converted to acre-feet by Geological Survey.

Gage height, in feet, and contents, in acre-feet, on indicated day, 1950

Day	April		May		June		July		August		September	
	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents	Gage height	Contents
10	5.20	47,400	7.26	74,240	6.28	61,410	6.39	62,840	6.29	61,530	6.03	58,160
20	5.77	54,780	6.95	70,180	6.46	63,770	6.31	61,800	6.16	59,840	6.13	59,460
30-1	6.50	64,280	6.33	62,060	6.48	64,030	6.32	61,920	6.12	59,310	6.08	58,810

Gull River at Gull Lake Dam, near Brainerd, Minn.

Location.--Lat 46°24'40", long. 94°21'12", in sec. 20, T. 134 N., R. 29 W., in headwater and tailwater of dam at outlet of Gull Lake, 8 miles northwest of Brainerd. Datum of gages is 1,188.14 ft above mean sea level, adjustment of 1912.
Drainage area.--287 sq mi.
Gage-height record.--Water-stage recording headwater gage and twice-daily readings of staff tailwater gage.
Discharge record.--Discharge computed on basis of head over dam using modified weir formulas and adjusted to conform with current-meter measurements. Gage heights used to hundredths.
Maxima.--April-June 1950: Daily discharge, 1,115 cfs May 10.
1929, 1941 to March 1950: Daily discharge, 1,080 cfs June 4, 1943.
A daily discharge of 1,123 cfs occurred May 15, 1938.
Remarks.--Flows above about 100 cfs regulated by Gull Lake Reservoir (see preceding station). Figures of monthly mean discharge and runoff in acre-feet and inches are adjusted for change in reservoir contents. No diversions. Meadows below dam are flooded. Records furnished by Corps of Engineers.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	139	720	627	11	156	1,097	63	21	450	900	72
2	139	720	190	12	186	1,094	64	22	480	880	71
3	140	742	130	13	183	1,082	66	23	538	882	72
4	140	732	132	14	180	1,032	69	24	550	872	74
5	140	777	130	15	177	1,032	70	25	650	844	76
6	139	847	88	16	177	1,007	71	26	726	817	77
7	137	962	63	17	180	992	71	27	730	785	74
8	136	1,032	62	18	294	970	71	28	735	767	75
9	136	1,085	62	19	396	935	72	29	725	742	158
10	142	1,115	63	20	430	927	72	30	723	647	147
								31	-	637	-
Monthly mean discharge, in cfs (adjusted)									629	857	137
Runoff, in acre-feet (adjusted)									37,430	52,690	8,150
Runoff, in inches (adjusted)									2.44	3.45	0.53

Sauk River basin

Sauk River near St. Cloud, Minn.

Location.--Lat 45°34', long. 94°14', in sec. 8, T. 124 N., R. 28 W., half a mile northwest of Waite Park, 3 miles west of St. Cloud, and 5 miles upstream from mouth. Datum of gage is 1,034.95 ft above mean sea level, adjustment of 1912.
Drainage area.--925 sq mi.
Gage-height record.--Water-stage recorder graph except period Mar. 8-22, Apr. 12-14, when there was no record.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Mar. 1 to Apr. 7. Discharge for periods of no gage-height record, Mar. 8-22, Apr. 12-14, computed on basis of weather records and records for Elk River near Big Lake. Gage heights used to hundredths.
Maxima.--March-June 1950: Discharge, 2,940 cfs 5:15 p.m. Apr. 8; gage height, 6.60 ft 6:30 p.m. Apr. 5 (backwater from ice).
1909-13, 1929 to February 1950: Daily discharge, 4,540 cfs Apr. 5, 1943; gage height, 7.67 ft Apr. 2, 1943 (backwater from ice).
Remarks.--Flow regulated by power plants and reservoirs. No diversions.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	40	1,400	1,080	591	16	42	1,270	1,140	145
2	40	1,600	1,120	402	17	42	1,290	1,100	348
3	40	1,700	1,100	344	18	42	1,460	693	149
4	40	1,800	980	212	19	42	1,460	572	163
5	42	2,000	959	255	20	44	1,380	573	123
6	44	2,400	1,060	386	21	44	1,300	764	110
7	50	2,400	796	378	22	44	1,240	818	116
8	60	2,300	904	363	23	46	1,100	913	190
9	50	1,980	1,430	341	24	55	1,150	866	208
10	50	2,050	1,420	275	25	110	1,340	796	123
11	46	1,860	1,350	158	26	260	1,350	742	106
12	46	1,700	1,310	173	27	600	1,280	698	271
13	46	1,600	1,270	311	28	600	1,160	538	297
14	42	1,500	1,080	286	29	700	1,090	519	118
15	42	1,420	1,070	123	30	1,100	1,010	523	87
					31	1,300	-	613	-
Monthly mean discharge, in cfs						186	1,553	929	238
Runoff, in acre-feet						11,440	92,410	57,120	14,160
Runoff, in inches						0.23	1.87	1.16	0.29

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 24			Mar. 29 (Con.)			Apr. 3			Apr. 6 (Con.)	
4	1.55		8	5.76		2	5.76		N	5.64	
8	1.57		10	5.88		4	5.70		2	5.85	
N	1.61		12	5.85		6	5.66		4	5.91	
4	1.68			Mar. 30		8	5.62		6	5.82	
8	1.95		4	5.55		10	5.58		8	5.78	
12	2.47		8	5.26		N	5.59		10	5.76	
	Mar. 25		N	5.17		2	5.75		12	5.58	
4	2.53		4	5.24		4	5.85			Apr. 7	
8	2.53		8	5.27		6	5.95		2	5.38	
N	2.59		12	5.27		8	6.11		4	5.25	
4	2.75			Mar. 31		10	6.18		6	5.09	
8	2.89		4	5.07		12	6.15		8	5.00	
12	2.90		8	4.85			Apr. 4		10	5.07	
	Mar. 26		N	4.91		2	6.13		N	5.37	
4	2.82		4	4.89		4	6.08		2	5.57	
8	2.75		8	4.81		6	6.05		4	5.61	
N	2.96		12	4.77		8	6.00		6	5.59	
4	3.27			Apr. 1		10	5.96		8	5.55	
8	3.78		2	4.74		N	5.93		10	5.48	
12	4.09		4	4.71		2	5.98		12	5.28	
	Mar. 27		6	4.73		4	6.01			Apr. 8	
4	4.27		8	4.78		6	5.93		2	5.07	2,110
8	4.26		10	4.95		8	6.08		4	4.81	1,880
N	4.26		N	5.10		10	6.13		6	4.64	1,740
4	4.35		2	5.21		12	6.07		8	4.66	1,760
8	4.22		4	5.38			Apr. 5		10	4.69	1,780
12	3.92		6	5.73		2	5.98		N	5.03	2,070
	Mar. 28		8	5.94		4	5.92		2	5.48	2,640
4	3.65		10	5.92		6	5.73		4	5.65	2,900
8	3.53		12	5.84		8	5.65		6	5.67	2,920
N	3.99			Apr. 2		10	5.70		8	5.59	2,800
4	4.60		2	5.66		N	5.77		10	5.48	2,640
8	5.56		4	5.51		2	5.86		12	5.31	2,400
12	5.76		6	5.32		4	6.25			Apr. 9	
	Mar. 29		8	5.16		6	6.57		2	5.11	2,150
2	5.63		10	5.14		8	6.51		4	4.93	1,980
4	5.44		N	5.14		10	6.28		6	4.83	1,900
6	5.24		2	5.73		12	6.06		8	4.80	1,870
8	5.11		4	5.79			Apr. 6		10	4.79	1,860
10	4.99		6	5.80		2	5.86		N	4.80	1,890
N	5.11		8	5.77		4	5.68		2	4.82	1,920
2	5.44		10	5.78		6	5.53		4	4.86	1,980
4	5.53		12	5.78		8	5.47		6	4.93	2,020
6	5.64					10	5.53		8	4.98	2,050

Sauk River near St. Cloud, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 9 (Con.)			Apr. 22 (Con.)			May 5			May 16	
10	5.01	2,050	N	3.88	1,250	4	3.02	780	6	3.68	1,130
12	5.01	2,050	6	3.89	1,250	8	3.22	880	N	3.66	1,120
	Apr. 10		12	3.84	1,220	N	3.54	1,050	6	3.72	1,150
2	4.99	2,030		Apr. 23		4	3.64	1,110	12	3.71	1,150
4	4.97	2,010	6	3.63	1,100	8	3.55	1,060		May 17	
6	4.98	2,020	N	3.58	1,070	12	3.55	1,060	6	3.69	1,130
8	4.95	2,000	6	3.57	1,070		May 6		N	3.67	1,120
10	4.95	2,000	12	3.55	1,060	4	3.54	1,050	6	3.65	1,110
N	5.01	2,050		Apr. 24		8	3.59	1,080	12	3.32	931
2	5.10	2,140	6	3.55	1,060	N	3.63	1,100		May 18	
4	5.10	2,140	N	3.62	1,100	4	3.59	1,080	6	2.91	730
6	5.11	2,150	6	3.88	1,250	8	3.55	1,060	N	2.88	716
8	5.03	2,070	12	3.99	1,310	12	3.39	970	6	2.60	591
10	4.95	2,000		Apr. 25			May 7		12	2.48	540
12	4.85	1,910	6	4.03	1,340	4	3.13	835		May 19	
	Apr. 11		N	4.04	1,340	8	3.04	790	6	2.51	552
2	4.67	1,770	6	4.05	1,350	N	3.01	775	N	2.56	574
4	4.57	1,690	12	4.07	1,360	4	2.98	761	6	2.62	600
6	4.53	1,660		Apr. 26		8	2.96	752	12	2.59	587
8	4.52	1,650	6	4.06	1,360	12	2.98	761		May 20	
10	4.54	1,670	N	4.05	1,350		May 8		6	2.36	490
N	4.80	1,870	6	4.03	1,340	4	3.02	780	N	2.35	486
2	5.06	2,100	12	4.02	1,330	8	3.04	790	6	2.75	658
4	5.16	2,210		Apr. 27		N	3.19	865	12	2.91	730
6	5.02	2,060	6	3.97	1,300	4	3.38	964		May 21	
8	4.87	1,930	N	3.94	1,280	8	3.50	1,030	6	3.00	770
10	4.82	1,890	6	3.91	1,270	12	3.85	1,230	N	2.98	761
12	4.70	1,790	12	3.88	1,250		May 9		6	3.01	775
	Apr. 15			Apr. 28		4	4.09	1,370	12	3.00	770
6	4.12	1,390	6	3.78	1,190	8	4.22	1,450		May 22	
N	4.21	1,450	N	3.72	1,150	N	4.23	1,460	6	3.01	775
6	4.22	1,450	6	3.69	1,130	4	4.25	1,470	N	3.00	770
12	4.14	1,400	12	3.67	1,120	8	4.25	1,470	6	3.22	880
	Apr. 16			Apr. 29		12	4.26	1,480	12	3.31	926
6	3.92	1,270	6	3.64	1,110		May 10			May 23	
N	3.86	1,240	N	3.61	1,090	6	4.22	1,450	6	3.33	936
6	3.86	1,240	6	3.59	1,080	N	4.17	1,420	N	3.27	905
12	3.86	1,240	12	3.56	1,060	6	4.14	1,400	6	3.26	900
	Apr. 17			Apr. 30		12	4.08	1,370	12	3.25	895
6	3.87	1,240	6	3.44	997		May 11			May 24	
N	3.89	1,250	N	3.44	997	6	4.07	1,360	6	3.24	890
6	4.04	1,340	6	3.47	1,010	N	4.05	1,350	N	3.18	860
12	4.13	1,400	12	3.48	1,020	6	4.03	1,340	6	3.15	845
	Apr. 18			May 1		12	4.02	1,330	12	3.14	840
6	4.21	1,450	6	3.48	1,020		May 12			May 25	
M	4.27	1,480	N	3.54	1,050	6	4.01	1,330	6	3.11	825
6	4.26	1,480	6	3.71	1,150	N	3.99	1,310	N	3.05	795
12	4.28	1,490	12	3.73	1,160	6	3.95	1,290	6	2.98	761
	Apr. 19			May 2		12	3.95	1,290	12	3.00	770
6	4.27	1,480	6	3.68	1,130		May 13			May 26	
N	4.22	1,450	N	3.65	1,110	6	3.95	1,290	6	2.95	748
6	4.20	1,440	6	3.66	1,120	N	3.91	1,270	N	2.94	743
12	4.20	1,440	12	3.65	1,110	6	3.89	1,250	6	2.90	725
	Apr. 20			May 3		12	3.83	1,220	12	2.91	730
6	4.15	1,410	6	3.64	1,110		May 14			May 27	
N	4.10	1,380	N	3.63	1,100	6	3.60	1,080	6	2.87	712
6	4.07	1,360	6	3.61	1,090	N	3.53	1,050	N	2.86	707
12	4.04	1,340	12	3.59	1,080	6	3.52	1,040	6	2.84	698
	Apr. 21			May 4		12	3.51	1,040	12	2.68	626
6	4.00	1,320	4	3.56	1,060		May 15			May 28	
N	3.97	1,300	8	3.54	1,050	6	3.50	1,030	6	2.46	531
6	3.95	1,290	N	3.53	1,050	N	3.51	1,040	N	2.45	527
12	3.90	1,260	4	3.50	1,030	6	3.67	1,120	6	2.44	523
	Apr. 22		8	3.13	835	12	3.69	1,130	12	2.42	514
6	3.90	1,260	12	2.82	689						

Elk River basin

Elk River near Big Lake, Minn.

Location.--Lat 45°20', long. 93°40', in sec. 23, T. 33 N., R. 27 W., at highway bridge 4 miles east of Big Lake and 4 miles downstream from St. Francis River.
Drainage area.--615 sq mi.
Gage-height record.--Water-stage recorder graph except for periods of missing record, Apr. 8, 9, 12, 13.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Mar. 1 to Apr. 2.
Maxima.--March-June 1950: Discharge, 2,730 cfs noon May 9; gage height, 8.45 ft 11 a.m. Apr. 2 (backwater from ice).
1911-17, 1931 to February 1950: Discharge, 5,100 cfs May 7, 1912 (gage height, 10 ft), from rating curve extended above 3,800 cfs.
Remarks.--No regulation. No diversions except water pumped into Big Lake.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	60	1,700	473	428	16	70	867	890	182
2	60	2,000	473	393	17	70	849	906	179
3	60	2,000	473	358	18	70	859	806	172
4	60	1,810	473	323	19	70	861	734	165
5	60	1,680	631	292	20	70	822	695	155
6	65	1,670	880	265	21	70	757	724	146
7	80	1,550	1,040	247	22	75	696	709	139
8	100	1,500	1,680	232	23	80	637	678	136
9	90	1,400	2,670	221	24	90	595	653	132
10	75	1,330	2,520	207	25	113	596	659	126
11	70	1,290	2,140	200	26	260	576	635	117
12	70	1,200	1,790	193	27	500	548	587	117
13	65	1,100	1,550	196	28	550	526	548	110
14	65	953	1,340	193	29	700	507	518	101
15	65	889	1,150	193	30	900	485	492	101
					31	1,400	-	466	-
Monthly mean discharge, in cfs						198	1,075	970	201
Runoff, in acre-feet						12,170	63,970	59,640	11,960
Runoff, in inches						0.37	1.95	1.82	0.36

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 26			Mar. 30 (Con.)			Apr. 2 (Con.)			Apr. 10 (Con.)	
4	1.91		10	5.52		8	6.10		12	4.46	1,410
8	2.00		N	5.70		10	5.92			Apr. 11	
N	2.15		2	6.06		12	5.82		2	4.38	1,370
4	2.40		4	6.31			Apr. 3		4	4.26	1,320
8	2.57		6	6.49		4	5.72	2,030	6	4.13	1,260
12	2.77		8	6.60		8	5.66	2,000	8	4.05	1,220
	Mar. 27		10	6.83		N	5.68	2,010	10	3.98	1,190
4	2.86		12	6.91		4	5.67	2,000	N	4.05	1,220
8	2.93			Mar. 31		8	5.61	1,970	2	4.17	1,280
N	2.99		2	6.94		12	5.50	1,900	4	4.25	1,310
4	3.11		4	6.95			Apr. 4		6	4.27	1,320
8	3.19		6	6.93		4	5.42	1,860	8	4.25	1,310
12	3.16		8	6.89		8	5.31	1,800	10	4.22	1,300
	Mar. 28		10	6.85		N	5.26	1,780	12	4.20	1,290
2	3.14		N	6.84		4	5.26	1,780		Apr. 14	
4	3.12		2	6.88		8	5.26	1,780	8	3.48	966
6	3.09		4	6.85		12	5.26	1,780	4	3.44	948
8	3.05		6	6.75			Apr. 5		12	3.36	913
10	3.06		8	6.75		4	5.23	1,760		Apr. 15	
N	3.24		10	6.79		8	5.11	1,700	8	3.31	891
2	3.26		12	6.79		N	4.96	1,630	4	3.29	883
4	3.28			Apr. 1		4	4.89	1,600	12	3.27	875
6	3.28		2	6.76		8	4.95	1,630		Apr. 16	
8	3.31		4	6.66		12	5.06	1,680	8	3.26	871
10	3.35		6	6.50			Apr. 6		4	3.25	866
12	3.41		8	6.37		4	5.08	1,690	12	3.22	854
	Mar. 29		10	6.33		8	5.03	1,660		Apr. 17	
2	3.47		N	6.36		N	5.04	1,670	8	3.21	850
4	3.52		2	6.59		4	5.06	1,680	4	3.20	846
6	3.57		4	7.10		8	5.01	1,660	12	3.20	846
8	3.59		6	7.20		12	4.90	1,600		Apr. 18	
10	3.64		8	7.85			Apr. 7		8	3.24	862
N	3.66		10	7.94		4	4.82	1,570	4	3.24	862
2	3.63		12	7.98		8	4.81	1,560	12	3.24	862
4	3.68			Apr. 2		N	4.81	1,560		Apr. 19	
6	3.74		2	7.90		4	4.77	1,550	8	3.25	866
8	3.88		4	7.78		8	4.72	1,520	4	3.24	862
10	4.11		6	7.58		12	4.66	1,500	12	3.21	850
12	4.37		8	7.41			Apr. 10			Apr. 20	
	Mar. 30		10	7.49		4	4.09	1,240	8	3.16	830
2	4.67		N	6.81		8	4.17	1,280	4	3.12	815
4	4.99		2	7.71		N	4.28	1,330	12	3.06	792
6	5.21		4	7.10		4	4.42	1,390		Apr. 21	
8	5.38		6	6.43		8	4.50	1,420	8	2.99	766

Crow River basin

North Fork Crow River near Regal, Minn.

Location.--Lat 45°22'55", long. 94°47'40", in S½ sec. 11, T. 122 N., R. 33 W., 12 ft upstream from highway bridge and 3 miles southeast of Regal.
Drainage area.--215 sq mi.
Gage-height record.--Water-stage recorder graph except period, noon Mar. 12 to 2:35 p.m. Mar. 22, when no gage heights were obtained.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Mar. 5-12, Mar. 22 to Apr. 4, Apr. 9-14. Discharge for period of no gage-height record computed on basis of weather records and records for preceding and following days.
Maxima.--March-June 1950: Daily discharge, 550 cfs Mar. 27 (affected by ice); gage height, 5.73 ft 1 p.m. Mar. 28 (backwater from ice).
1943 to February 1950: Discharge observed, 760 cfs Apr. 11, 1947; gage height observed, 5.86 ft Mar. 14, 1946 (backwater from ice).
Remarks.--No regulation or diversions.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	0	320	122	54	16	0	208	137	31
2	0	300	127	44	17	0	246	136	37
3	0	300	154	36	18	0	248	138	30
4	0	280	169	33	19	0	288	141	26
5	0	289	212	31	20	0	267	145	22
6	11	272	292	28	21	0	238	144	19
7	46	317	301	23	22	0	216	131	16
8	26	236	279	19	23	0	191	117	16
9	6.0	160	323	18	24	.1	173	108	16
10	2.8	95	317	24	25	18	171	98	18
11	.6	70	295	25	26	160	160	86	14
12	.1	75	249	19	27	550	145	81	12
13	0	75	212	22	28	500	137	76	12
14	0	90	183	23	29	460	132	65	11
15	0	136	155	23	30	400	126	61	9
					31	360	-	60	-
Monthly mean discharge, in cfs						82.0	200	165	23.7
Runoff, in acre-feet						5,040	11,900	10,150	1,410
Runoff, in inches						0.44	1.04	0.88	0.12

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 25			Mar. 28 (Con.)			Mar. 31 (Con.)			Apr. 6	
2	3.42		N	5.68		10	4.01		4	3.08	271
4	3.53		2	5.67		12	3.98		8	2.98	251
6	3.65		4	5.23			Apr. 1		N	3.06	267
8	3.71		6	5.03		2	4.01		4	3.07	269
10	3.76		8	4.77		4	4.03		8	3.13	282
N	3.78		10	4.74		6	4.04		12	3.17	291
2	3.87		12	4.93		8	4.12			Apr. 7	
4	3.93			Mar. 29		10	4.43		4	3.21	300
6	3.94		2	5.02		N	4.25		8	3.29	320
8	3.87		4	5.08		2	4.03		N	3.30	323
10	3.90		6	5.08		4	3.60		4	3.26	313
12	3.92		8	5.09		6	3.75		8	3.34	333
	Mar. 26		10	5.28		8	3.83		12	3.36	338
2	3.91		N	5.23		10	3.93			Apr. 8	
4	3.90		2	4.84		12	3.71		4	3.15	286
6	3.91		4	4.85			Apr. 2		8	3.04	263
8	3.94		6	4.88		4	3.44		N	2.79	214
10	3.95		8	4.81		8	3.63		4	2.65	188
N	3.97		10	4.75		N	3.74		8	2.66	189
2	4.01		12	4.75		4	3.71		12	2.79	214
4	4.41			Mar. 30		8	3.75			Apr. 9	
6	4.95		2	4.81		12	3.43		4	2.91	
8	5.09		4	4.86			Apr. 3		8	3.00	
10	5.18		6	4.89		4	3.37		N	2.99	
12	5.09		8	4.91		8	3.36		4	2.92	
	Mar. 27		10	4.96		N	3.62		8	2.81	
2	5.10		N	5.11		4	3.44		12	2.71	
4	5.21		2	5.03		8	3.43			Apr. 10	
6	5.29		4	4.85		12	3.33		4	2.69	
8	5.27		6	4.78			Apr. 4		8	2.69	
10	5.59		8	4.76		4	3.24		N	2.72	
N	5.66		10	4.70		8	3.14		4	2.63	
2	5.65		12	4.66		N	3.17		8	2.61	
4	5.68			Mar. 31		4	3.34		12	2.46	
6	5.72		2	4.64		8	3.35			Apr. 11	
8	5.63		4	4.61		12	3.23		4	2.29	
10	5.48		6	4.56			Apr. 5		8	2.26	
12	5.37		8	4.68		4	3.20	298	N	2.24	
	Mar. 28		10	4.68		8	3.09	273	4	2.36	
2	5.28		N	4.55		N	3.09	273	8	2.65	
4	5.07		2	4.57		4	3.19	296	12	2.81	
6	4.97		4	4.49		8	3.21	300		Apr. 12	
8	4.94		6	4.48		12	3.19	296	2	2.80	
10	5.23		8	4.33					4	2.71	

North Fork Crow River near Regal, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 12 (Con.)			Apr. 17 (Con.)			May 5 (Con.)			May 13 (Con.)	
6	2.61		8	3.01	257	6	2.84	224	4	2.76	208
8	2.57		12	3.07	269	12	3.04	263	12	2.69	195
10	2.50			Apr. 18			May 6			May 14	
N	2.29		4	3.16	289	6	3.15	286	8	2.64	186
2	2.26		8	3.21	300	N	3.19	296	4	2.61	180
4	2.33		N	3.25	310	6	3.22	303	12	2.55	169
6	2.44		4	3.23	306	12	3.22	303		May 15	
8	2.53		8	3.21	300		May 7		8	2.49	158
10	2.63		12	3.18	293	6	3.22	303	4	2.45	152
12	2.70			Apr. 19		N	3.22	303	12	2.40	143
	Apr. 13		4	3.17	291	6	3.21	300		May 16	
4	2.63		8	3.16	289	12	3.18	293	8	2.36	137
8	2.53		N	3.16	289		May 8		4	2.35	135
N	2.26		4	3.16	289	4	3.15	286	12	2.36	137
4	2.31		8	3.14	284	8	3.12	280		May 17	
8	2.35		12	3.13	282	N	3.09	273	8	2.36	137
12	2.35			Apr. 20		4	3.06	267	4	2.35	135
	Apr. 14		8	3.09	273	8	3.09	273	12	2.36	137
4	2.31		4	3.03	261	12	3.21	300		May 18	
8	2.29		12	2.99	253		May 9		8	2.37	138
N	2.24			Apr. 21		4	3.29	320	4	2.37	138
4	2.24		8	2.94	243	8	3.27	316	12	2.37	138
8	2.44		4	2.89	233	N	3.30	323		May 19	
12	2.33		12	2.85	226	4	3.33	330	8	2.37	138
	Apr. 15			Apr. 22		8	3.32	328	4	2.41	145
4	2.19	111	8	2.82	220	12	3.32	328	12	2.41	145
8	2.18	109	4	2.79	214		May 10			May 20	
N	2.30	127	12	2.74	205	4	3.30	323	8	2.41	145
4	2.47	155		May 2		8	3.30	323	4	2.42	146
8	2.52	164	8	2.27	122	N	3.28	318	12	2.41	145
12	2.53	165	4	2.31	129	4	3.25	310		May 21	
	Apr. 16		12	2.39	141	8	3.25	310	8	2.41	145
4	2.59	176		May 3		12	3.25	310	4	2.42	146
8	2.72	201	8	2.44	150		May 11		12	2.39	141
N	2.83	222	4	2.50	160	8	3.22	303		May 22	
4	2.86	227	12	2.53	165	4	3.17	291	8	2.33	132
8	2.87	229		May 4		12	3.08	271	4	2.31	129
12	2.87	229	8	2.54	167		May 12		12	2.28	124
	Apr. 17		4	2.55	169	8	3.00	255		May 23	
4	2.88	231	12	2.60	178	4	2.94	243	8	2.25	120
8	2.93	241		May 5		12	2.86	227	4	2.21	114
N	2.96	247	6	2.70	197		May 13		12	2.19	111
4	2.99	253	N	2.76	208	8	2.80	216			

Crow River at Rockford, Minn.

Location.--Lat 45°05'15", long. 93°44'00", in sec. 29, T. 119 N., R. 24 W., at Rockford, 1 mile downstream from confluence of North and South Forks. Datum of gage is 893.65 ft above mean sea level, adjustment of 1912.
Drainage area.--2,520 sq mi.
Gage-height record.--Water-stage recorder graph except Apr. 12-14.
Discharge record.--Stage-discharge relation defined by current-meter measurements, affected by ice Mar. 1 to Apr. 4. Discharge for period of no gage-height record interpolated.
Maxima.--March-June 1950: Discharge, 5,680 cfs 7:30 a.m. Apr. 3 (gage height, 10.78 ft, backwater from ice).
1909-17, 1929 to February 1950: Discharge observed, 10,600 cfs Apr. 2, 3, 1916 (gage height, 15.90 ft, former datum).
Remarks.--No diversions or regulation.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	20	2,600	1,310	1,250	16	60	2,500	2,890	445
2	20	4,000	1,280	1,160	17	60	2,390	2,700	453
3	20	5,500	1,270	1,080	18	60	2,290	2,510	476
4	22	4,600	1,260	1,010	19	60	2,170	2,380	481
5	24	3,940	1,550	922	20	60	2,060	2,290	462
6	48	3,670	2,050	851	21	60	1,960	2,280	427
7	160	3,520	2,480	752	22	60	1,840	2,230	402
8	180	3,290	2,850	673	23	60	1,730	2,170	382
9	140	2,920	3,160	616	24	75	1,630	2,070	352
10	120	2,870	3,410	555	25	140	1,610	1,980	330
11	100	2,760	3,600	529	26	320	1,560	1,870	309
12	80	2,750	3,640	500	27	900	1,510	1,760	288
13	70	2,720	3,520	471	28	1,000	1,450	1,640	271
14	65	2,690	3,350	440	29	1,200	1,380	1,540	262
15	60	2,620	3,120	431	30	1,600	1,340	1,430	242
					31	2,000	-	1,330	-
Monthly mean discharge, in cfs						285	2,597	2,288	561
Runoff, in acre-feet						17,520	154,500	140,700	33,380
Runoff, in inches						0.13	1.15	1.05	0.25

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 24			Mar. 31 (Con.)			Apr. 4			Apr. 10 (Con.)	
6	2.06		8	7.00		4	9.24		N	6.65	2,850
N	2.08		N	7.06		8	9.00		4	6.70	2,890
6	2.30		4	7.04		N	8.74		8	6.72	2,910
12	2.39		8	7.16		4	8.55		12	6.67	2,870
	Mar. 25		12	7.19		8	8.38			Apr. 11	
6	2.37			Apr. 1		12	8.28		4	6.59	2,800
N	2.38		2	7.30			Apr. 5		8	6.40	2,650
6	2.68		4	7.37		4	8.16	4,080	N	6.47	2,710
12	2.69		6	7.38		8	8.06	3,990	4	6.59	2,800
	Mar. 26		8	7.37		N	7.98	3,920	8	6.64	2,840
6	2.78		10	7.41		4	7.91	3,860	12	6.64	2,840
N	3.22		N	7.50		8	7.86	3,820		Apr. 12	
6	3.85		2	7.57		12	7.81	3,780	4	6.56	2,780
12	4.27		4	7.68			Apr. 6		8	6.50	2,730
	Mar. 27		6	7.87		4	7.76	3,740	N	6.49	2,720
4	4.45		8	8.00		8	7.71	3,700	4	6.50	2,730
8	4.56		10	8.11		N	7.64	3,640	8	6.51	2,740
N	4.62		12	7.98		4	7.62	3,630	12	6.51	2,740
4	4.75			Apr. 2		8	7.61	3,620		May 5	
8	4.93		2	8.11		12	7.58	3,590	8	4.73	1,430
12	5.06		4	8.26			Apr. 7		4	5.08	1,680
	Mar. 28		6	8.40		4	7.56	3,580	12	5.28	1,820
4	5.07		8	8.49		8	7.53	3,550		May 6	
8	5.07		10	8.64		N	7.51	3,540	8	5.48	1,960
N	5.43		N	8.98		4	7.46	3,500	4	5.71	2,130
4	5.40		2	9.13		8	7.40	3,450	12	5.90	2,280
8	5.54		4	9.62		12	7.36	3,420		May 7	
12	5.54		6	9.92			Apr. 8		8	6.08	2,410
	Mar. 29		8	10.20		4	7.32	3,390	4	6.26	2,540
4	5.60		10	10.49		8	7.26	3,340	12	6.44	2,680
8	5.67		12	10.59		N	7.19	3,280		May 8	
N	5.77			Apr. 3		4	7.16	3,260	8	6.60	2,810
4	6.30		2	10.76		8	7.09	3,200	4	6.70	2,890
8	6.48		4	10.75		12	7.04	3,160	12	6.87	3,030
12	6.63		6	10.73			Apr. 9			May 9	
	Mar. 30		8	10.71		4	6.90	3,050	8	6.99	3,120
4	6.68		10	10.64		8	6.71	2,900	4	7.09	3,200
8	6.70		N	10.59		N	6.64	2,840	12	7.20	3,290
N	6.69		2	10.33		4	6.68	2,870		May 10	
4	6.79		4	10.40		8	6.67	2,870	8	7.31	3,380
8	6.85		6	10.31		12	6.65	2,850	4	7.40	3,450
12	6.92		8	9.97			Apr. 10		12	7.50	3,530
	Mar. 31		10	9.84		4	6.69	2,880		May 11	
4	6.96		12	9.63		8	6.66	2,860	8	7.57	3,590

Crow River at Rockford, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 11 (Con.)			May 14			May 16 (Con.)			May 19	
4	7.63	3,630	8	7.33	3,390	12	6.60	2,810	8	6.04	2,380
12	7.64	3,640	4	7.24	3,320		May 17		4	6.02	2,360
	May 12		12	7.14	3,240	8	6.52	2,750	12	5.98	2,340
8	7.65	3,650		May 15		4	6.41	2,660		May 20	
4	7.65	3,650	8	7.04	3,160	12	6.33	2,600	8	5.93	2,300
12	7.59	3,600	4	6.95	3,090		May 18		4	5.87	2,250
	May 13		12	6.84	3,000	8	6.25	2,540	12	5.90	2,280
8	7.53	3,550		May 16		4	6.17	2,480		May 21	
4	7.46	3,500	8	6.73	2,910	12	6.12	2,440	8	5.92	2,290
12	7.39	3,440	4	6.65	2,850				4	5.90	2,280

Middle Fork Crow River near Spicer, Minn.

Location.--Lat 45°15'45", long. 94°48'10", in NE¼ sec. 27, T. 121 N., R. 33 W., 6.8 miles northeast of Spicer.

Drainage area.--179 sq mi.

Gage-height record.--Chain gage read twice daily except Mar. 13-21, when no readings were made.

Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to half-tenths between 1.6 and 2.1 ft, hundredths below and tenths above. Stage-discharge relation affected by ice Mar. 1 to Apr. 16 (no gage-height record Mar. 13-21; discharge interpolated). Shifting-control method used June 17-30.

Maxima.--March-June 1950: Daily discharge observed, 188 cfs May 18-20; gage height observed, 4.44 ft 7:42 a.m. May 20.
1949 to February 1950: Discharge observed, 44 cfs Apr. 24-29, May 2, 7, 1949; gage height observed, 3.83 ft Mar. 10, 1949 (backwater from ice).

Remarks.--No diversions. Most of flow represents drainage out of Lake Calhoun and is regulated by dam at lake outlet, approximately 2 miles above station. Station established Mar. 1, 1949.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	5.0	13	106	125	16	1.0	60	160	125
2	4.6	17	100	94	17	1.0	64	181	118
3	4.4	18	112	94	18	1.0	70	188	118
4	4.4	19	112	100	19	1.0	76	188	112
5	4.4	19	125	100	20	1.0	76	188	106
6	20	19	146	106	21	1.0	94	181	100
7	20	20	139	118	22	2.0	82	174	94
8	1.5	22	132	125	23	3.4	82	167	94
9	1.3	24	160	132	24	8.0	82	153	94
10	1.2	40	160	118	25	1.2	88	146	82
11	1.0	50	160	106	26	7.5	94	146	88
12	.8	50	167	112	27	40	94	153	76
13	1.0	50	167	118	28	46	88	160	76
14	1.0	50	167	125	29	36	94	160	70
15	1.0	55	160	132	30	11	100	160	64
					31	11	-	153	-
Monthly mean discharge, in cfs						7.86	57.0	154	104
Runoff, in acre-feet						483	3,390	9,470	6,190
Runoff, in inches						0.05	0.36	0.99	0.65

South Fork Crow River at Cosmos, Minn.

Location.--Lat 44°56'05", long. 94°40'20", in SW¼ sec. 14, T. 117 N., R. 32 W., 1 mile east of Cosmos and 2½ miles upstream from mouth of unnamed tributary. Datum of gage is 1,082.09 ft above mean sea level, adjustment of 1929 (level by Corps of Engineers).
Drainage area.--221 sq mi.
Gage-height record.--Graph constructed from wire-weight gage read once daily beginning Apr. 1 except for Sundays, and observed readings Mar. 27-30.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Mar. 25 to Apr. 18. Discharge for days of no gage-height record interpolated. Gage height used to hundredths.
Maxima.--March-June 1950: Discharge observed, 268 cfs 11:10 a.m. May 5 (gage height, 5.38 ft); gage height observed, 7.11 ft 11:50 a.m. Mar. 27 (backwater from ice).
1945 to February 1950: Discharge observed, 400 cfs Mar. 24, 1948; gage height observed, 7.45 ft Mar. 23, 1948 (backwater from ice).
Remarks.--No regulation or diversion.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	0	85	46	35	16	0	88	95	13
2	0	85	43	30	17	0	85	92	12
3	0	85	50	29	18	0	80	86	12
4	0	80	53	25	19	0	76	83	13
5	0	70	217	21	20	0	72	84	13
6	0	65	186	18	21	0	66	83	12
7	0	65	182	15	22	0	62	82	12
8	0	65	178	14	23	0	58	72	11
9	0	90	212	13	24	0	53	68	12
10	0	110	151	12	25	0	55	67	12
11	0	95	126	12	26	100	56	62	12
12	0	90	111	12	27	220	52	56	11
13	0	80	107	12	28	180	48	51	10
14	0	80	98	12	29	140	46	46	8.6
15	0	90	90	13	30	100	46	44	8.4
					31	90	-	41	-
Monthly mean discharge, in cfs						26.8	72.6	95.5	14.8
Runoff, in acre-feet						1,650	4,320	5,870	881
Runoff, in inches						0.14	0.37	0.50	0.07

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 27			Apr. 5			May 4 (Con.)			May 9	
10	7.08		6	3.37		6	2.27	48	6	4.96	226
N	7.11		N	3.29		12	3.08	88	N	4.91	221
	Mar. 30		6	3.22			May 5		6	4.74	204
4	5.96		12	3.11		6	4.75	205	12	4.45	178
6	6.05			Apr. 6		N	5.38	268		May 10	
	Apr. 1		6	3.01		6	5.14	244	6	4.20	156
10	5.95		N	2.93		12	4.83	213	N	4.08	148
	Apr. 3		6	2.90			May 6		6	4.00	142
6	5.14		12	2.90		6	4.62	193	12	3.92	136
N	4.92			May 3		N	4.48	180		May 11	
6	4.32		6	2.34	51	6	4.43	176	8	3.80	129
12	3.83		N	2.32	50	12	4.41	174	4	3.70	123
	Apr. 4		6	2.29	48		May 8		12	3.61	118
6	3.60		12	2.28	48	6	4.37	170		May 12	
N	3.54			May 4		N	4.38	171	8	3.53	113
6	3.49		6	2.27	48	6	4.47	179	4	3.46	109
12	3.43		N	2.26	47	12	4.82	212	12	3.40	105

South Fork Crow River near Mayer, Minn.

Location.--Lat 44°54', long. 93°53', on line between secs. 30 and 31, T. 117 N., R. 25 W., fifth principal meridian, at bridge on Highway 7, 1½ miles north of Mayer, 4 miles southwest of Watertown, and 16 miles upstream from confluence with North Fork. Datum of gage is 926.00 ft above sea level (levels by Hennepin County Park Board Survey).

Drainage area.--1,170 sq mi.

Gage-height record.--Graph drawn on basis of twice-daily wire-weight gage readings for periods Mar. 30 to Apr. 5, May 5-7, 21-29. Average of twice-daily or once-daily readings used Mar. 1-29, Apr. 6 to May 4, May 8-20, May 30 to June 30, except 17-18, May 12, 25, when no readings were obtained.

Discharge record.--Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Mar. 1 to Apr. 5, Apr. 8-13. Discharge for periods of no gage-height record during open water were interpolated or were computed on basis of records for stations at Cosmos and Crow River near Rockford. Gage heights used to hundredths.

Maxima.--March-June 1950: Discharge, 2,280 cfs p.m. Apr. 2; gage height observed, 9.34 ft 6:15 p.m. Apr. 1 (backwater from ice).
1934 to February 1950: Discharge observed, 4,620 cfs Mar. 27, 1948 (gage height, 12.11 ft).

Remarks.--No regulation or diversions.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	0	1,900	376	320	16	0.9	920	1,200	67
2	0	2,200	366	270	17	.8	880	1,100	66
3	0	2,200	362	241	18	.7	840	995	73
4	0	2,200	370	212	19	.6	808	908	77
5	.8	2,000	669	190	20	.6	772	846	74
6	19	1,910	1,340	170	21	.6	682	844	70
7	95	1,760	1,490	147	22	.6	607	876	64
8	80	1,400	1,640	134	23	.7	540	790	57
9	36	1,100	1,900	122	24	2.8	495	600	51
10	14	950	2,010	109	25	65	490	562	49
11	3.8	900	1,970	107	26	220	502	548	41
12	2.4	900	1,800	82	27	600	475	524	39
13	2.0	950	1,680	73	28	850	428	559	41
14	1.6	973	1,560	70	29	1,100	394	409	34
15	1.2	950	1,380	67	30	1,200	378	366	26
					31	1,400	-	334	-
Monthly mean discharge, in cfs						184	1,050	980	104
Runoff, in acre-feet						11,310	62,480	60,260	6,190
Runoff, in inches						0.18	1.00	0.97	0.10

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 25			Apr. 3 (Con.)			May 9			May 22	
8	2.50		4	8.79		8	7.63	1,860	6	4.97	871
6	3.33		12	8.67		6	7.84	1,950	N	5.01	883
	Mar. 26			Apr. 4			May 10		6	5.01	883
9	4.46		8	8.56		6	7.94	2,000	12	4.98	874
4	5.84		4	8.45		4	7.99	2,020		May 23	
	Mar. 27		12	8.34			May 11		6	4.91	853
8	6.77			Apr. 5		6	7.87	1,970	N	4.76	808
5	7.23		8	8.20			May 13		6	4.49	727
	Mar. 28		4	8.08		7	7.26	1,700	12	4.29	667
8	7.66		12	7.96		6	7.15	1,660		May 24	
5	8.02			Apr. 6			May 14		6	4.18	634
	Mar. 29		8	7.83	1,950	7	6.97	1,590	N	4.10	610
7	8.18		6	7.66	1,870	5	6.80	1,520	6	4.04	592
4	8.05			Apr. 7			May 15		12	3.99	577
	Mar. 30		8	7.53	1,810	7	6.55	1,420		May 25	
6	8.05		6	7.28	1,710	6	6.31	1,330	8	3.95	565
N	7.97			May 5			May 16		4	3.92	556
6	7.94		4	3.09	364	7	6.04	1,240	12	3.91	553
12	7.97		8	3.13	372	6	5.85	1,170		May 26	
	Mar. 31		N	4.04	592		May 17		8	3.90	550
6	8.05		4	5.00	880	7	5.69	1,120	4	3.89	548
N	8.14		8	5.49	1,050	5	5.55	1,070	12	3.87	542
6	8.27		12	5.79	1,150		May 18			May 27	
12	8.54			May 6		6	5.41	1,020	8	3.83	532
	Apr. 1		6	6.13	1,270	6	5.27	970	4	3.78	520
6	8.98		N	6.38	1,360		May 19		12	3.69	498
N	9.24		6	6.56	1,420	6	5.13	920		May 28	
6	9.34		12	6.63	1,450	6	5.05	895	8	3.58	470
12	9.31			May 7			May 20		4	3.47	443
	Apr. 2		6	6.67	1,470	6	4.93	859	12	3.40	428
6	9.19		N	6.73	1,490	6	4.84	832		May 29	
N	9.13		6	6.78	1,510		May 21		8	3.35	417
6	9.05		12	6.86	1,540	6	4.86	838	4	3.28	402
12	8.98			May 8		N	4.87	841	12	3.21	388
	Apr. 3		8	6.96	1,580	6	4.90	850			
8	8.88		6	7.22	1,690	12	4.93	859			

Rum River basin

Rum River near St. Francis, Minn.

Location.--Lat 45°19'40", long. 93°22'20", in SE¼ sec. 19, T. 33 N., R. 24 W., 4 miles south of St. Francis and 15½ miles upstream from mouth. Datum of gage is 861.12 ft above mean sea level, adjustment of 1912.
Drainage area.--1,360 sq mi.
Gage-height record.--Water-stage recorder graph.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Mar. 1 to Apr. 7.
Maxima.--March-June 1950: Discharge, 7,540 cfs 1 p.m. May 11 (gage height, 9.45 ft).
1929 to February 1950: Discharge, 6,780 cfs June 19, 1944 (gage height, 9.35 ft).
Remarks.--Flow regulated by Mille Lacs Lake (occasionally), Ogechie and Onamia Lakes, and several small lakes above station. No diversions above station.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	110	1,200	1,720	1,020	16	110	2,750	3,630	477
2	110	1,400	1,660	924	17	110	2,650	3,150	466
3	110	1,700	1,650	844	18	110	2,520	2,640	466
4	110	2,000	1,650	765	19	110	2,420	2,280	455
5	120	2,400	1,730	712	20	110	2,500	2,000	455
6	120	2,800	2,060	663	21	110	2,840	1,830	450
7	120	3,600	2,620	622	22	110	3,270	1,710	438
8	110	3,720	3,540	596	23	110	3,560	1,620	438
9	110	3,450	5,660	558	24	110	3,490	1,570	428
10	110	3,130	7,040	540	25	110	3,190	1,580	411
11	110	2,870	7,410	516	26	140	2,770	1,630	400
12	110	2,810	6,640	504	27	200	2,420	1,610	395
13	110	2,900	5,830	510	28	300	2,170	1,550	395
14	110	2,910	4,960	504	29	500	1,980	1,410	390
15	110	2,830	4,230	494	30	750	1,840	1,270	390
					31	1,000	-	1,130	-
Monthly mean discharge, in cfs						183	2,670	2,871	541
Runoff, in acre-feet						11,250	158,900	176,500	32,190
Runoff, in inches						0.16	2.19	2.43	0.44

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 27			Apr. 2			Apr. 6 (Con.)			May 8	
6	3.21		4	4.64		10	7.03		6	6.32	3,190
N	3.33		8	4.80		12	7.78		N	6.57	3,470
6	3.48		N	4.80			Apr. 7		6	6.91	3,850
12	3.56		4	4.79		4	6.77		12	7.36	4,390
	Mar. 28		8	4.86		8	6.65			May 9	
6	3.55		12	4.99		N	6.61		6	7.92	5,110
N	3.56			Apr. 3		4	6.65		N	8.35	5,720
6	3.62		4	5.08		8	6.71		6	8.71	6,290
12	3.68		8	5.17		12	6.78		12	8.92	6,620
	Mar. 29		N	5.13			Apr. 8			May 10	
4	3.86		4	5.10		6	6.82	3,740	4	9.01	6,780
8	3.99		8	5.20		N	6.82	3,740	8	9.07	6,880
N	3.61		12	5.26		6	6.79	3,710	N	9.17	7,050
4	3.66			Apr. 4		12	6.73	3,640	4	9.25	7,180
8	3.68		4	5.29			Apr. 9		8	9.33	7,320
12	3.79		8	5.35		6	6.65	3,560	12	9.38	7,410
	Mar. 30		N	5.39		N	6.54	3,430		May 11	
4	3.95		4	5.41		6	6.48	3,370	4	9.42	7,490
8	4.08		8	5.42		12	6.39	3,270	8	9.42	7,490
N	3.92		12	5.57			Apr. 10		N	9.42	7,490
4	3.92			Apr. 5		6	6.32	3,190	4	9.37	7,400
8	4.01		2	5.67		N	6.24	3,100	8	9.31	7,290
12	4.13		4	5.73		6	6.21	3,070	12	9.24	7,170
	May 31		6	5.78		12	6.16	3,020		May 12	
4	4.21		8	5.80			Apr. 11		4	9.12	6,960
8	4.29		10	5.70		6	6.05	2,900	8	8.97	6,710
N	4.45		N	5.71		N	6.01	2,850	N	8.90	6,590
4	6.26		2	5.74		6	5.99	2,830	4	8.83	6,480
8	4.48		4	5.65		12	5.95	2,780	8	8.79	6,410
12	4.59		6	5.31			May 5		12	8.69	6,250
	Apr. 1		8	5.16		6	4.85	1,660		May 13	
2	4.68		10	5.94		N	4.91	1,720	4	8.59	6,090
4	4.78		12	6.12		6	4.99	1,800	8	8.54	6,010
6	4.86			Apr. 6		12	5.02	1,830	N	8.43	5,840
8	4.94		2	6.24			May 6		4	8.33	5,700
10	4.96		4	6.27		6	5.10	1,910	8	8.21	5,520
N	4.96		6	6.40		N	5.23	2,040	12	8.12	5,390
2	4.50		8	6.47		6	5.39	2,200		May 14	
4	4.36		10	6.43		12	5.54	2,350	4	8.04	5,280
6	4.46		N	6.32			May 7		8	7.90	5,080
8	4.44		2	6.32		6	5.66	2,470	N	7.80	4,950
10	4.55		4	6.43		N	5.79	2,610	4	7.69	4,810
12	4.60		6	6.33		6	5.92	2,750	8	7.58	4,660
			8	6.85		12	6.10	2,950	12	7.50	4,560

Rum River near St. Francis, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 15			May 18			May 21			May 24	
4	7.39	4,430	4	5.98	2,820	4	5.07	1,880	4	4.74	1,570
8	7.31	4,330	8	5.73	2,540	8	5.03	1,840	8	4.74	1,570
N	7.23	4,240	N	5.85	2,680	N	5.01	1,820	N	4.73	1,560
4	7.14	4,130	4	5.78	2,600	4	5.00	1,810	4	4.74	1,570
8	7.04	4,010	8	5.71	2,520	8	4.97	1,780	8	4.74	1,570
12	6.97	3,920	12	5.65	2,460	12	4.95	1,760	12	4.76	1,580
	May 16			May 19			May 22			May 25	
4	6.83	3,760	4	5.59	2,400	4	4.94	1,750	4	4.74	1,570
8	6.75	3,660	8	5.52	2,330	8	4.92	1,730	8	4.74	1,570
N	6.72	3,630	N	5.46	2,270	N	4.89	1,700	N	4.75	1,580
4	6.67	3,580	4	5.41	2,220	4	4.88	1,690	4	4.76	1,580
8	6.61	3,510	8	5.35	2,160	8	4.86	1,670	8	4.78	1,600
12	6.52	3,410	12	5.30	2,110	12	4.84	1,660	12	4.79	1,610
	May 17			May 20			May 23			May 26	
4	6.42	3,300	4	5.27	2,080	4	4.82	1,640	4	4.81	1,630
8	6.35	3,220	8	5.23	2,040	8	4.81	1,630	8	4.80	1,620
N	6.28	3,150	N	5.18	1,990	N	4.79	1,610	N	4.82	1,640
4	6.20	3,060	4	5.14	1,950	4	4.78	1,600	4	4.87	1,680
8	6.15	3,000	8	5.10	1,910	8	4.77	1,590	8	4.77	1,590
12	6.06	2,910	12	5.09	1,900	12	4.77	1,590	12	4.83	1,650

St. Croix River basin

St. Croix River near Danbury, Wis.

Location.--Lat 46°04'30", long. 92°14'50", in sec. 33, T. 42 N., R. 15 W., on State Trunk Highway 35, 3½ miles downstream from Namekagon River and 10 miles northeast of Danbury.
Drainage area.--1,550 sq mi.
Gage-height record.--Water-stage recorder graph.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-14. Shifting-control method used Apr. 27 to May 5, May 16 to June 30.
Maxima.--April-June 1950: Discharge, 10,200 cfs 10 p.m. May 6 (gage height, 8.22 ft). 1914 to March 1950: Discharge, 8,990 cfs June 6, 1944;(gage height, 7.95 ft Mar. 19, 1945 (backwater from ice).
Remarks.--No diversions. Diurnal fluctuation, caused by power plants upstream, equals about a tenth of a foot.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	1,680	3,420	1,830	11	2,080	6,520	1,260	21	7,210	2,610	1,030
2	1,700	3,300	1,780	12	2,200	5,930	1,260	22	7,570	2,570	995
3	1,700	3,410	1,700	13	2,280	5,460	1,350	23	7,230	2,490	960
4	1,700	3,620	1,660	14	2,360	4,960	1,320	24	6,420	2,450	939
5	1,730	4,470	1,580	15	2,440	4,410	1,300	25	5,710	2,680	981
6	1,760	8,570	1,540	16	2,770	4,010	1,230	26	4,810	2,630	1,320
7	1,800	8,580	1,500	17	4,300	3,780	1,190	27	4,480	2,400	1,360
8	1,850	6,230	1,440	18	6,600	3,550	1,140	28	4,136	2,190	1,420
9	1,910	6,100	1,380	19	7,790	3,150	1,110	29	3,800	1,940	1,390
10	1,990	6,740	1,300	20	7,360	2,790	1,080	30	3,510	1,870	1,430
								31	-	1,880	-
Monthly mean discharge, in cfs									3,762	4,023	1,326
Runoff, in acre-feet									223,900	247,400	78,900
Runoff, in inches									2.71	3.00	0.95

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 9			Apr. 13 (Con.)			Apr. 18 (Con.)			May 4	
2	3.27		10	3.95			6.10	6,750	6	3.57	3,550
4	3.25		N	3.78		4	6.20	6,900	N	3.64	3,630
6	3.27		2	3.53		8	6.34	7,120	6	3.70	3,700
8	3.32		4	3.38		12	6.45	7,300	12	3.75	3,750
10	3.38		6	3.23			Apr. 19			May 5	
N	3.37		8	3.12		4	6.66	7,610	2	3.78	3,780
2	3.35		10	3.05		8	6.78	7,810	4	3.80	3,800
4	3.34		12	3.01		N	6.76	7,780	6	3.83	3,840
6	3.25			Apr. 14		4	6.77	7,790	8	3.90	3,920
8	3.18		2	3.00		8	6.96	8,100	10	3.96	3,980
10	3.25		4	2.99		12	6.87	7,950	N	4.15	4,210
12	3.36		6	3.00			Apr. 20		2	4.35	4,450
	Apr. 10		8	3.10		4	6.71	7,700	4	4.56	4,720
2	3.40		10	3.12		8	6.49	7,360	6	4.74	4,980
4	3.43		N	3.06		N	6.44	7,280	8	4.95	5,280
6	3.54		2	2.97		4	6.39	7,200	10	5.25	5,710
8	3.63		4	2.86		8	6.35	7,140	12	5.61	6,250
10	3.69		6	2.74		12	6.32	7,090		May 6	
N	3.74		8	2.68			Apr. 21		6	6.56	7,460
2	3.83		10	2.65		4	6.34	7,120	N	7.32	8,680
4	3.91		12	2.61		8	6.36	7,160	6	8.00	9,830
6	3.96			Apr. 15		N	6.42	7,250	12	8.20	10,200
8	3.99		4	2.59	2,440	4	6.43	7,260		May 7	
10	4.02		8	2.60	2,450	8	6.43	7,260	6	7.80	9,490
12	4.02		N	2.63	2,480	12	6.45	7,300	N	7.24	8,550
	Apr. 11		4	2.56	2,410		Apr. 22		6	6.72	7,710
4	4.05		8	2.55	2,400	6	6.57	7,480	12	6.25	6,980
8	4.14		12	2.60	2,450	N	6.68	7,650		May 8	
N	4.20			Apr. 16		6	6.71	7,700	6	5.93	6,500
4	4.12		4	2.67	2,510	12	6.65	7,600	N	5.69	6,140
8	3.98		8	2.72	2,560		Apr. 23		6	5.53	5,900
12	3.87		N	2.80	2,630	6	6.55	7,440	12	5.50	5,860
	Apr. 12		4	3.04	2,860	N	6.43	7,260		May 9	
4	3.74		8	3.30	3,120	6	6.26	7,000	6	5.55	5,930
8	3.13		12	3.58	3,400	12	6.14	6,810	N	5.63	6,040
N	3.90			Apr. 17			May 2		6	5.76	6,240
4	3.79		4	3.74	3,570	6	3.33	3,300	12	5.92	6,480
8	3.58		8	3.95	3,800	N	3.31	3,280		May 10	
12	3.45		N	4.35	4,270	6	3.31	3,280	6	6.05	6,680
	Apr. 13		4	4.72	4,740	12	3.40	3,370	N	6.15	6,820
2	3.41		8	4.93	5,030		May 3		6	6.16	6,840
4	3.41		12	5.15	5,350	6	3.43	3,400	12	6.12	6,780
6	3.48			Apr. 18		N	3.43	3,400		May 11	
8	3.60		4	5.52	5,890	6	3.45	3,420	6	6.05	6,680
									N	5.93	6,520
									6	5.84	6,360
									12	5.75	6,220

St. Croix River near Grantsburg, Wis.

Location.--Lat 45°55'25", long. 92°38'20", near center of sec. 30, T. 40 N., R. 18 W., at Norway Point, 0.5 mile downstream from Sand Creek and 10 miles north of Grantsburg. Datum of gage is 848.98 ft above mean sea level, adjustment of 1912 (levels by Northern States Power Co.).
Drainage area.--2,820 sq mi.
Gage-height record.--Water-stage recorder graph except 11 p.m. May 6 to 6 p.m. May 8, when graph was based on floodmark, 3 gage readings, and direction of recorder graph at beginning and end.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-16.
Maxima.--April-June 1950: Discharge, 26,300 cfs 9 a.m. to noon May 7 (gage height, 15.06 ft, from floodmarks in gage house).
1923 to March 1950: Discharge, 15,900 cfs June 7, 1944 (gage height, 12.79 ft).
Remarks.--No diversions. Power plants on tributaries upstream cause a slight diurnal fluctuation at low and medium stages.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	4,100	6,500	2,940	11	6,800	14,000	2,000	21	17,900	4,970	1,730
2	4,300	6,110	2,890	12	7,100	13,200	2,020	22	16,000	4,620	1,720
3	4,600	6,450	2,770	13	7,500	11,800	2,150	23	15,600	4,540	1,670
4	4,800	7,270	2,620	14	8,000	10,400	2,160	24	15,200	4,380	1,660
5	5,100	8,830	2,570	15	8,600	9,280	2,090	25	14,300	4,220	1,620
6	5,400	15,300	2,430	16	9,600	8,210	2,030	26	12,800	4,260	1,880
7	5,600	25,300	2,310	17	11,400	7,360	1,950	27	10,700	4,000	2,200
8	5,900	22,100	2,260	18	15,900	6,810	1,900	28	8,950	3,580	2,210
9	6,200	16,600	2,210	19	19,300	6,420	1,830	29	7,870	3,200	2,180
10	6,600	14,400	2,100	20	20,000	5,710	1,780	30	7,090	2,960	2,130
								31	-	2,980	-
Monthly mean discharge, in cfs.									9,774	8,573	2,134
Runoff, in acre-feet									581,600	527,100	127,000
Runoff, in inches									3.87	3.50	0.84

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 15			Apr. 19 (Con.)			Apr. 26			May 8	
4	9.54		12	13.53	20,100	6	11.33	13,300	6	14.41	23,500
8	9.47			Apr. 20		N	11.13	12,800	N	14.08	22,200
N	9.55		6	13.55	20,200	6	10.93	12,300	6	13.68	20,600
4	9.68		N	13.53	20,100	12	10.71	11,700	12	13.27	19,200
8	9.81		6	13.49	20,000		May 5			May 9	
12	9.90		12	13.37	19,600	3	8.90	7,870	6	12.77	17,500
	Apr. 16			Apr. 21		6	8.96	7,980	N	12.46	16,500
4	10.07		6	13.14	18,800	9	9.08	8,210	6	12.13	15,500
8	10.11		N	12.88	17,800	N	9.37	8,790	12	11.97	15,000
N	10.36		6	12.62	17,000	3	9.58	9,220		May 10	
4	10.81		12	12.47	16,500	6	9.75	9,580	6	11.82	14,600
8	10.49			Apr. 22		9	9.92	9,930	N	11.73	14,300
12	10.36		6	12.36	16,200	12	10.15	10,400	6	11.67	14,100
	Apr. 17		N	12.31	16,000		May 6		12	11.66	14,100
4	10.09	10,300	6	12.21	15,700	3	10.44	11,100		May 11	
8	10.13	10,400	12	12.17	15,600	6	10.85	12,100	6	11.65	14,000
N	10.35	10,900		Apr. 23		9	11.84	14,600	N	11.63	14,000
4	10.70	11,700	6	12.17	15,600	N	11.85	14,600	6	11.60	13,900
8	11.20	12,900	N	12.18	15,600	3	12.39	16,300	12	11.53	13,800
12	11.54	13,800	6	12.19	15,700	6	12.93	18,000		May 12	
	Apr. 18		12	12.17	15,600	9	13.43	19,800	6	11.44	13,500
4	11.80	14,500		Apr. 24		12	13.90	21,500	N	11.32	13,200
8	12.07	15,300	6	12.12	15,500		May 7		6	11.18	12,900
N	12.30	16,000	N	12.04	15,200	3	14.38	23,400	12	11.03	12,500
4	12.53	16,700	6	11.99	15,100	6	14.90	25,600		May 13	
8	12.71	17,200	12	11.91	14,800	9	15.06	26,300	N	10.72	11,800
12	12.92	18,000		Apr. 25		N	15.06	26,300	12	10.43	11,100
	Apr. 19		6	11.82	14,600	3	15.02	26,200		May 14	
6	13.16	18,800	N	11.72	14,300	6	14.95	25,800	N	10.14	10,400
N	13.34	19,500	6	11.63	14,000	9	14.83	25,300	12	9.86	9,810
6	13.45	19,800	12	11.50	13,700	12	14.70	24,700			

St. Croix River near Rush City, Minn.

Location.--Lat 45°42', long. 92°52', in SW¼ sec. 8, T. 37 N., R. 20 W., 200 ft upstream from Northern Pacific Railway bridge, 5 miles east of Rush City, and 10 miles downstream from Snake River. Datum of gage is 772.47 ft above mean sea level, datum of 1929.
Drainage area.--5,120 sq mi.
Gage-height record.--Water-stage recorder graph except 8 p.m. Apr. 17 to 3 a.m. Apr. 27 and 9 p.m. May 5 to 5 p.m. May 14, for which graph was drawn on basis of wire-weight gage readings.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Mar. 1 to Apr. 16. Shifting-control method used June 1-30. Discharge for period of no recorder record Apr. 6-14, computed from graph based on once-daily gage readings except on Apr. 18, 19, 23, 26, May 11, when graph was drawn on basis of trend of chart before or after each period and record for station near Grantsburg.
Maxima.--March-June 1950: Discharge observed, 60,600 cfs about 2 a.m. May 8 (gage height, 19.04 ft).
1923 to February 1950: Discharge, 38,900 cfs June 7, 1944, from rating curve extended above 28,000 cfs; gage height, 18.8 feet Mar. 19, 1945 (backwater from ice).
Remarks.--No diversions. Very slight regulation from power plants upstream.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	1,550	6,700	13,700	5,790	16	1,670	16,000	17,800	2,860
2	1,550	7,200	12,700	5,400	17	1,680	21,200	15,700	2,740
3	1,550	7,600	13,100	4,960	18	1,680	30,300	14,300	2,610
4	1,570	8,000	14,300	4,600	19	1,700	38,400	13,300	2,460
5	1,580	8,400	18,700	4,270	20	1,700	41,600	12,200	2,400
6	1,580	8,800	33,000	3,980	21	1,740	37,200	11,100	2,320
7	1,600	9,200	51,400	3,690	22	1,780	33,300	10,400	2,280
8	1,600	9,400	58,100	3,500	23	1,840	32,000	10,500	2,240
9	1,600	9,800	46,900	3,280	24	1,900	31,500	10,200	2,180
10	1,600	10,200	40,600	3,160	25	2,000	30,200	9,760	2,140
11	1,600	10,600	36,700	2,950	26	2,250	26,400	9,760	2,280
12	1,600	11,200	33,000	2,860	27	3,500	21,600	9,170	2,700
13	1,600	11,600	28,800	3,070	28	4,500	18,700	8,200	2,780
14	1,620	12,200	24,500	3,030	29	5,200	16,400	7,380	2,800
15	1,640	13,400	20,800	2,970	30	5,800	14,900	6,680	2,760
		16,000			31	6,200	-	6,310	-
Monthly mean discharge, in cfs						2,225	18,470	19,970	3,169
Runoff, in acre-feet						136.8	1,099	1,228	188.6
Runoff, in inches						0.50	4.03	4.50	0.69

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 26			Apr. 4			Apr. 13			Apr. 22	
6	4.80		6	7.51		6	9.55		6	14.16	33,700
N	4.80		N	7.50		N	9.26		N	14.00	33,100
6	4.79		6	7.53		6	9.33		6	13.91	32,700
12	5.16		12	7.63		12	9.42		12	13.83	32,400
	Mar. 27			Apr. 5			Apr. 14			Apr. 23	
6	5.63		6	7.55		6	9.40		6	13.77	32,200
N	5.80		N	7.45		N	9.31		N	13.72	32,000
6	5.86		6	7.65		6	9.14		6	13.68	31,800
12	5.97		12	7.75		12	9.98		12	13.65	31,800
	Mar. 28			Apr. 6			Apr. 15			Apr. 24	
6	6.12		6	7.64		6	9.90		6	13.62	31,700
N	6.34		N	7.60		N	9.82		N	13.58	31,500
6	6.35		6	7.84		6	10.96		6	13.55	31,400
12	6.28		12	8.10		12	11.40		12	13.45	31,000
	Mar. 29			Apr. 7			Apr. 16			Apr. 25	
6	6.32		6	8.23		6	10.55		6	13.38	30,800
N	6.35		N	8.32		N	9.41		N	13.26	30,400
6	6.12		6	8.45		6	8.80		6	13.03	29,600
12	5.93		12	8.63		12	9.32		12	12.77	28,700
	Mar. 30			Apr. 8			Apr. 17			May 5	
6	5.96		6	8.56		6	10.21	20,000	4	8.59	15,300
N	6.01		N	8.40		N	10.50	20,900	8	8.79	15,900
6	6.20		6	8.56		6	11.00	22,500	N	9.27	17,200
12	6.29		12	8.60		12	11.79	25,300	4	10.30	20,300
	Mar. 31			Apr. 9			Apr. 18		8	11.19	23,200
6	6.28		6	8.58		6	12.60	28,100	12	11.90	25,600
N	6.30		N	8.44		N	13.23	30,300		May 6	
6	6.40		6	8.39		6	13.88	32,600	N	13.85	32,500
12	6.58		12	8.39		12	14.42	34,800	12	15.78	41,300
	Apr. 1			Apr. 10			Apr. 19			May 7	
6	6.54		6	8.38		6	14.87	36,800	N	17.65	52,000
N	6.51		N	8.50		N	15.25	38,600	12	18.96	60,200
6	6.77		6	8.75		6	15.54	40,100		May 8	
12	6.96		12	9.17		12	15.72	41,000	4	19.03	60,600
	Apr. 2			Apr. 11			Apr. 20		8	18.98	60,300
6	7.05		6	9.35		6	15.83	41,600	N	18.84	59,400
N	7.04		N	9.23		N	15.94	42,200	4	18.48	57,200
6	7.11		6	9.39		6	15.91	42,000	8	18.07	54,600
12	7.27		12	9.67		12	15.60	40,400	12	17.69	52,200
	Apr. 3			Apr. 12			Apr. 21			May 9	
6	7.34		6	9.58		6	15.18	38,300	6	17.17	49,100
N	7.40		N	9.45		N	14.87	36,800	N	16.73	46,600
6	7.44		6	9.62		6	14.73	36,200	6	16.34	44,400
12	7.53		12	9.76		12	14.45	34,900	12	16.02	42,600

St. Croix River at St. Croix Falls, Wis.

Location.--Lat 45°24'30", long. 92°38'45", in NW¼ sec. 30, T. 34 N., R. 18 W., 1,800 ft downstream from Northern States Power Co. power plant in town of St. Croix Falls. Datum of gage is 690.1 ft above mean sea level (unadjusted).
Drainage area.--5,930 sq mi.
Gage-height record.--Water stage recorder graph except period 4 p.m. May 7 to 8 a.m. May 12, for which graph was drawn on basis of staff gage readings.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths.
Maxima.--April-June 1950: Discharge, 54,900 cfs 6 p.m. May 8 (gage height, 25.19 ft). 1902-5, 1908 to March 1950: Discharge, 44,600 cfs Mar. 20, 1945 (gage height, 20.53 ft, from floodmark).
Remarks.--No diversions. Flow controlled by power plant and regulated by Nevers dam, 10 miles above station.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	7,290	16,400	6,550	11	12,200	41,700	3,270	21	40,600	13,200	2,980
2	7,520	15,600	6,200	12	12,900	38,500	3,880	22	37,300	12,100	2,550
3	8,670	12,000	5,230	13	13,000	34,200	3,070	23	34,400	12,600	2,270
4	9,020	16,700	4,920	14	12,900	29,700	3,480	24	34,300	11,100	2,470
5	8,680	18,800	4,910	15	14,200	25,300	3,400	25	33,400	10,100	2,350
6	8,940	30,200	4,650	16	18,100	22,000	3,370	26	30,900	11,100	2,420
7	9,900	43,000	3,830	17	22,200	18,900	2,840	27	26,800	10,700	2,680
8	10,300	53,900	4,160	18	29,400	17,100	2,860	28	22,500	9,940	3,050
9	10,200	52,000	3,700	19	35,900	15,800	2,960	29	20,100	9,520	3,200
10	10,600	45,900	2,980	20	40,500	14,600	2,470	30	18,000	7,550	2,880
								31	-	6,960	-
Monthly mean discharge, in cfs									20,040	21,840	3,519
Runoff, in thousands of acre-feet									1,192	1,343	209.4
Runoff, in inches									3.77	4.24	0.66

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 15			Apr. 18			Apr. 24 (Con.)			May 2 (Con.)	
2	6.58	13,200	N	13.87	29,500	12	15.87	34,000	4	7.31	14,800
4	6.90	13,900	2	14.25	30,400		Apr. 25		6	8.44	17,400
6	6.92	13,900	4	14.80	31,700	6	15.75	33,800	8	8.54	17,600
8	6.62	13,200	6	14.69	31,400	N	15.64	33,600	10	7.86	16,000
10	6.87	13,800	8	14.80	31,700	6	15.44	33,100	12	7.54	15,300
N	6.97	14,000	10	14.98	32,100	12	15.19	32,600		May 3	
2	7.08	14,300	12	15.14	32,400		Apr. 26		2	7.39	15,000
4	7.15	14,400		Apr. 19		6	14.84	31,800	4	7.31	14,800
6	7.25	14,700	2	15.49	33,200	N	14.47	30,900	6	6.96	14,000
8	7.60	15,500	4	15.95	34,200	6	14.12	30,100	8	6.06	12,000
10	7.53	15,300	6	15.88	34,100	12	13.68	29,200	10	4.19	7,340
12	7.41	15,000	8	16.06	34,500		Apr. 27		N	5.79	11,400
	Apr. 16		10	16.32	35,100	6	13.20	28,100	2	6.23	12,400
2	7.43	15,100	N	16.60	35,700	N	12.60	26,700	4	6.17	12,200
4	8.00	16,400	2	17.70	38,200	6	11.78	24,900	6	4.22	7,430
6	8.69	17,900	4	17.32	37,300	12	11.70	24,200	8	4.13	7,150
8	8.60	17,700	6	17.37	37,400		Apr. 28		10	7.84	16,000
10	8.75	18,000	8	17.50	37,700	6	11.30	23,800	12	8.37	17,200
N	8.85	18,300	10	17.73	38,300	N	10.34	21,600		May 4	
2	9.02	18,600	12	17.93	38,700	6	10.39	21,800	2	8.24	16,900
4	9.37	19,400		Apr. 20		12	10.19	21,300	4	7.90	16,100
6	9.42	19,500	6	18.41	39,800		Apr. 29		6	7.88	16,100
8	9.43	19,600	N	18.78	40,700	6	9.98	20,600	8	7.49	15,200
10	9.39	19,500	6	19.10	41,400	N	9.64	20,100	10	7.47	15,100
12	9.41	19,500	12	19.25	41,700	6	9.41	19,500	N	8.29	17,000
	Apr. 17			Apr. 21		12	9.18	19,000	2	8.52	17,500
2	9.48	19,700	6	19.07	41,300		Apr. 30		4	8.57	17,600
4	9.59	20,000	N	18.85	40,800	6	8.94	18,500	6	8.52	17,500
6	9.69	20,200	6	18.53	40,100	N	8.74	18,000	8	8.41	17,300
8	9.85	20,500	12	18.11	39,100	6	8.55	17,600	10	8.38	17,200
10	10.16	21,200		Apr. 22		12	8.35	17,200	12	8.34	17,100
N	10.48	22,000	6	17.66	38,100		May 1			May 5	
2	10.80	22,700	N	17.28	37,300	6	8.18	16,800	2	8.32	17,100
4	11.07	23,200	6	16.92	36,400	N	8.04	16,500	4	8.32	17,100
6	11.47	24,100	12	16.60	35,700	6	7.86	16,000	6	8.32	17,100
8	11.78	24,900		Apr. 23		12	7.68	15,700	8	8.37	17,200
10	11.85	25,000	6	16.35	35,200		May 2		10	8.42	17,300
12	11.93	25,200	N	16.19	34,800	2	7.64	15,600	N	8.64	17,800
	Apr. 18		6	16.10	34,600	4	7.59	15,500	2	8.84	18,300
2	12.12	25,600	12	16.08	34,600	6	7.54	15,300	4	9.22	19,100
4	12.57	26,600		Apr. 24		8	7.50	15,200	6	9.77	20,300
6	13.07	27,700	6	16.02	34,400	10	7.42	15,000	8	10.22	21,300
8	13.52	28,800	N	15.95	34,200	N	7.38	15,000	10	10.65	22,300
10	13.62	29,000	6	15.93	34,200	2	7.33	14,900	12	11.10	23,300

St. Croix River at St. Croix Falls, Wis.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 6			May 8			May 11 (Con.)			May 15 (Con.)	
2	12.47	26,400	2	23.65	51,500	6	18.89	40,900	4	11.70	24,700
4	12.27	25,900	4	24.18	52,700	12	18.59	40,200	6	11.54	24,300
6	12.35	26,200	6	24.47	53,300		May 12		8	11.52	24,300
8	12.70	26,900	8	24.70	53,800	6	18.23	39,400	10	11.43	24,100
10	14.62	31,200	10	24.88	54,200	N	17.84	38,500	12	11.28	23,800
N	14.77	31,600	N	25.01	54,500	6	17.52	37,800		May 16	
2	14.90	31,900	2	25.13	54,800	12	16.95	36,500	6	10.84	22,800
4	15.06	32,200	4	25.19	54,900		May 13		N	10.47	21,900
6	15.19	32,600	6	25.19	54,900	6	16.45	35,400	6	10.17	21,200
8	15.74	33,800	8	25.15	54,800	N	15.94	34,200	12	9.77	20,300
10	15.89	34,100	10	25.08	54,700	6	15.45	33,100		May 17	
12	16.30	35,000	12	25.02	54,500	12	14.92	31,900	6	9.37	19,400
	May 7			May 9			May 14		N	9.07	18,700
2	17.10	36,800	6	24.54	53,500	6	14.40	30,800	6	8.92	18,400
4	17.33	37,400	N	23.91	52,100	N	13.85	29,500	12	8.71	17,900
6	18.00	38,900	6	23.18	50,500	6	13.46	28,600		May 18	
8	18.49	40,000	12	22.48	49,000	12	13.02	27,600	6	8.48	17,500
10	19.13	41,500		May 10			May 15		N	8.32	17,100
N	19.72	42,800	6	21.82	47,500	2	12.88	27,400	6	8.17	16,700
2	20.27	44,000	N	21.05	45,800	4	12.73	27,000	12	8.02	16,400
4	21.26	46,200	6	20.35	44,200	6	12.58	26,700		May 19	
6	22.11	48,100	12	19.90	43,200	8	12.45	26,400	6	7.87	16,000
8	22.33	48,600		May 11		10	11.60	24,500	N	7.75	15,800
10	22.55	49,100	6	19.58	42,500	N	11.07	23,200	6	7.71	15,700
12	23.05	50,200	N	19.24	41,700	2	11.56	24,400	12	7.52	15,300

Namekagon River near Trego, Wis.

Location.--Lat 45°57', long. 91°53', in SW¼ sec. 17, T. 40 N., R. 12 W., at power house of the Wisconsin Hydroelectric Co., and 5 miles northwest of Trego.

Drainage area.--489 sq mi.

Discharge record.--Daily discharge computed from hourly records of plant load, head on turbines and gates, and gate openings. Load-discharge ratings of hydroelectric units and rating for discharge through taintor gates developed by Geological Survey in 1937 and 1941, respectively. Two discharge measurements made in 1950 check load-discharge ratings within 6.5 percent.

Maxima.--April-June 1950: Daily discharge, 2,160 cfs Apr. 19, 20.
1927 to March 1950: Daily discharge, 5,200 cfs Sept. 2, 1941.

Remarks.--Diurnal fluctuation caused by power plant above station.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	487	981	604	11	511	1,760	432	21	1,910	983	399
2	489	981	573	12	529	1,690	434	22	1,610	911	379
3	484	1,050	574	13	588	1,570	4 8	23	1,490	853	388
4	485	1,170	544	14	669	1,510	478	24	1,410	800	403
5	567	1,270	531	15	678	1,390	463	25	1,410	779	389
6	469	1,410	505	16	1,020	1,300	447	26	1,310	683	418
7	481	1,620	506	17	1,430	1,240	406	27	1,220	673	503
8	495	1,780	480	18	1,840	1,160	394	28	1,090	642	462
9	497	1,890	471	19	2,160	1,120	410	29	972	625	474
10	497	1,850	438	20	2,160	1,000	411	30	1,030	577	488
								31	-	574	-
Monthly mean discharge, in cfs									996	1,156	463
Runoff, in acre-feet									59,270	71,080	27,550
Runoff, in inches									2.28	2.72	1.06

Sunrise River near Stacy, Minn.

Location.--Lat 45°24'30", long. 92°55'50", in NW¼NW¼ sec. 26, T. 34 N., R. 21 W., at highway bridge 2½ miles northeast of Stacy.

Drainage area.--94.7 sq mi.

Gage-height record.--Water-stage recorder graph except periods, 3 p.m. Mar. 26 to 10:45 a.m. Mar. 29, 7 a.m. Mar. 30 to 10:30 a.m. Mar. 31, 2-9 a.m. Apr. 7, 1 a.m. Apr. 8 to 6:30 p.m. Apr. 10, 4 p.m. Apr. 11 to 9:30 a.m. Apr. 12, 5 p.m. Apr. 12 to 11 a.m. Apr. 14, 12 p.m. Apr. 14 to 10 a.m. Apr. 15, for which graph was drawn (except for Apr. 9, 10, 13) on basis of trend of recorder graph before and after each period. Staff gage read once Apr. 8.

Discharge record.--Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Mar. 1 to Apr. 1. Discharge for periods of no gage-height record, Apr. 9, 10, 13, computed on basis of weather records and records for adjacent days. Gage heights used to hundredths.

Maxima.--March-June 1950: Discharge, 384 cfs 6 a.m. to 2 p.m. May 7 (gage height, 6.77 ft). 1949 to February 1950: Discharge observed, 162 cfs Mar. 28, 29, 1949 (gage height, 5.24 ft).

Remarks.--No regulation or diversion above station. Station established Jan. 28, 1949.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	11	190	193	101	16	5.0	283	223	48
2	10	222	193	94	17	4.8	262	220	46
3	10	259	197	87	18	4.4	248	211	45
4	10	266	202	81	19	4.2	238	201	44
5	11	250	259	74	20	4.2	226	194	40
6	13	236	365	70	21	4.4	212	188	38
7	15	221	382	66	22	5.0	200	183	35
8	19	211	366	62	23	7.0	191	176	34
9	22	200	361	60	24	11	184	165	32
10	16	215	330	55	25	18	184	155	31
11	13	262	308	52	26	38	189	143	30
12	10	293	289	49	27	80	191	132	28
13	8.5	320	272	57	28	120	192	125	26
14	7.0	327	255	54	29	150	193	119	24
15	6.0	307	237	50	30	160	193	113	23
					31	170	-	109	-
Monthly mean discharge, in cfs						31.2	232	221	51.2
Runoff, in acre-feet						1,920	13,800	13,590	3,050
Runoff, in inches						0.38	2.74	2.70	0.60

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 22			Mar. 30 (Con.)			Apr. 11			May 4 (Con.)	
6	3.15		6	6.28		4	6.14	244	12	6.58	324
N	3.16		12	6.18		8	6.19	252		May 6	
6	3.23			Mar. 31		N	6.23	258	4	6.66	347
12	3.27		6	6.12		4	6.31	271	8	6.71	363
	Mar. 23		N	6.12		8	6.38	283	N	6.74	373
6	3.29		6	6.14		12	6.43	292	4	6.75	377
N	3.30		12	6.14			Apr. 12		8	6.75	377
6	3.39			Apr. 1		8	6.53	312	12	6.76	381
12	3.44		6	6.17		4	6.53	312		May 7	
	Mar. 24		N	6.10		12	6.55	317	6	6.77	384
6	3.48		6	6.02			Apr. 14		N	6.77	384
N	3.54		12	5.94		8	6.60	329	6	6.76	381
6	3.68			Apr. 2		4	6.59	327	12	6.75	377
12	3.73		6	5.96	220	12	6.58	324		May 8	
	Mar. 25		N	5.93	217		Apr. 15		6	6.74	373
6	3.74		6	5.98	223	8	6.53	312	N	6.72	366
N	3.76		12	6.08	235	4	6.48	301	6	6.69	356
6	4.00			Apr. 3		12	6.44	294	12	6.71	363
12	4.19		6	6.18	250		Apr. 16			May 9	
	Mar. 26		N	6.26	263	8	6.41	288	6	6.72	366
6	4.27		6	6.31	271	4	6.36	279	N	6.72	366
N	4.44		12	6.32	272	12	6.32	272	6	6.69	356
6	5.11			Apr. 4			Apr. 17		12	6.66	347
12	5.46		6	6.31	271	8	6.28	266		May 10	
	Mar. 27		N	6.28	266	4	6.24	259	6	6.64	341
6	5.61		6	6.26	263	12	6.19	252	N	6.60	329
N	5.67		12	6.23	258		Apr. 18		6	6.55	317
6	5.75			Apr. 5		8	6.18	250	12	6.54	315
12	5.84		6	6.21	255	4	6.17	248		May 11	
	Mar. 28		N	6.21	255	12	6.13	242	6	6.53	312
6	5.96		6	6.12	241		May 5		N	6.52	310
N	6.03		12	6.09	237	2	5.83	206	6	6.49	303
6	6.10			Apr. 6		4	5.83	206	12	6.45	296
12	6.24		6	6.09	237	6	5.84	207		May 12	
	Mar. 29		N	6.09	237	8	5.89	212	6	6.44	294
6	6.31		6	6.08	235	10	6.08	235	N	6.42	290
N	6.32		12	6.05	232	N	6.34	276	6	6.39	284
6	6.34			Apr. 7		2	6.40	286	12	6.36	279
12	6.32		6	5.98	223	4	6.45	296		May 13	
	Mar. 30		N	5.94	218	6	6.48	301	8	6.34	276
6	6.32		6	5.94	218	8	6.49	303	4	6.29	267
N	6.31		12	5.94	218	10	6.54	315	12	6.27	264

Apple River near Somerset, Wis.

Location.--Lat 45°09'30", long. 92°43'00", in sec. 21, T. 31 N., R. 19 W., at power plant of Northern States Power Co., 3½ miles downstream from Somerset.
Drainage area.--550 sq mi.
Discharge record.--Records of daily discharge computed on basis of gate openings, head, and plant efficiency. The discharge as computed was checked within three percent by one discharge measurement made in September 1950 by the Geological Survey.
Maxima.--April-June 1950: Daily discharge, 1,290 cfs Apr. 3, May 8.
1901 to March 1950: Daily discharge, 2,460 cfs June 17, 1943.
Remarks.--Flow regulated by many power plants upstream. Records of daily discharge furnished by Northern States Power Co.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	1,140	676	284	11	1,130	927	276	21	1,210	547	215
2	1,270	662	134	12	1,070	680	207	22	1,150	480	253
3	1,290	661	128	13	1,120	773	289	23	773	466	218
4	1,260	660	282	14	1,160	680	320	24	830	438	216
5	1,180	743	219	15	979	644	220	25	720	364	169
6	1,030	827	203	16	940	587	250	26	735	363	148
7	900	1,050	230	17	1,100	588	235	27	764	406	197
8	1,020	1,290	278	18	1,210	354	225	28	679	315	158
9	1,050	1,170	247	19	1,200	517	210	29	685	355	199
10	1,240	938	226	20	1,200	569	313	30	676	320	211
								31	-	328	-
Monthly mean discharge, in cfs									1,024	625	226
Runoff, in acre-feet									60,930	38,430	13,450
Runoff, in inches									2.08	1.31	0.46

Cannon River basin

Cannon River at Welch, Minn.

Location.--Lat 44°34', long. 92°44', in sec. 28, T. 113 N., R. 16 W., at Welch, 3 miles upstream from Belle Creek.

Drainage area.--1,320 sq mi.

Gage-height record.--Water-stage recorder graph except for periods of faulty float operation, 1:30 - 11 p.m. Mar. 8, 4 a.m. to noon Mar. 9, 11:30 p.m. Mar. 11 to 11:00 a.m. Mar. 12, 4:30 a.m. to 6:30 p.m. Mar. 29, for which graph was drawn on basis of shape of graph as recorded.

Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Mar. 2-16.

Maxima.--March-June 1950: Discharge, 9,200 cfs 1 p.m. Mar. 27 (gage height, 10.17 ft). 1909-14, 1930 to February 1950: Discharge, 11,300 cfs Mar. 23, 1936 (gage height, 12.04 ft), from rating curve extended above 9,500 cfs.

Remarks.--Flow partly regulated by power plants above station. No diversion above station.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	340	2,380	209	146	16	750	491	354	147
2	280	2,060	357	189	17	710	483	385	137
3	240	1,760	355	193	18	695	468	381	143
4	240	1,440	368	151	19	572	473	385	119
5	220	1,210	400	127	20	273	413	315	167
6	550	1,050	441	192	21	366	399	179	147
7	1,800	943	300		22	359	397	227	166
8	2,200	898	280	132	23	645	293	374	246
9	2,800	836	407	133	24	1,550	192	372	192
10	1,200	1,260	427	138	25	1,570	258	356	144
11	900	967	377	134	26	3,380	282	312	151
12	850	834	379	122	27	8,620	368	210	244
13	800	537	373	803	28	5,730	381	139	147
14	750	539	266	224	29	3,600	379	93	129
15	750	529	192	182	30	2,450	286	139	114
					31	2,420	-	85	-
Monthly mean discharge, in cfs						1,536	760	304	180
Runoff, in acre-feet						94,440	45,220	18,690	10,710
Runoff, in inches						1.34	0.64	0.27	0.15

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 23			Mar. 26 (Con.)			Mar. 30 (Con.)			Apr. 5 (Con.)	
2	1.73	301	N	5.43	2,430	8	5.42	2,430	12	3.44	1,130
4	1.50	229	2	7.46	4,420	10	5.39	2,400		Apr. 6	
6	1.31	177	4	7.98	5,070	12	5.36	2,360	8	3.33	1,070
8	1.16	138	6	7.93	5,010		Mar. 31		4	3.25	1,030
10	1.10	124	8	8.03	5,140	2	5.39	2,400	12	3.18	989
N	1.05	113	10	8.56	5,920	4	5.40	2,410		Apr. 7	
2	1.12	129	12	9.36	7,370	6	5.38	2,390	6	3.14	967
4	3.44	1,130		Mar. 27		8	5.38	2,390	N	3.10	945
6	4.15	1,530	2	9.85	8,420	10	5.33	2,350	6	3.04	912
8	4.14	1,520	4	10.05	8,900	N	5.27	2,310	12	3.03	906
10	4.08	1,480	6	10.08	8,970	2	5.34	2,360		Apr. 8	
12	3.73	1,290	8	10.10	9,020	4	5.34	2,360	6	3.00	890
	Mar. 24		10	10.10	9,020	6	5.56	2,540	N	2.96	868
2	3.74	1,300	N	10.16	9,170	8	5.62	2,590	6	2.94	957
4	3.83	1,350	2	10.16	9,170	10	5.62	2,590	12	2.93	852
6	3.77	1,310	4	10.09	9,000	12	5.70	2,650		Apr. 9	
8	3.44	1,130	6	9.97	8,710		Apr. 1		6	2.91	840
10	3.23	1,020	8	9.75	8,200	4	5.71	2,660	N	2.90	835
N	3.47	1,150	10	9.49	7,640	8	5.45	2,450	4	2.90	835
2	4.37	1,090	12	9.27	7,190	N	5.27	2,310	12	2.87	818
4	5.05	2,140		Mar. 28		4	5.14	2,200		Apr. 10	
6	5.10	2,170	4	8.83	6,360	6	5.15	2,210	2	3.05	918
8	5.04	2,130	8	8.56	5,920	12	5.08	2,160	4	3.04	912
10	5.00	2,100	N	8.40	5,670		Apr. 2		6	3.00	890
12	5.04	2,130	4	8.20	5,380	4	5.01	2,110	8	2.98	879
	Mar. 25		8	7.99	5,090	8	4.92	2,040	10	3.09	940
2	4.92	2,040	12	7.74	4,760	N	4.79	1,950	N	3.25	1,030
4	4.56	1,790		Mar. 29		4	4.93	2,050	2	4.92	2,040
6	4.13	1,520	4	7.40	4,350	8	4.97	2,080	4	4.65	1,860
8	3.85	1,360	8	7.08	3,990	12	5.02	2,110	6	4.18	1,550
10	3.62	1,230	N	6.63	3,520		Apr. 3		8	4.16	1,540
N	3.50	1,160	4	6.17	3,070	4	4.80	1,960	10	3.97	1,420
2	3.51	1,170	8	6.01	2,930	8	4.58	1,810	12	3.77	1,310
4	4.07	1,480	12	5.82	2,760	N	4.44	1,710		Apr. 11	
6	4.48	1,740		Mar. 30		4	4.36	1,660	4	3.34	1,080
8	4.52	1,760	2	5.62	2,590	8	4.28	1,610	8	3:11	950
10	4.48	1,740	4	5.61	2,580	12	4.22	1,570	N	3.02	901
12	4.42	1,690	6	5.49	2,480		Apr. 4		4	2.98	879
	Mar. 26		8	5.43	2,430	8	4.06	1,480	8	2.95	862
2	4.46	1,720	10	5.41	2,420	4	3.91	1,390	12	2.92	946
4	4.34	1,640	N	5.41	2,420	12	3.75	1,300		Apr. 12	
6	4.17	1,540	2	5.34	2,360		Apr. 5		6	2.88	824
8	4.11	1,510	4	5.32	2,350	8	3.63	1,240	N	2.87	818
10	4.35	1,650	6	5.35	2,370	4	3.53	1,180	6	2.87	818

Cannon River at Welch, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 12 (Con.)			Apr. 13 (Con.)			June 12 (Con.)			June 13 (Con.)	
12	2.85	808	12	2.64	700	12	1.59	268	12	1.52	249
	Apr. 13			June 12			June 13			June 14	
2	2.85	808	2	0.76	81	2	2.24	508	2	1.67	292
4	2.67	715	4	.72	74	4	4.47	1,730	4	1.94	385
6	2.33	548	6	.72	74	6	4.65	1,860	6	1.61	274
8	2.07	436	8	.73	76	8	4.65	1,860	8	1.36	207
10	1.82	341	10	.84	94	10	2.61	685	10	1.24	178
N	1.65	286	N	.82	91	N	1.94	385	N	1.14	154
2	1.81	338	2	.75	79	2	1.99	404	2	1.06	137
4	2.05	428	4	.77	82	4	2.50	630	4	1.15	156
6	2.38	571	6	1.75	318	6	2.50	630	6	1.66	289
8	2.50	630	8	1.43	225	8	2.25	512	8	1.41	220
10	2.60	680	10	1.24	178	10	1.82	341	10	1.23	175
									12	1.11	147

Zumbro River basin

Zumbro River at Zumbro Falls, Minn.

Location.--Lat 44°17', long. 92°26', in sec. 36, T. 110 N., R. 14 W., at Zumbro Falls, 700 feet downstream from Spring Creek and 6.3 miles downstream from North Branch. Datum of gage is 811.26 ft above mean sea level, datum of 1929.
Drainage area.--1,130 sq mi.
Gage-height record.--Water-stage recorder graph except periods 1 p.m. Mar. 7 to 4 p.m. Mar. 8, 2-11 a.m. Mar. 9, 12:30 a.m. Mar. 12 to 2:30 p.m. Mar. 13, 9:30 a.m. to 4:30 p.m. June 13, for which graph was drawn (except for Mar. 12) on basis of shape of recorded graph before and after each period.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Discharge for Mar. 12 interpolated. Stage-discharge relation affected by ice Mar. 1-7.
Maxima.--March-June 1950: Discharge, 21,200 cfs 10 a.m. Mar. 27 (gage height, 24.82 ft). 1909-17, 1929 to February 1950: Discharge, 21,800 cfs Apr. 4, 1934 (gage height, 26.26 ft).
Stage known, about 30.5 ft, present site and datum, or 29.7 ft, original site and datum, sometime in April 1888.
Remarks.--No diversions. Diurnal fluctuation caused by power plant above station.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	128	1,270	207	149	16	486	315	314	318
2	134	1,150	235	162	17	308	367	268	227
3	134	1,170	225	149	18	266	370	179	172
4	135	1,020	280	124	19	231	321	159	204
5	220	885	372	130	20	284	293	156	181
6	1,100	853	384	147	21	260	275	164	184
7	7,500	813	297	142	22	221	269	188	166
8	11,200	769	299	133	23	843	191	313	160
9	2,170	505	260	135	24	2,240	305	206	138
10	1,170	751	228	127	25	4,470	343	200	134
11	959	752	223	107	26	7,970	338	204	141
12	903	688	226	98	27	17,200	337	176	130
13	847	490	210	5,490	28	4,210	338	155	127
14	809	469	167	962	29	1,760	250	200	124
15	739	437	194	825	30	1,220	212	164	123
					31	1,160	-	154	-
Monthly mean discharge, in cfs						2,299	552	226	380
Runoff, in acre-feet						141,400	32,850	13,900	22,610
Runoff, in inches						2.35	0.54	0.23	0.38

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 5			Mar. 13 (Con.)			Mar. 25			Mar. 28 (Con.)	
4	7.27		N	8.31	892	2	10.65	2,740	N	12.24	3,840
8	6.87		6	8.27	862	4	11.15	3,160	2	11.85	3,530
N	6.79		12	8.20	810	6	12.00	3,880	4	11.42	3,190
4	7.38			Mar. 14		8	12.67	4,450	6	11.07	2,190
8	7.71		4	8.18	795	10	13.07	3,790	8	10.80	2,690
12	7.78		8	7.98	646	N	13.32	5,010	10	10.56	2,520
	Mar. 6		N	8.35	922	2	13.46	5,130	12	10.00	2,370
4	7.77		4	8.25	848	4	13.64	5,280		Mar. 29	
8	7.77		8	8.24	840	6	13.84	5,460	2	10.14	2,230
N	7.76		12	8.18	795	8	13.82	5,440	4	10.00	2,130
4	8.49			Mar. 15		10	13.70	5,330	6	9.82	2,000
8	10.51		4	8.12	750	12	13.44	5,110	8	9.67	1,900
12	11.19		8	7.75	490		Mar. 26		10	9.65	1,880
	Mar. 7		N	8.25	848	2	12.90	4,650	N	9.51	1,790
6	11.39		4	8.20	810	4	12.80	4,560	2	9.33	1,660
N	15.83		8	8.19	802	6	12.81	4,570	4	9.15	1,540
6	20.00		12	8.10	735	8	12.80	4,560	6	9.00	1,430
12	23.16			Mar. 23		10	13.73	5,360	8	8.92	1,370
	Mar. 8		2	7.70	460	N	15.97	7,470	10	8.86	1,330
6	21.35	15,200	4	7.44	328	2	17.07	8,770	12	8.83	1,310
N	18.96	11,400	6	7.21	234	4	17.80	9,750		Mar. 30	
6	15.50	7,000	8	7.10	195	6	18.45	10,700	2	8.82	1,300
12	11.91	3,810	10	7.07	186	8	19.27	11,900	4	8.81	1,300
	Mar. 9		N	7.09	192	10	20.23	13,400	6	8.78	1,280
6	10.23	2,390	2	7.69	454	12	21.18	14,900	8	8.70	1,220
N	9.74	2,000	4	8.54	1,060		Mar. 27		10	8.68	1,210
6	9.34	1,680	6	9.34	1,680	2	22.02	16,300	N	8.71	1,230
12	8.99	1,400	8	9.83	2,070	4	23.08	18,100	2	8.69	1,210
	Mar. 10		10	9.79	2,040	6	24.05	19,800	4	8.66	1,190
4	8.83	1,280	12	9.64	1,920	8	24.65	20,900	6	8.65	1,180
8	8.59	1,100		Mar. 24		10	24.82	21,200	8	8.63	1,170
N	8.77	1,240	2	9.53	1,830	N	24.59	20,800	10	8.63	1,170
4	8.61	1,120	4	9.49	1,800	2	23.98	19,700	12	8.62	1,160
8	8.56	1,080	6	9.45	1,770	4	23.06	18,100		Mar. 31	
12	8.50	1,040	8	9.35	1,690	6	21.78	15,900	2	8.60	1,150
	Mar. 11		10	9.26	1,620	8	20.26	13,400	4	8.60	1,150
4	8.45	998	N	9.43	1,750	10	18.61	10,900	6	8.58	1,140
8	8.29	878	2	10.10	2,290	12	17.06	8,760	8	8.49	1,070
N	8.40	960	4	11.08	3,100		Mar. 28		10	8.56	1,120
4	8.44	990	6	11.48	3,440	2	15.48	6,810	N	8.60	1,150
8	8.41	968	8	11.28	3,270	4	14.38	5,710	2	8.59	1,140
12	8.34	915	10	10.94	2,980	6	13.67	5,050	4	8.60	1,150
	Mar. 13		12	10.78	2,850	8	13.09	4,530	6	8.61	1,160
6	8.13	758				10	12.64	4,160	8	8.74	1,250

Zumbro River at Zumbro Falls, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 31 (Con.)			Apr. 2 (Con.)			June 12 (Con.)			June 14 (Con.)	
10	8.78	1,280	2	8.57	1,130	8	6.67	88	4	8.29	933
12	8.77	1,270	4	8.56	1,120	N	6.66	86	8	8.24	898
	Apr. 1		6	8.55	1,120	4	6.77	109	12	8.24	898
2	8.86	1,330	8	8.70	1,220	8	6.85	128		June 15	
4	8.91	1,370	10	8.69	1,210	12	6.74	103	4	8.23	891
6	8.89	1,350	12	8.80	1,290		June 13		8	8.03	751
8	8.74	1,250		Apr. 3		2	15.56	6,900	N	8.12	814
10	8.77	1,270	4	8.83	1,310	4	20.13	13,200	4	8.14	828
N	8.78	1,280	8	8.60	1,150	6	19.61	12,400	8	8.14	828
2	8.76	1,260	N	8.62	1,160	8	18.21	10,300	12	8.13	821
4	8.73	1,240	4	8.58	1,140	10	15.96	7,380		June 16	
6	8.72	1,230	8	8.53	1,100	N	13.90	5,260	2	8.07	779
8	8.70	1,220	12	8.50	1,080	2	11.35	3,120	4	7.65	502
10	8.68	1,210		Apr. 4		4	10.15	2,240	6	7.37	327
12	8.65	1,180	4	8.49	1,070	6	9.34	1,670	8	7.22	250
	Apr. 2		8	8.35	975	8	9.03	1,450	10	7.20	240
2	8.64	1,180	N	8.41	1,020	10	8.86	1,330	N	7.10	200
4	8.63	1,170	4	8.42	1,020	12	8.65	1,180	2	7.07	190
6	8.60	1,150	8	8.40	1,010		June 14		4	7.04	180
8	8.46	1,050	12	8.39	1,000	4	8.49	1,070	6	7.13	212
10	8.51	1,090		June 12		8	8.26	912	8	7.20	240
N	8.57	1,130	4	6.67	88	N	8.25	905	10	7.09	197
									12	7.02	174

Zumbro River at Theilman, Minn.

Location.--Lat 44°17'20", long. 92°11'10", in sec. 31, T. 110 N., R. 11 W., at Theilman, a quarter of a mile downstream from highway bridge and half a mile upstream from an unnamed tributary. Datum of gage is 700.00 ft above mean sea level, adjustment of 1912.

Drainage area.--1,320 sq mi.

Gage-height record.--Cantilever chain gage graph constructed on basis of twice-daily readings except Mar. 11-14, June 14-26 when gage was not working and observer probably used a reference mark.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 10,000 cfs and extended to peak stage by logarithmic plotting. Stage-discharge relation affected by ice Mar. 1-7, 13-21, 24. Shifting-control method used Mar. 26 to June 12. Gage heights used to hundredths.

Maxima.--March-June 1950: Discharge, 23,000 cfs June 13 (gage height, 42.09 ft, from floodmark).
1938 to February 1950: Discharge observed, 22,000 cfs Mar. 15, 1945 (gage height, 40.10 ft).

Remarks.--No diversions above station. Diurnal fluctuation from power plant upstream. Gage-height record furnished by Corps of Engineers.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	140	1,400	301	245	16	380	500	387	440
2	130	1,310	308	230	17	340	514	387	321
3	130	1,300	328	236	18	340	542	351	223
4	130	1,120	320	220	19	320	490	280	246
5	160	1,020	500	210	20	320	438	269	205
6	440	965	494	214	21	340	448	245	199
7	6,000	931	494	205	22	373	420	249	201
8	17,400	872	413	203	23	506	362	275	180
9	9,160	828	442	190	24	2,000	338	379	158
10	6,580	735	370	190	25	3,240	442	284	164
11	3,360	994	351	189	26	7,340	420	266	184
12	1,170	757	332	647	27	17,600	445	266	205
13	550	732	335	11,300	28	10,500	429	251	232
14	460	628	325	1,210	29	2,820	362	218	221
15	420	556	264	507	30	1,640	345	298	197
					31	1,460	-	238	-
Monthly mean discharge, in cfs						3,089	688	330	646
Runoff, in acre-feet						189,900	40,940	20,290	38,440
Runoff, in inches						2.70	0.58	0.29	0.55

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 5			Mar. 9 (Con.)			Mar. 26			June 12	
6	27.89		6	36.66	6,980	6	34.53	4,350	4	26.60	173
N	27.95		12	36.30	6,380	N	36.35	6,800	8	26.60	173
6	28.17			Mar. 10		6	37.69	10,100	N	26.59	172
12	28.56		6	36.02	5,960	12	38.26	12,200	4	26.60	173
	Mar. 6		N	36.42	6,570		Mar. 27		8	29.90	1,220
6	29.02		6	36.82	7,290	8	38.91	15,400	12	34.00	3,760
N	29.42		12	36.22	6,260	4	39.74	19,900		June 13	
6	30.75			Mar. 23		12	39.83	20,900	4	38.20	10,600
12	33.70		6	27.38	315		Mar. 28		8	42.09	23,000
	Mar. 7		N	27.59	370	6	38.32	15,500	N	39.85	15,500
6	37.40		6	28.38	632	N	35.93	8,550	4	37.75	9,400
N	38.38		12	29.60	1,090	6	34.40	5,620	8	35.70	5,520
6	39.13			Mar. 24		12	33.09	4,130	12	33.70	3,520
12	39.81		8	31.90			Mar. 29			June 14	
	Mar. 8		4	33.94		8	31.77	3,000	4	31.50	2,010
6	40.48	17,500	12	33.18		4	30.92	2,420	8	29.70	1,120
N	40.76	18,500		Mar. 25		12	30.21	1,970	N	29.10	875
6	40.64	18,100	6	32.10	2,380		Mar. 30		4	28.52	654
12	39.65	14,800	N	33.40	3,280	8	29.74	1,660	8	28.33	586
	Mar. 9		6	34.12	3,870	4	29.48	1,530	12	28.14	521
6	38.22	10,600	12	34.27	4,050	12	29.34	1,460			
N	37.36	8,480									

Whitewater River basin

Whitewater River at Beaver, Minn.

Location.--Lat 44°08'35", long. 92°00'14", in sec. 15, T. 108 N., R. 10 W., 500 ft downstream from Beaver Creek and half a mile northeast of Beaver. Datum of gage is 688.70 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers).
Drainage area.--288 sq mi.
Gage-height record.--Water-stage recorder graph except period Mar. 1-10, for which graph was drawn on basis of once- or twice-daily readings.
Discharge record.--Stage-discharge relation defined by current-meter measurements below 2,700 cfs and extended to peak stage by logarithmic plotting. Stage-discharge relation affected by ice Mar. 1-5, 23, 24. Gage heights used to hundredths. Shifting-control method used Mar. 27, 28, June 13, and June 19-30.
Maxima.--March-June 1950: Discharge, 10,500 cfs 10 a.m. June 13 (gage height, 10.75 ft, from floodmark).
1939 to February 1950: Discharge, 5,350 cfs Apr. 5, 1947, from rating curve extended above 2,700 cfs by logarithmic plotting; gage height, 9.01 ft Mar. 4, 1949.
Flood in September 1938 reached a stage of 92.75 ft, original site and datum, from floodmarks (discharge, 7,500 cfs, computed by Corps of Engineers).
Remarks.--No diversions above station.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	44	327	83	71	16	88	87	78	140
2	42	193	81	72	17	85	86	79	113
3	42	271	81	71	18	83	86	79	103
4	46	149	80	70	19	81	86	78	100
5	48	120	85	69	20	82	83	78	90
6	397	109	80	69	21	82	81	79	84
7	3,030	105	78	68	22	81	80	78	81
8	3,650	101	78	68	23	220	81	76	83
9	264	100	86	89	24	1,600	83	76	89
10	174	104	83	72	25	2,390	96	77	75
11	132	148	80	69	26	3,800	90	76	72
12	109	113	80	68	27	2,910	87	74	69
13	97	97	80	5,130	28	614	85	74	68
14	94	92	80	1,240	29	225	83	73	67
15	89	89	79	195	30	196	86	72	67
					31	235	-	72	-
Monthly mean discharge, in cfs						646	113	78.5	291
Runoff, in acre-feet						39,720	6,720	4,830	17,320
Runoff, in inches						2.59	0.44	0.31	1.13

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 23			Mar. 26 (Con.)			Mar. 31 (Con.)			Apr. 3 (Con.)	
2	1.51		N	7.40	2,390	6	2.66	265	4	2.55	246
4	1.50		2	8.24	3,840	8	2.64	262	6	2.43	227
6	1.48		4	8.67	4,670	10	2.55	246	8	2.27	202
8	1.48		6	9.66	6,990	N	2.43	227	10	2.17	186
10	1.48		8	9.98	7,940	2	2.35	214	12	2.10	176
N	1.49		10	9.62	6,880	4	2.27	202		Apr. 14	
2	1.60		12	9.12	5,620	6	2.24	197	4	2.01	163
4	1.96			Mar. 27		8	2.48	235	8	1.96	156
6	5.72		2	8.84	5,010	10	2.55	246	N	1.89	147
8	6.51		4	8.63	4,950	12	2.83	295	4	1.84	140
10	6.73		6	8.36	4,060		Apr. 1		8	1.80	135
12	6.96		8	8.06	3,490	2	3.51	418	12	1.77	131
	Mar. 24		10	7.77	2,960	4	3.64	443		Apr. 5	
2	7.33		N	7.55	2,600	6	3.43	403	4	1.72	125
4	7.40		2	7.36	2,340	8	3.14	351	8	1.69	122
6	7.25		4	7.10	2,010	10	3.03	331	N	1.67	120
8	7.02		6	6.76	1,690	N	3.05	335	4	1.65	118
10	6.78		8	6.43	1,490	2	3.01	328	8	1.63	115
N	6.62		10	6.08	1,300	4	2.87	303	12	1.62	114
2	6.70		12	5.83	1,140	6	2.71	274		Apr. 6	
4	6.94			Mar. 28		8	2.56	248	4	1.59	111
6	7.10		4	5.31	924	10	2.46	232	8	1.56	108
8	7.33		8	4.62	686	12	2.36	216	N	1.55	106
10	7.70		N	4.08	552		Apr. 2		4	1.58	110
12	8.18		4	3.56	442	2	2.34	212	8	1.58	110
	Mar. 25		8	3.16	359	4	2.33	211	12	1.55	106
2	8.20	3,760	12	2.84	305	6	2.30	206		June 12	
4	8.09	3,550		Mar. 29		8	2.27	202	N	1.14	69
6	7.89	3,170	4	2.67	267	10	2.19	190	12	1.13	68
8	7.73	2,890	8	2.51	240	N	2.14	182		June 13	
10	7.60	2,680	N	2.33	211	2	2.09	175	2	4.91	846
N	7.30	2,260	4	2.23	196	4	2.07	172	4	6.86	1,850
2	6.89	1,770	8	2.20	191	6	2.11	178	6	7.87	3,140
4	6.32	1,290	12	2.19	190	8	2.20	191	8	8.63	4,590
6	6.45	1,390		Mar. 30		10	2.16	185	10	10.75	10,500
8	6.57	1,480	4	2.47	233	12	2.36	216	N	10.48	9,580
10	6.80	1,680	8	2.42	225		Apr. 3		2	9.86	7,570
12	6.96	1,850	N	2.19	190	2	3.11	346	4	9.38	6,240
	Mar. 26		4	2.08	173	4	3.18	358	6	9.20	5,800
2	6.94	1,820	8	2.02	165	6	2.95	317	8	8.96	5,270
4	6.90	1,780	12	2.20	191	8	2.76	283	10	8.62	4,570
6	6.86	1,740		Mar. 31		10	2.83	295	12	8.29	3,930
8	6.94	1,820	2	2.45	230	N	2.93	313		June 14	
10	7.13	2,050	4	2.62	258	2	2.77	285	2	7.98	3,340

Whitewater River at Beaver, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	June 14 (Con.)			June 15			June 16 (Con.)			June 19	
4	7.64	2,740	4	2.81	224	8	1.92	129	8	1.61	102
6	7.19	2,120	8	2.68	208	12	1.88	125	4	1.56	97
8	6.58	1,490	N	2.51	188		June 17		12	1.51	93
10	5.52	888	4	2.41	177	8	1.79	117		June 20	
N	4.56	547	8	2.31	166	4	1.69	108	8	1.49	91
2	3.95	410	12	2.24	159	12	1.64	104	4	1.46	89
4	3.64	356		June 16			June 18		12	1.42	85
6	3.42	318	4	2.16	151	8	1.61	101		June 21	
8	3.26	293	8	2.10	145	4	1.63	103	8	1.40	84
10	3.12	270	N	2.04	140	12	1.69	108	4	1.39	83
12	3.00	252	4	1.99	135				12	1.38	82

South Fork Whitewater River near Altura, Minn.

Location.--Lat 44°04'10", long. 91°58'49", in SE¼ sec. 14, T. 107 N., R. 10 W., 500 ft upstream from highway bridge, 1.4 miles upstream from unnamed tributary entering from the west, 2 miles west of Altura, and 2.4 miles upstream from Keefer Creek. Datum of gage is 761.80 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers).
Drainage area.--76.8 sq mi.
Gage-height record.--Water-stage recorder graph except for period 10 p.m. Mar. 5 to 5 p.m. Mar. 6, 10 a.m. June 13 to June 30 when there was no gage-height record.
Discharge record.--Stage-discharge relation defined by current-meter measurements below 1,700 cfs and extended to peak on basis of velocity-area studies. Discharge affected by ice Mar. 1-6, 8-14. Discharges for periods of no gage-height record were computed on basis of one discharge measurement, weather records, and records for Rush Creek near Rushford. Gage heights used to hundredths.
Maxima.--March-June 1950: Discharge, 3,460 cfs 3 p.m. Mar. 26 (gage height, 9.84 ft).
1939 to February 1950: Discharge, 3,880 cfs Aug. 31, 1947 (gage height, 10.61 ft), from rating curve extended above 1,700 cfs as described above.
Remarks.--No regulation or diversions above station.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	11	49	14	13	16	13	14	14	14
2	11	31	14	14	17	13	14	14	13
3	11	41	14	13	18	13	14	14	15
4	11	23	14	13	19	12	14	14	20
5	110	19	14	12	20	12	14	15	15
6	1,000	17	14	12	21	13	14	15	14
7	1,400	16	14	12	22	13	14	14	13
8	380	16	14	13	23	176	14	14	25
9	40	16	16	18	24	485	15	14	15
10	22	16	15	14	25	430	16	15	14
11	17	20	15	13	26	1,790	15	14	13
12	14	19	14	13	27	511	15	14	13
13	12	16	14	762	28	88	14	14	13
14	13	15	14	40	29	34	14	14	13
15	14	14	14	15	30	35	15	14	13
					31	49	-	14	-
Monthly mean discharge, in cfs						218	18.1	14.2	40.0
Runoff, in acre-feet						13,400	1,080	873	2,380
Runoff, in inches						3.27	0.26	0.21	0.58

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 5			Mar. 8 (Con.)			Mar. 24 (Con.)			Mar. 27 (Con.)	
2	1.35		N	2.18		6	2.28	164	8	3.50	531
4	1.35		2	2.01		8	2.40	190	N	3.00	359
6	1.34		4	1.98		10	2.36	181	4	2.65	254
8	1.34		6	1.96		N	2.40	190	8	2.43	197
10	1.34		8	1.95		2	3.50	531	12	2.24	156
N	1.34		10	1.90		4	4.75	1,020		Mar. 28	
2	1.35		12	1.85		6	4.73	1,010	4	2.12	134
4	1.35			Mar. 9		8	4.36	860	8	1.93	104
6	1.69		4	1.72		10	4.31	840	N	1.73	78
8	2.00		8	1.69		12	4.34	852	4	1.60	61
10	5.30		N	1.54			Mar. 25		8	1.52	52
12	6.15		4	1.29		2	4.10	758	12	1.50	49
	Mar. 6		8	1.23		4	3.82	650		Mar. 29	
6	3.75		12	1.25		6	3.46	517	2	1.44	43
8	3.45			Mar. 10		8	3.04	372	4	1.40	39
10	4.04		4	1.26		10	2.61	243	6	1.36	35
12	4.45		8	1.32		N	2.35	179	8	1.32	32
	Mar. 7		N	1.32		2	2.48	209	10	1.28	28
2	4.36	860	4	1.20		4	3.13	402	N	1.25	26
4	4.32	844	8	1.21		6	3.30	460	2	1.23	25
6	4.50	916	12	1.36		8	3.14	405	4	1.24	26
8	4.76	1,020		Mar. 23		10	3.00	359	6	1.28	28
10	4.86	1,060	2	.98	12	12	3.10	392	8	1.32	32
N	5.10	1,160	4	.98	12		Mar. 26		10	1.48	47
2	6.10	1,580	6	.99	13	2	3.00	359	12	1.44	43
4	7.76	2,360	8	.99	13	4	3.08	385		June 13	
6	7.47	2,220	10	.99	13	6	4.30	836	2	5.00	1,120
8	6.72	1,850	N	1.05	15	8	4.74	1,010	4	7.72	2,340
10	6.37	1,700	2	1.41	40	10	4.55	936	6	7.18	2,070
12	6.05	1,560	4	2.45	202	N	8.50	2,730	8	5.73	1,420
	Mar. 8		6	3.45	513	2	9.55	3,300	10	4.60	956
2	5.21		8	3.60	567	4	9.30	3,160	N	3.70	604
4	4.39		10	3.08	385	6	8.70	2,840	2	2.90	327
6	3.44		12	2.65	254	8	8.53	2,750	4	2.10	130
8	2.85			Mar. 24		10	7.65	2,300	6	1.60	61
10	2.46		2	2.30	168	12	6.10	1,580	8	1.40	39
			4	2.08	127		Mar. 27		10	1.40	39
						4	4.35	856	12	1.40	39

Gilmore Creek basin

Gilmore Creek at Winona, Minn.

Location.--Lat 44°02'40", long. 91°41'25", in sec. 29, T. 107 N., R. 7 W., at west edge of Winona, 1,500 ft upstream from U. S. Highway 14, 2¼ miles upstream from Lake Winona, and 6½ miles upstream from mouth. Datum of gage is 672.92 ft above mean sea level, adjustment of 1912.

Drainage area.--8.95 sq mi.

Gage-height record.--Water-stage recorder graph.

Discharge record.--Stage-discharge relation defined by current-meter measurements. Shifting-control method used Mar. 5, 7, 16, 17, Mar. 19 to June 30. Stage-discharge relation affected by ice Mar. 1-5, 8-15, 18. Gage heights used to hundredths.

Maxima.--March-June 1950: Discharge, 330 cfs 12:30 p.m. Mar. 26 (gage height, 3.00 ft). 1939 to February 1950: Discharge, 2,460 cfs July 27, 1947 (gage height, 6.97 ft), from rating curve extended above 260 cfs on basis of slope-area determination at gage height, 6.74 ft.

Remarks.--Regulation at times by swimming pool three-quarters of a mile upstream. No diversions.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	3.2	3.7	3.5	3.2	16	3.2	3.6	3.3	3.2
2	3.0	3.7	3.5	3.2	17	3.2	3.6	3.3	3.2
3	3.0	3.7	3.5	3.2	18	3.2	3.6	3.3	3.2
4	3.2	3.7	3.5	3.2	19	3.3	3.6	3.3	3.1
5	34	3.7	3.5	3.1	20	3.2	3.6	3.3	3.1
6	51	3.6	3.4	3.1	21	3.2	3.5	3.3	3.2
7	63	3.7	3.4	3.1	22	3.6	3.5	3.3	3.2
8	4.3	3.8	3.4	3.1	23	17	3.5	3.3	9.0
9	3.4	3.8	3.7	3.5	24	23	3.5	3.3	3.5
10	3.1	4.2	3.6	3.2	25	16	3.7	3.6	3.3
11	3.1	3.8	3.5	3.2	26	63	3.6	3.3	3.2
12	3.1	3.8	3.4	3.2	27	7.8	3.6	3.3	3.2
13	3.1	3.6	3.4	14	28	4.2	3.5	3.3	3.2
14	3.2	3.6	3.3	3.3	29	3.7	3.5	3.3	3.2
15	3.2	3.6	3.3	3.2	30	3.8	3.5	3.3	3.2
					31	3.9	-	3.3	-
Monthly mean discharge, in cfs						11.4	3.65	3.39	3.76
Runoff, in acre-feet						701	217	208	224
Runoff, in inches						1.46	0.45	0.44	0.47

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 5			Mar. 8			Mar. 24			Mar. 27	
2	0.80		2	0.60		2	0.67	11	2	0.61	13
4	.80		4	.51		4	.63	9.6	4	.59	12
6	.80		6	.52		6	.64	10	6	.58	11
8	.79		8	.57		8	.64	10	8	.49	7.6
10	.78		10	.58		10	.81	18	10	.45	6.0
N	.77		N	.57		N	.82	18	N	.44	5.7
2	.86	16	2	.53		2	1.30	46	2	.44	5.7
4	1.65	65	4	.49		4	1.32	47	4	.44	5.7
6	1.99	98	6	.49		6	1.30	46	6	.44	5.7
8	1.94	92	8	.58		8	1.01	28	8	.44	5.7
10	1.66	66	10	.62		10	.81	18	10	.44	5.7
12	1.41	47	12	.61		12	.68	12	12	.43	5.5
	Mar. 6			Mar. 22			Mar. 25			Mar. 28	
2	1.26	37	2	.40	3.2	2	.60	8.8	4	.39	4.6
4	1.18	33	4	.40	3.2	4	.55	6.8	8	.36	4.2
6	1.10	28	6	.40	3.2	6	.52	5.7	N	.34	3.9
8	1.04	25	8	.40	3.2	8	.49	5.0	4	.34	3.9
10	.98	22	10	.40	3.2	10	.48	4.8	8	.34	3.9
N	.95	20	N	.40	3.2	N	.49	5.0	12	.33	3.8
2	.94	20	2	.41	3.3	2	.74	15		June 13	
4	1.37	44	4	.49	4.2	4	1.26	44	2	.65	12
6	2.36	147	6	.53	4.8	6	1.14	36	4	2.01	116
8	2.14	116	8	.50	4.3	8	.98	27	6	.95	27
10	1.76	75	10	.47	3.9	10	.81	18	8	.64	12
12	1.48	52	12	.44	3.6	12	.69	13	10	.44	4.6
	Mar. 7			Mar. 23			Mar. 26		N	.38	3.8
2	1.41	48	2	.43	3.7	2	.64	10	2	1.16	39
4	1.40	47	4	.42	3.6	4	.63	10	4	.36	3.6
6	1.41	48	6	.41	3.5	6	1.60	71	6	.35	3.5
8	1.41	48	8	.41	3.5	8	1.80	90	8	.35	3.5
10	1.43	49	10	.40	3.4	10	1.33	50	10	.34	3.4
N	1.53	57	N	.65	9.6	N	2.50	202	12	.34	3.4
2	1.62	64	2	1.12	33	2	1.85	102		June 14	
4	2.62	192	4	1.28	43	4	1.48	66	4	.34	3.4
6	1.90	89	6	1.30	44	6	1.06	36	8	.34	3.4
8	1.33	42	8	1.10	32	8	.88	26	N	.33	3.3
10	1.04	26	10	.90	22	10	.72	18	4	.32	3.2
12	.78	13	12	.76	14	12	.66	15	8	.32	3.2
									12	.32	3.2

Root River basin

Root River near Lanesboro, Minn.

Location.--Lat 43°44'58", long. 91°58'43", in sec. 1, T. 103 N., R. 10 W., half a mile upstream from County Highway 3, 1½ miles upstream from South Branch, and 2½ miles northeast of Lanesboro. Datum of gage is 791.84 ft above mean sea level, adjustment of 1912.
Drainage area.--615 sq mi.
Gage-height record.--Water-stage recorder graph except for period 4 p.m. Mar. 8 to 5 p.m. Mar. 10 when there was no record. For period 4 - 12 p.m. Mar. 8 graph was drawn on basis of trend of adjacent recorder graph.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Discharge for period of no gage-height record computed on basis of records for station near Houston, and weather records. Stage-discharge relation affected by ice Mar. 1-7. Shifting-control method used Mar. 14-22.
Maxima.--March-June 1950: Discharge, 20,500 cfs 3 - 4 a.m. Mar. 27 (gage height, 15.55 ft). 1910-17, 1940 to February 1950: Discharge, 15,000 cfs June 29, 1942 (gage height, 14.53 ft), by slope-area method.
Remarks.--Flood flow not affected by storage.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	100	718	163	101	16	226	177	134	144
2	90	555	160	98	17	218	181	131	117
3	85	599	153	98	18	179	166	131	131
4	90	454	150	98	19	198	166	120	111
5	160	360	120	94	20	187	166	126	114
6	1,700	285	147	91	21	165	156	123	108
7	5,500	261	140	88	22	162	147	120	101
8	7,840	221	147	88	23	505	150	117	101
9	2,400	241	173	200	24	2,110	147	106	106
10	800	237	170	172	25	3,090	166	114	68
11	253	281	173	124	26	10,900	181	117	96
12	265	301	166	105	27	15,200	193	111	96
13	288	265	153	2,700	28	2,480	173	106	86
14	268	213	150	304	29	856	156	106	86
15	268	193	134	182	30	652	160	106	80
					31	587	-	101	-
Monthly mean discharge, in cfs						1,865	256	135	203
Runoff, in acre-feet						114,700	15,230	8,300	12,080
Runoff, in inches						3.50	0.46	0.25	0.37

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 5			Mar. 8 (Con.)			Mar. 25 (Con.)			Mar. 30 (Con.)	
2	2.18		N	10.13	8,070	10	6.18	2,670	8	4.03	728
4	2.18		2	9.54	7,110	12	6.25	2,750	N	3.92	662
6	2.18		4	8.82	6,100		Mar. 26		4	3.84	617
8	2.25		6	8.25	5,400	2	6.23	2,730	8	3.77	578
10	2.27		8	7.62	4,640	4	6.18	2,670	12	3.73	556
N	2.34		10	6.90	3,820	6	7.16	3,890		Mar. 31	
2	2.96		12	6.35	3,220	8	7.50	4,330	4	3.72	551
4	3.17			Mar. 23		10	9.67	7,310	8	3.84	617
6	5.29		2	2.18	268	N	12.60	13,200	N	3.87	634
8	5.70		4	2.18	268	2	13.15	14,500	4	3.80	595
10	4.55		6	2.15	259	4	13.90	16,300	8	3.77	578
12	4.67		8	2.05	229	6	14.42	17,600	12	3.70	540
	Mar. 6		10	2.01	218	8	14.75	18,400		Apr. 1	
2	4.71		N	2.12	250	10	14.93	18,900	4	3.95	680
4	5.15		2	2.80	452	12	15.17	19,500	8	4.30	900
6	5.21		4	3.30	638		Mar. 27		N	4.19	828
8	5.11		6	3.95	944	2	15.51	20,400	4	4.00	710
10	5.18		8	4.14	989	4	15.55	20,500	8	3.91	656
N	5.15		10	4.30	1,010	6	15.31	19,800	12	3.80	595
2	5.12		12	4.23	895	8	14.95	18,900		Apr. 2	
4	5.69			Mar. 24		10	14.52	17,800	4	3.78	584
6	6.00		2	4.18	822	N	14.10	16,800	8	3.84	617
8	9.18		4	4.15	802	2	13.61	15,600	N	3.85	622
10	9.14		6	4.14	796	4	12.73	13,500	4	3.67	524
12	9.50		8	4.15	802	6	11.73	11,300	8	3.62	496
	Mar. 7		10	4.32	914	8	10.50	8,740	12	3.58	475
2	9.07		N	4.63	1,140	10	9.44	6,960		Apr. 3	
4	8.94		2	5.10	1,530	12	8.55	5,700	4	3.66	518
6	8.46		4	5.94	2,400		Mar. 28		8	4.11	776
8	8.03		6	7.12	3,840	4	6.95	3,620	N	3.94	674
10	7.83		8	7.88	4,820	8	6.15	2,640	4	3.78	584
N	8.23		10	7.83	4,760	N	5.60	2,030	8	3.77	578
2	9.01		12	7.58	4,430	4	5.26	1,680	12	3.60	485
4	10.87			Mar. 25		8	5.00	1,440		Apr. 4	
6	11.24		2	7.34	4,120	12	4.78	1,250	4	3.62	496
8	11.54		4	7.05	3,740		Mar. 29		8	3.62	496
10	11.71		6	6.79	3,410	4	4.57	1,090	N	3.55	460
12	11.61		8	6.62	3,190	8	4.27	880	4	3.48	425
	Mar. 8		10	6.41	2,940	N	4.11	776	8	3.45	410
2	11.24	10,300	N	6.27	2,770	4	4.02	722	12	3.41	390
4	11.87	11,600	2	6.22	2,710	8	3.97	692		Apr. 5	
6	11.59	11,000	4	6.23	2,730	12	3.98	698	4	3.36	365
8	10.99	9,730	6	6.13	2,610		Mar. 30		8	3.33	350
10	10.54	8,820	8	6.10	2,580	4	3.98	698	N	3.29	331

Root River near Lanesboro, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 5 (Con.)			June 10 (Con.)			June 12 (Con.)			June 15 (Con.)	
4	3.29	331	8	2.82	147	8	2.64	96	N	3.11	257
8	3.24	310	10	2.80	140	10	2.64	96	4	2.86	160
12	3.25	314	12	2.76	128	12	2.64	96	8	2.90	173
	June 9			June 11			June 13		12	2.87	163
2	3.03	225	2	2.74	123	2	3.19	289		June 16	
4	2.97	201	4	2.74	123	4	8.03	6,020	2	2.86	160
6	3.08	245	6	2.74	123	6	9.01	6,340	4	2.86	160
8	2.76	128	8	2.68	106	8	8.24	5,290	6	2.78	134
10	2.74	123	10	2.76	128	10	7.31	4,080	8	2.82	147
N	2.87	163	N	2.76	128	N	6.99	3,670	10	2.80	140
2	3.03	225	2	2.75	126	2	6.44	2,980	N	2.65	98
4	2.93	185	4	2.74	123	4	5.35	1,7	2	2.70	111
6	2.90	173	6	2.76	128	6	4.66	1,160	4	2.78	134
8	3.14	269	8	2.75	126	8	4.19	828	6	2.78	134
10	3.18	285	10	2.74	123	10	3.88	639	8	2.77	131
12	3.09	249	12	2.74	123	12	3.68	529	10	2.99	209
	June 10			June 12			June 14		12	2.92	181
2	3.02	221	2	2.68	106	4	3.42	395		June 17	
4	2.95	193	4	2.66	101	8	3.26	318	4	2.81	143
6	2.91	177	6	2.66	101	N	3.13	265	8	2.77	131
8	2.90	173	8	2.71	114	4	3.05	233	N	2.77	131
10	2.81	143	10	2.71	114	8	3.09	249	4	2.58	82
N	2.92	181	N	2.71	114	12	2.97	201	8	2.44	56
2	2.90	173	2	2.70	111		June 15		12	2.79	137
4	2.88	166	4	2.65	98	4	2.92	181			
6	2.86	160	6	2.65	98						

Root River near Houston, Minn.

Location.--Lat 43°46', long. 91°35', in sec. 32, T. 104 N., R. 6 W., 1 mile west of Houston and 2½ miles upstream from South Fork. Datum of gage is 671.86 ft above mean sea level, datum of 1929.
Drainage area.--1,270 sq mi.
Gage-height record.--Water-stage recorder graph except periods of no gage-height record, Mar. 8, 9, Mar. 20-22, May 28 to June 9. Graphs for Mar. 8, 9, June 9 partly estimated.
Discharge record.--Stage-discharge relation defined by current-meter measurements below 20,000 cfs and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Mar. 1-7, 9-20, 22-24. Discharge for period of no gage-height record computed on basis of one discharge measurement, interpolated, and records for station below South Fork. Shifting-control method used Mar. 29 to June 30.
Maxima.--March-June 1950: Discharge, 26,200 cfs 2 p.m. Mar. 27 (gage height, 14.15 ft).
1909-17, 1929 to February 1950: Discharge, 26,600 cfs Mar. 31, 1933, from rating curve extended above 20,000 cfs; gage height, 14.9 ft Mar. 11, 1936.
Remarks.--Power Plant at Rushford, 12 miles upstream, causes considerable diurnal fluctuations. Small diversion through culvert and over highway between the bridge and railroad during high stages.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	240	1,150	408	307	16	500	477	357	695
2	220	1,070	403	298	17	500	463	357	562
3	220	940	403	295	18	480	458	346	501
4	220	897	395	295	19	440	444	330	463
5	320	766	426	285	20	440	435	323	421
6	3,800	677	440	276	21	440	426	334	444
7	11,000	621	382	270	22	440	412	338	378
8	13,000	594	369	270	23	650	403	326	361
9	2,800	578	496	766	24	3,000	430	326	430
10	1,500	588	487	575	25	5,790	496	350	361
11	850	605	435	409	26	9,500	463	338	316
12	650	599	426	359	27	24,200	426	319	308
13	600	568	408	5,540	28	10,300	444	320	301
14	550	531	395	1,990	29	2,220	435	320	291
15	550	496	378	1,230	30	1,430	417	323	279
					31	1,210	-	315	-
Monthly mean discharge, in cfs						3,192	577	373	643
Runoff, in acre-feet						196,300	34,330	22,930	38,260
Runoff, in inches						2.90	0.51	0.34	0.56

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 5			Mar. 9 (Con.)			Mar. 16			Mar. 24 (Con.)	
4	3.02		8	6.31		4	4.05		10	8.16	
8	3.04		12	6.02		8	3.81		12	8.63	
N	3.11			Mar. 10		N	3.90			Mar. 25	
4	3.50		4	5.72		4	4.01		2	8.85	6,520
8	5.12		8	5.83		8	4.08		4	8.92	6,630
12	5.66		N	5.91		12	4.01		6	8.93	6,650
	Mar. 6		4	6.29			Mar. 17		8	8.93	6,650
2	5.80		8	6.24		4	3.87		10	8.82	6,470
4	7.53		12	6.00		8	3.79		N	8.46	5,930
6	7.61			Mar. 11		N	3.73		2	8.15	5,500
8	7.63		4	5.80		4	3.87		4	7.87	5,150
10	7.81		8	5.59		8	3.82		6	7.67	4,910
N	8.40		N	5.61		12	3.60		8	7.57	4,790
2	8.97		4	5.59			Mar. 18		10	7.56	4,780
4	9.11		8	5.40		4	3.50		12	7.60	4,830
6	9.56		12	5.15		8	3.42			Mar. 26	
8	10.10			Mar. 12		N	3.39		2	7.60	4,830
10	10.80		4	4.87		4	3.23		4	7.63	4,870
12	10.89		8	4.78		8	3.16		6	7.73	4,990
	Mar. 7		N	4.78		12	3.14		8	8.24	5,630
2	11.46		4	5.12			Mar. 23		10	8.69	6,280
4	10.73		8	4.98		2	2.77		N	10.48	10,500
6	9.15		12	4.77		4	2.77		2	10.88	12,000
8	10.81			Mar. 13		6	2.75		4	10.94	12,300
10	10.70		4	4.58		8	2.73		6	11.03	12,600
N	10.81		8	4.34		10	2.71		8	11.23	13,400
2	10.93		N	4.21		N	2.70		10	11.67	15,200
4	11.23		4	4.68		2	2.91		12	12.53	18,900
6	11.22		8	4.71		4	3.50			Mar. 27	
8	11.25		12	4.50		6	4.09		2	13.02	21,100
10	11.20			Mar. 14		8	4.41		4	13.30	22,400
12	11.22		4	4.30		10	4.74		6	13.59	23,700
	Mar. 8		8	4.07		12	5.90		8	13.91	25,100
4	11.32	13,800	N	3.80			Mar. 24		10	13.97	25,400
8	11.17	13,200	4	4.37		2	6.50		N	14.12	26,000
N	11.35	13,900	8	4.47		4	6.70		2	14.15	26,200
4	11.37	14,800	12	4.46		6	6.94		4	14.14	26,100
8	11.62	15,000		Mar. 15		8	6.98		6	14.06	25,800
12	10.75	11,500	4	4.18		10	6.87		8	13.83	24,700
	Mar. 9		8	3.97		N	6.66		10	13.55	23,500
4	9.05		N	3.84		2	6.51		12	13.28	22,300
8	7.77		4	4.22		4	6.52			Mar. 28	
N	7.09		8	4.24		6	6.85		4	12.36	18,100
4	6.77		12	4.23		8	7.50		8	11.38	14,100

Root River near Houston, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 28 (Con.)			Apr. 2 (Con.)			June 9 (Con.)			June 14	
N	9.92	8,760	N	3.32	1,040	2	3.10	936	2	6.47	3,520
4	7.59	4,820	4	3.24	1,000	4	4.00	1,440	4	5.78	2,730
8	6.60	3,700	8	3.22	995	6	4.13	1,530	6	5.30	2,200
12	5.96	3,060	12	3.21	988	8	3.78	1,300	8	4.92	1,860
	Mar. 29			Apr. 3		10	3.33	1,050	10	4.59	1,600
4	5.54	2,670	4	3.22	995	12	2.93	870	N	4.35	1,440
8	5.20	2,370	8	3.08	930		June 10		2	4.15	1,320
N	4.96	2,160	N	3.03	912	4	2.42	670	4	3.98	1,220
4	4.73	1,960	4	2.97	882	8	2.18	610	6	3.85	1,140
8	4.51	1,800	8	3.08	930	N	2.00	526	8	4.72	1,690
12	4.33	1,670	12	3.24	1,000	4	1.94	506	10	5.23	2,130
	Mar. 30			Apr. 4		8	1.85	477	12	5.20	2,110
4	4.16	1,550	4	3.16	960	12	1.76	453		June 15	
8	3.99	1,430	8	3.06	924		June 11		6	4.41	1,480
N	3.91	1,370	N	2.99	888	6	1.68	426	N	3.78	1,100
4	3.88	1,360	4	2.90	852	N	1.61	408	6	3.40	900
8	3.88	1,360	8	2.86	840	6	1.55	390	12	3.14	792
12	3.86	1,350	12	2.85	834	12	1.49	373		June 16	
	Mar. 31			Apr. 5			June 12		6	3.00	732
4	3.77	1,300	6	2.75	798	6	1.46	365	N	2.87	687
8	3.66	1,230	N	2.67	762	N	1.42	357	6	2.79	654
N	3.55	1,170	6	2.58	726	6	1.40	353	12	2.70	621
4	3.46	1,110	12	2.56	720	12	1.38	350		June 17	
8	3.51	1,150		Apr. 6			June 13		6	2.60	578
12	3.63	1,210	6	2.52	704	2	1.50	378	N	2.50	541
	Apr. 1		N	2.42	670	4	3.40	1,090	6	2.52	551
4	3.65	1,220	6	2.36	648	6	7.70	4,950	12	2.49	536
8	3.51	1,150	12	2.38	654	8	8.32	5,740		June 18	
N	3.37	1,070		June 9		10	8.38	5,820	6	2.45	526
4	3.32	1,040	2	1.20	276	N	9.92	8,760	N	2.33	487
8	3.57	1,180	4	1.20	276	2	9.92	8,760	6	2.31	482
12	3.66	1,230	6	1.22	282	4	9.89	8,680	12	2.34	492
	Apr. 2		8	1.50	378	6	9.90	8,700		June 19	
4	3.57	1,180	10	2.03	536	8	9.08	6,900	6	2.30	477
8	3.45	1,110	N	2.38	660	10	7.86	5,120	N	2.23	453
						12	7.10	4,180	6	2.24	453
									12	2.22	449

Root River below South Fork, near Houston, Minn.

Location.--Lat 43°46', long. 91°32', in sec. 34, T. 104 N., R. 6 W., 600 ft downstream from South Fork and 1½ miles northeast of Houston. Datum of gage is 660.00 ft above mean sea level, adjustment of 1912.

Drainage area.--1,560 sq mi.

Gage-height record.--Graph drawn on basis of chain gage or staff gage readings and floodmarks for periods Mar. 5-7, 9, 11-15, June 8-16. Gage read twice daily except Mar. 26 (one reading) and Mar. 7, 8, 10, 27 when no readings were made. Floodmarks were available Mar. 7, 27. Average of twice-daily readings used Mar. 1-4, 16-22, Apr. 1 to June 7, June 17-30.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 6,900 cfs and extended to peak stage on basis of flow of Root River near Houston combined with flow of South Fork, as determined from contracted-opening measurement. Gage heights used to hundredths. Stage-discharge relation affected by ice Mar. 1-7, 9, 11-24. Discharge for periods of no gage-height record Mar. 8, 10, computed on basis of records for station near Houston. Shifting-control method used Mar. 25, 26, Mar. 30 to June 30.

Maxima.--March-June 1950: Discharge, 31,100 cfs 6 a.m. Mar. 27 (gage height, 16.56 ft, from floodmark).

1938-February 1950: Discharge observed, 23,600 cfs June 30, 1942; gage height observed, 18.05 ft Sept. 10, 11, 1938, on high-water staff gage 1,000 ft upstream.

Remarks.--Flow partly regulated by power plants above station. No diversions above station. Gage-height record furnished by Corps of Engineers.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	280	1,680	614	356	16	550	675	493	1,070
2	260	1,680	609	356	17	600	670	457	946
3	260	1,400	592	360	18	550	664	474	758
4	280	1,280	576	344	19	500	664	440	648
5	460	1,050	763	347	20	500	631	449	565
6	4,600	840	680	334	21	550	642	453	900
7	17,000	796	503	325	22	600	626	440	544
8	19,000	763	453	326	23	900	604	444	503
9	3,200	730	834	1,120	24	4,400	604	432	796
10	1,700	730	741	795	25	6,940	870	440	592
11	1,100	796	604	482	26	17,000	730	436	457
12	850	780	582	412	27	29,800	680	413	406
13	750	758	560	8,530	28	13,800	664	391	398
14	700	736	544	3,100	29	2,770	648	367	406
15	600	708	538	2,140	30	2,070	648	367	409
					31	1,810	-	370	-
Monthly mean discharge, in cfs						4,335	825	518	958
Runoff, in acre-feet						266,500	49,090	31,850	57,000
Runoff, in inches						3.20	0.59	0.38	0.68

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 5			Mar. 13 (Con.)			Mar. 27			June 10	
6	7.19		N	11.36		6	16.56	31,100	8	7.16	802
N	7.39		6	11.36		N	16.54	30,900	4	6.92	670
6	7.79		12	11.38		6	16.38	29,300	12	6.73	565
12	9.85			Mar. 14		12	16.00	25,500		June 11	
	Mar. 6		6	11.36			Mar. 28		8	6.57	493
6	12.59		N	11.23		6	15.53	21,300	4	6.49	457
N	13.00		6	10.98		N	14.74	14,700	12	6.42	428
6	13.48		12	10.35		6	11.51	4,580		June 12	
12	15.00			Mar. 15		12	10.24	3,440	8	6.35	402
	Mar. 7		6	9.75			Mar. 29		4	6.32	391
4	16.40		N	9.81		6	9.52	2,930	12	6.49	457
8	16.53		6	9.97		N	9.17	2,690		June 13	
N	16.43		12	9.96		6	8.98	2,560	4	6.72	631
4	16.21			Mar. 23		12	8.66	2,330	8	9.00	2,490
8	15.99		8	6.41			Mar. 30		N	12.50	6,500
12	15.79		4	6.60		6	8.49	2,090	4	15.00	21,900
	Mar. 9		12	10.40		N	8.40	2,020	8	14.38	16,500
4	14.94			Mar. 24		6	8.37	2,000	12	12.50	5,900
8	14.94		6	13.43		12	8.34	1,980		June 14	
N	15.26		N	13.40			Mar. 31		6	10.31	3,500
4	15.42		6	13.40		6	8.27	1,850	N	8.77	2,310
8	15.22		12	13.48		N	8.34	1,900	6	8.13	1,790
12	14.80			Mar. 25		6	8.04	1,690	12	10.55	3,680
	Mar. 11		6	13.55	8,670	12	7.97	1,640		June 15	
6	12.42		N	12.86	6,640		June 8		4	10.37	3,540
N	12.23		6	11.78	5,680	6	6.13	328	8	9.34	2,780
6	12.31		12	11.42	5,100	N	6.10	319	N	8.04	1,720
12	12.02			Mar. 26		6	6.08	314	4	7.40	1,250
	Mar. 12		4	11.43	5,110	12	6.18	344	8	7.30	1,170
6	11.58		8	11.80	5,710		June 9		12	7.24	1,120
N	11.73		N	15.00	16,700	6	6.62	498		June 16	
6	11.75		4	16.15	27,000	N	8.00	1,340	8	7.15	1,050
12	11.57		8	16.40	29,500	6	8.57	1,740	4	7.17	1,060
	Mar. 13		12	16.50	30,500	12	7.88	1,260	12	7.19	1,090
6	11.40										

Rush Creek near Rushford, Minn.

Location.--Lat 43°50'00", long. 92°46'40", on line between secs. 3 and 10, T. 104 N., R. 8 W., 1½ miles northwest of Rushford and 3 miles upstream from mouth. Datum of gage is 735.00 ft above mean sea level, adjustment of 1912.

Drainage area.--129 sq mi.

Gage-height record.--Water-stage recorder graph Mar. 1 to June 14, except faulty record, Mar. 28, 29, and no gage-height record June 7-14. Graph for faulty record partly estimated. Chain gage or reference point readings made twice daily June 15-30, but readings on June 27-30 were considered doubtful.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 1,100 cfs and extended above on basis of contracted-opening determination of peak stage. Discharge affected by ice Mar. 1-7. Discharge for periods of doubtful gage readings and no gage-height record computed on basis of weather records, engineers' notes, and records for Root River near Lanesboro. Shifting-control method used Mar. 8-23, Apr. 26 to June 6 and June 15-30. Gage heights used to hundredths.

Maxima.--March-June 1950: Discharge, 11,600 cfs 4 p.m. Mar. 26 (gage height, 13.54 ft, from floodmark).

1942 to February 1950: Discharge, 7,130 cfs Jan. 5, 1946 (gage height, 13.10 ft), from rating curve extended above 1,600 cfs on basis of slope-area determination at gage height 15.00 ft, present datum.

Discharge previously known, 11,000 cfs June 28, 29, 1942, by slope-area method.

Remarks.--No diversions or regulation above station.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	34	52	38	34	16	43	34	34	48
2	32	50	37	34	17	43	34	36	46
3	32	48	37	34	18	42	34	34	46
4	32	45	37	34	19	42	34	33	46
5	260	42	64	36	20	43	33	34	40
6	650	42	43	34	21	45	32	33	38
7	2,000	38	38	33	22	48	30	33	34
8	296	37	37	33	23	492	30	34	40
9	78	40	98	80	24	931	34	33	38
10	52	48	48	45	25	311	45	40	34
11	45	46	42	38	26	3,460	38	37	32
12	42	38	40	35	27	420	36	36	32
13	43	37	38	1,500	28	138	36	36	32
14	45	37	37	150	29	69	37	36	32
15	45	36	36	68	30	55	38	37	32
					31	55	-	36	-
Monthly mean discharge, in cfs						320	38.7	39.7	91.9
Runoff, in acre-feet						19,680	2,300	2,440	5,470
Runoff, in inches						2.86	0.33	0.36	0.80

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 5			Mar. 7 (Con.)			Mar. 23 (Con.)			Mar. 26 (Con.)	
2	4.18		3	7.76		4	3.77	60	4	4.75	292
4	4.18		4	8.28		6	3.78	62	6	6.00	1,080
6	4.18		5	9.10		8	3.79	64	8	6.28	1,310
8	4.17		6	9.21		10	3.78	62	10	8.12	3,280
10	4.17		7	9.98		N	3.77	60	N	10.14	5,770
N	4.16		8	9.55		2	4.07	122	2	10.94	6,810
2	4.18		9	9.60		4	4.63	283	4	13.54	11,600
4	5.80		10	8.73		6	6.30	1,330	6	10.24	5,900
6	6.20		11	7.90		8	6.92	1,940	8	7.60	2,680
8	6.33		12	6.86		10	6.25	1,280	10	6.60	1,620
10	6.34			Mar. 8		12	5.77	902	12	6.08	1,140
12	6.18		2	5.77	902		Mar. 24			Mar. 27	
	Mar. 6		4	5.14	485	2	5.32	593	2	5.76	895
2	5.99		6	4.76	296	4	4.99	404	4	5.51	717
4	5.77		8	4.48	186	6	4.76	296	6	5.26	556
6	5.33		10	4.31	133	8	4.61	234	8	5.08	451
8	5.07		N	4.22	108	10	4.56	215	10	4.92	369
10	4.86		2	4.15	94	N	4.66	254	N	4.78	304
N	4.74		4	4.11	89	2	5.30	580	2	4.68	262
2	4.75		6	4.10	89	4	6.89	1,910	4	4.61	234
4	6.78		8	4.09	87	6	7.36	2,420	6	4.56	215
8	8.22		10	4.08	87	8	6.88	1,900	8	4.51	197
10	8.18		12	4.06	85	10	6.30	1,300	10	4.47	183
12	7.87			Mar. 9		12	5.70	850	12	4.43	170
	Mar. 7		4	4.03	82		Mar. 25			Mar. 28	
1	7.10		8	4.01	80	2	5.24	543	4	4.42	167
2	6.71		N	4.05	92	4	4.92	369	8	4.41	163
3	6.42		4	3.99	80	6	4.68	262	N	4.33	139
4	6.19		8	3.90	64	8	4.560	193	4	4.27	122
5	6.04		12	3.85	57	10	4.36	148	8	4.21	106
6	5.87			Mar. 22		N	4.34	142	12	4.16	94
7	5.84		4	3.68	45	2	4.39	157		Mar. 29	
8	5.85		8	3.68	45	4	4.55	212	4	4.10	80
9	5.89		N	3.68	45	6	4.76	296	8	4.06	72
10	5.97		4	3.70	48	8	4.90	359	N	4.03	66
11	6.07		8	3.75	57	10	5.04	430	4	4.01	62
N	6.19		12	3.74	55	12	4.96	389	8	4.00	60
1	6.58			Mar. 23			Mar. 26		12	3.99	58
2	7.30		2	3.73	53	2	4.82	322			

Iowa River basin

Cedar River near Austin, Minn.

Location.--Lat 43°38'20", long. 92°58'20", in NE¼ sec. 15, T. 102 N., R. 18 W., 200 ft upstream from abandoned power house, 500 ft upstream from county highway bridge, three-quarters of a mile downstream from Turtle Creek, and 1 mile south of Austin.
Drainage area.--425 sq mi.
Gage-height record.--Water-stage recorder graph.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Mar. 1-5. Discharge for period of backwater from aquatic vegetation, May 11 to June 30, computed on basis of two discharge measurements and gage heights.
Maxima.--March-June 1950: Discharge, 8,800 cfs 8:30 p.m. Mar. 26 (gage height, 17.81 ft).
1909-14, 1944 to February 1950: Discharge, 7,750 cfs Mar. 15, 1945 (gage height, 16.62 ft).
Remarks.--No diversion or regulation above station.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	36	334	142	47	16	77	88	60	55
2	30	289	117	50	17	71	88	58	50
3	34	271	114	50	18	68	98	53	58
4	46	221	103	49	19	65	98	53	55
5	75	170	103	49	20	64	88	53	52
6	429	146	123	50	21	65	79	49	50
7	3,010	146	100	52	22	87	77	49	48
8	1,800	120	92	52	23	308	75	46	49
9	519	120	146	55	24	882	84	49	46
10	292	175	162	53	25	1,380	117	55	42
11	172	247	120	52	26	5,190	133	48	42
12	121	168	92	52	27	5,670	120	47	37
13	98	120	79	54	28	1,850	100	46	36
14	88	112	68	56	29	718	95	47	35
15	82	95	61	56	30	581	120	50	34
					31	397	-	49	-
Monthly mean discharge, in cfs						784	140	78.5	48.9
Runoff, in acre-feet						48,210	8,330	4,830	2,910
Runoff, in inches						2.13	0.37	0.21	0.13

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 5			Mar. 8 (Con.)			Mar. 23			Mar. 27 (Con.)	
2	2.27		N	5.89	1,560	4	2.82	192	10	9.12	3,320
4	2.27		2	5.61	1,420	8	2.87	209	12	8.59	3,020
6	2.26		4	5.38	1,310	N	2.93	230		Mar. 28	
8	2.25		6	5.13	1,180	4	3.23	338	2	8.12	2,770
10	2.27		8	4.89	1,060	8	3.60	488	4	7.67	2,520
N	2.26		10	4.61	925	12	3.96	640	6	7.27	2,300
2	2.31		12	4.43	845		Mar. 24		8	6.86	2,070
4	2.66			Mar. 9		4	4.15	722	10	6.52	1,890
6	2.74		2	4.22	753	8	4.39	828	N	6.23	1,740
8	2.73		4	4.07	687	N	4.44	850	2	5.99	1,620
10	2.72		6	3.94	631	4	4.61	925	4	5.72	1,480
12	2.73		8	3.81	576	8	4.85	1,040	6	5.50	1,370
	Mar. 6		10	3.57	475	12	5.21	1,220	8	5.36	1,300
2	2.69	149	N	3.50	446		Mar. 25		10	5.10	1,170
4	2.67	142	2	3.51	450	4	5.45	1,340	12	4.82	1,030
6	2.65	136	4	3.48	438	8	5.57	1,400		Mar. 29	
8	2.64	133	6	3.41	409	N	5.59	1,420	4	4.39	828
10	2.65	136	8	3.37	393	4	5.62	1,430	8	3.90	614
N	2.73	162	10	3.32	373	8	5.57	1,400	N	3.84	589
2	2.96	240	12	3.28	357	12	5.45	1,340	4	4.00	657
4	3.34	381		Mar. 10			Mar. 26		8	4.16	726
6	3.72	538	4	3.23	338	2	5.39	1,320	12	4.23	757
8	4.32	797	8	3.19	323	4	6.47	1,860		Mar. 30	
10	5.50	1,370	N	3.13	301	6	6.89	2,090	4	4.13	713
12	6.29	1,760	4	3.04	268	8	8.13	2,770	8	3.93	627
	Mar. 7		8	2.96	240	10	10.30	3,960	N	3.70	530
2	6.98	2,140	12	2.87	209	N	12.79	5,370	4	3.64	505
4	7.44	2,390		Mar. 11		2	14.81	6,590	8	3.61	492
6	7.79	2,580	6	2.80	185	4	16.34	7,560	12	3.58	480
8	8.16	2,790	N	2.75	168	6	17.43	8,460		Mar. 31	
10	8.46	2,950	6	2.73	162	8	17.80	8,790	6	3.45	426
N	8.77	3,120	12	2.65	136	10	17.67	8,670	N	3.34	381
2	9.02	3,260		Mar. 12		12	17.28	8,320	6	3.29	361
4	9.32	3,430	6	2.61	123		Mar. 27		12	3.29	361
6	9.65	3,610	N	2.60	120	2	16.71	7,830		Apr. 1	
8	9.73	3,650	6	2.60	120	4	16.23	7,480	6	3.28	357
10	9.69	3,630	12	2.56	109	6	15.75	7,160	N	3.23	338
12	9.31	3,420		Mar. 22		8	15.16	6,800	6	3.15	308
	Mar. 8		4	2.36	65	10	14.44	6,360	12	3.14	305
2	8.69	3,080	8	2.34	63	N	13.57	5,840		Apr. 2	
4	8.07	2,740	N	2.35	64	2	12.57	5,240	6	3.10	290
6	7.42	2,380	4	2.52	98	4	11.44	4,590	N	3.08	283
8	6.82	2,050	8	2.63	130	6	10.48	4,060	6	3.10	290
10	6.27	1,760	12	2.67	142	8	9.76	3,670	12	3.08	283

Cedar River near Austin, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 3			Apr. 3 (Con.)			Apr. 4 (Con.)			Apr. 5	
6	3.07	279	12	2.99	250	N	2.90	219	6	2.79	182
N	3.05	272		Apr. 4		6	2.88	212	N	2.75	168
6	3.03	265	6	2.93	230	12	2.85	199	12	2.70	152

Des Moines River basin

West Fork Des Moines River at Jackson, Minn.

Location.--Lat 43°37'10", long. 94°59'10", in SW¼ sec. 24, T. 102 N., R. 35 W., 200 ft downstream from power plant, one block downstream from Ashlay Street Bridge in Jackson.
Drainage area.--1,220 sq mi.
Gage-height record.--Water-stage recorder graph.
Discharge record.--Stage-discharge relation defined by current-meter measurements below 750 cfs and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Mar. 4, 5, 10-24, Apr. 4.
Maxima.--March-June 1950: Discharge, 1,340 cfs 11 p.m. Apr. 2 (gage height, 8.14 ft). 1909-13, 1930 to February 1950: Discharge, 3,410 cfs Sept. 3, 1942 (gage height, 12.2 ft, from graph based on gage readings, site and datum then in use).
Remarks.--Flow partly regulated by Yankton, Long, Shetek, and Heron Lakes.

Mean discharge, in cubic feet per second, 1950

Day	March	April	May	June	Day	March	April	May	June
1	2.7	503	185	175	16	19	309	291	66
2	2.7	862	179	173	17	20	290	301	64
3	2.7	1,190	183	165	18	18	294	287	78
4	26	950	187	163	19	16	282	282	84
5	150	715	201	149	20	14	267	299	90
6	284	640	259	142	21	12	245	306	79
7	288	563	274	129	22	14	239	294	65
8	168	520	239	122	23	26	229	282	61
9	71	449	327	120	24	110	217	285	64
10	55	404	371	104	25	223	221	257	56
11	44	329	342	91	26	352	221	231	53
12	36	310	330	78	27	576	193	219	50
13	30	274	332	76	28	843	181	213	43
14	24	270	327	79	29	780	185	215	42
15	20	297	306	80	30	416	187	205	34
					31	415	-	191	-
Monthly mean discharge, in cfs						163	395	265	92.5
Runoff, in acre-feet						10,020	23,500	16,290	5,500
Runoff, in inches						0.16	0.37	0.26	0.09

West Fork Des Moines River at Jackson, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 4			Mar. 15			Mar.31 (Con.)			Apr. 10	
4	2.94		8	3.34		12	5.53	443	4		428
8	2.94		4	3.32			Apr. 1		8	5.46	425
N	2.92		12	3.32		4	5.55	448	N	5.22	366
4	3.65			Mar. 22		8	5.56	451	4	5.38	405
8	4.15		4	3.24		N	5.75	500	8	5.34	395
12	4.35		8	3.24		4	5.84	524	12	5.31	388
	Mar. 5		N	3.23		8	6.00	565		Apr. 11	
4	4.41		4	3.31		12	6.19	616	2	5.28	380
8	4.34		8	3.37			Apr. 2		4	5.30	385
N	4.41		12	3.36		2	6.24	631	6	5.20	361
4	4.96			Mar. 23		4	6.29	648	8	4.86	280
8	5.09		4	3.33		6	6.36	667	10	5.11	339
12	4.81		8	3.32		8	6.44	691	N	5.20	361
	Mar. 6		N	3.34		10	6.48	703	2	5.16	351
4	4.64	235	4	3.38		N	6.54	722	4	5.06	327
8	4.48	203	8	3.64		2	6.62	747	6	4.91	291
N	4.64	235	12	3.80		4	7.06	891	8	4.81	269
4	5.08	332		Mar. 24		6	7.62	1,110	10	4.75	257
8	5.28	389	2	3.87		8	7.89	1,230	12	4.91	291
12	5.25	373	4	3.92		10	8.11	1,320		Apr. 12	
	Mar. 7		6	3.93		12	8.12	1,330	2	5.14	347
2	5.20	361	8	3.93			Apr. 3		4	5.30	385
4	5.14	347	10	3.90		2	7.98	1,270	6	5.32	390
6	5.04	323	N	3.89		4	7.86	1,210	8	5.25	373
8	4.98	308	2	3.96		6	7.83	1,200	10	5.16	351
10	4.96	303	4	4.11		8	7.82	1,190	N	5.05	325
N	4.94	299	6	4.33		10	7.85	1,210	2	4.86	280
2	4.93	296	8	4.47		N	7.85	1,210	4	4.64	235
4	4.89	287	10	4.51		2	7.82	1,190	6	4.47	201
6	4.71	249	12	4.47		4	7.71	1,140	8	4.51	209
8	4.51	209		Mar. 25		6	7.73	1,150	10	4.92	294
10	4.37	181	4	4.33	173	8	7.76	1,170	12	5.26	375
12	4.57	221	8	4.24	155	10	7.69	1,140		Apr. 13	
	Mar.8		N	4.27	161	12	7.60	1,100	2	5.40	410
2	4.90	289	4	4.89	287		Apr. 4		4	5.42	415
4	4.97	306	8	4.97	306	2	7.55	1,080	6	5.35	398
6	4.84	276	12	4.99	311	4	7.46	1,040	8	5.10	337
8	4.67	241		Mar. 26		6	7.44		10	4.88	285
10	4.47	201	4	4.58	224	8	7.44		N	4.80	267
N	4.23	153	8	4.74	255	10	7.22		2	4.61	229
2	3.99	110	N	5.07	330	N	7.13		4	4.42	191
4	3.81	84	4	5.51	438	2	7.08		6	4.27	161
6	3.74	75	8	5.64	471	4	7.27		8	4.15	138
8	3.70	70	12	5.64	471	6	7.25		10	4.21	149
10	3.68	67		Mar. 27		8	7.24		12	4.67	241
12	3.68	67	4	5.66	477	10	7.10			Apr. 14	
	Mar. 9		8	5.75	500	12	6.86		2	5.01	315
4	3.72	73	N	5.97	557		Apr. 5		4	5.10	337
8	3.73	74	4	6.22	625	4	6.78	799	6	5.10	337
N	3.72	73	8	6.45	694	8	6.61	744	8	5.02	318
4	3.71	71	12	6.60	741	N	6.44	691	10	4.91	291
8	3.70	70		Mar. 28		4	6.32	655	N	4.80	267
12	3.68	67	4	6.65	757	8	6.27	640	2	4.69	245
	Mar. 10		8	6.71	776	12	6.44	691	4	4.60	227
6	3.64		N	7.03	880		Apr. 6		6	4.54	215
N	3.62		4	7.15	922	4	6.49	706	8	4.54	215
6	3.62		8	7.18	933	8	6.36	667	10	4.61	229
12	3.61		12	6.89	834	N	6.22	625	12	4.70	247
	Mar. 11			Mar. 29		4	6.15	606		Apr. 15	
6	3.59		4	6.81	808	8	6.12	597	4	4.85	278
N	3.55		8	6.84	818	12	6.04	576	8	4.94	299
6	3.53		N	7.03	880		Apr. 7		N	4.97	306
12	3.50		4	6.74	786	6	6.00	565	4	4.98	308
	Mar. 12		8	6.44	691	N	5.98	560	8	4.99	311
6	3.49		12	5.97	557	6	5.98	560	12	4.99	311
N	3.45			Mar. 30		12.	5.98	560		Apr. 16	
6	3.46		4	5.63	469		Apr. 8		6	5.00	313
12	3.44		8	5.46	425	6	5.90	539	N	4.99	311
	Mar. 13		N	5.35	398	N	5.82	518	6	4.97	306
6	3.42		4	5.30	385	6	5.76	503	12	4.95	301
N	3.40		8	5.20	361	12	5.68	482		Apr. 17	
6	3.41		12	5.19	359		Apr. 9		6	4.93	296
12	3.39			Mar. 31		4	5.64	471	N	4.90	289
	Mar. 14		4	5.28	380	8	5.60	461	6	4.89	287
6	3.37		8	5.35	398	N	5.56	451	12	4.86	280
N	3.36		N	5.46	425	4	5.50	435			
6	3.37		4	5.52	440	8	5.46	425			
12	3.35		8	5.53	443	12	5.45	422			

Streams Tributary to Lake Superior

Pigeon River at Middle Falls, below International Bridge, Minn. (International gaging station)

Location.--Lat 48°00'44", long. 89°36'58", in NW¼ sec. 24, T. 64 N., R. 6 E., 400 ft upstream from Middle Falls, 3½ miles upstream from mouth, and 5¾ miles downstream from International Bridge. Datum of gage is 789.58 ft above mean sea level, datum of 1929.
Drainage area.--600 sq mi at present site.
Gage-height record.--Water-stage recorder graph except period, 12:01 a.m. Apr. 1 to 10:35 a.m. Apr. 7, when there was no record, and on May 22, when graph was drawn on basis of gage readings.
Discharge record.--Stage-discharge record defined by current-meter measurements below 7,000 cfs and extended to peak stage. Discharge for period of no gage-height record computed on basis of weather records and records for Baptism River near Beaver Bay. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 7 to May 7.
Maxima.--April-June 1950: Discharge, 7,760 cfs 11 p.m. May 11 (gage height, 9.25 ft).
1923 to March 1950: Discharge observed, 11,000 cfs May 5, 1934 (gage height, 7.6 ft, site and datum then in use), from rating curve extended above 7,000 cfs.
Remarks.--Regulation in the spring of the year during log-driving operations, by control dams on lakes in the upper reaches of the river. No diversions. This station is one of the international gaging stations maintained by the United States under agreement with Canada.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	160	700	2,700	11	200	6,890	1,310	21	500	4,730	1,260
2	160	700	2,460	12	200	7,290	1,230	22	600	4,600	1,260
3	160	700	2,220	13	200	6,400	1,150	23	650	4,300	1,760
4	160	700	2,010	14	220	6,580	1,090	24	750	4,080	1,780
5	160	1,000	2,040	15	240	7,220	1,050	25	800	3,830	1,480
6	160	2,600	1,920	16	260	6,470	1,190	26	800	3,500	1,330
7	170	4,000	1,760	17	280	5,480	1,270	27	800	3,180	1,280
8	180	4,660	1,610	18	300	4,840	1,130	28	750	3,000	1,260
9	180	4,750	1,510	19	360	4,640	1,050	29	750	2,640	1,220
10	190	5,140	1,400	20	420	4,710	1,200	30	700	2,490	1,200
								31	-	2,680	-
Monthly mean discharge, in cfs									382	4,016	1,504
Runoff, in acre-feet									22,730	246,900	89,490
Runoff, in inches									0.71	7.72	2.80

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 22 (Con.)			Apr. 28 (Con.)			May 5	
4	2.85		N	4.90		8	4.26		4	3.70	
8	2.87		4	5.07		12	4.22		8	4.00	
N	2.90		8	5.05			Apr. 29		N	4.71	
4	2.96		12	4.92		4	4.19		4	5.18	
8	3.01			Apr. 23		8	4.16		8	6.49	
12	2.98		4	4.85		N	4.13		12	8.70	
	Apr. 17		8	4.85		4	4.13			May 6	
4	3.02		N	4.90		8	4.09		4	6.85	
8	3.12		4	5.02		12	4.02		8	7.02	
N	3.29		8	5.13			Apr. 30		N	6.92	
4	3.60		12	5.10		4	4.01		4	7.12	
8	3.47			Apr. 24		8	3.99		8	7.34	
12	3.43		4	5.09		N	3.97		12	7.26	
	Apr. 18		8	5.28		4	3.94			May 7	
4	3.42		N	5.24		8	3.90		4	7.25	
8	3.45		4	5.13		12	3.86		8	7.12	
N	3.46		8	5.28			May 1		N	7.14	
4	3.69		12	5.33		4	3.82		4	7.36	
8	3.78			Apr. 25		8	3.78		8	7.65	
12	3.85		4	5.33		N	3.80		12	7.74	
	Apr. 19		8	5.32		4	3.94			May 8	
4	3.92		N	5.25		8	3.86		4	7.69	4,730
8	3.88		4	5.14		12	3.81		8	7.55	4,550
N	4.05		8	4.98			May 2		N	7.51	4,500
4	4.04		12	4.79		4	3.79		4	7.61	4,620
8	4.15			Apr. 26		8	3.81		8	7.70	4,740
12	4.15		4	4.63		N	3.88		12	7.75	4,800
	Apr. 20		8	4.48		4	3.88			May 9	
4	4.12		N	4.43		8	3.74		4	7.72	4,770
8	4.13		4	4.50		12	3.68		8	7.66	4,690
N	4.31		8	4.54			May 3		N	7.66	4,690
4	4.46		12	4.50		4	3.59		4	7.70	4,740
8	4.47			Apr. 27		8	3.49		8	7.75	4,800
12	4.45		4	4.47		N	3.44		12	7.76	4,820
	Apr. 21		8	4.48		4	3.49			May 10	
4	4.41		N	4.47		8	3.48		4	7.76	4,820
8	4.38		4	4.42		12	3.48		8	7.72	4,770
N	4.55		8	4.35			May 4		N	7.72	4,770
4	4.68		12	4.38		4	3.48		4	7.96	5,100
8	4.67			Apr. 28		8	3.48		8	8.34	5,750
12	4.68		4	4.30		N	3.49		12	8.66	6,390
	Apr. 22		8	4.28		4	3.59			May 11	
4	4.73		N	4.31		8	3.51		2	8.71	6,490
8	4.83		4	4.30		12	3.56		4	8.72	6,510

Pigeon River at Middle Falls, below International Bridge, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 11 (Con.)			May 13 (Con.)			May 16 (Con.)			May 21 (Con.)	
6	8.69	6,450	4	8.52	6,100	12	8.48	6,020	8	7.68	4,710
8	8.64	6,340	6	8.58	6,220		May 17		N	7.65	4,680
10	8.64	6,340	8	8.64	6,340	4	8.38	5,820	4	7.67	4,700
N	8.69	6,450	10	8.67	6,410	8	8.26	5,600	8	7.71	4,750
2	8.85	6,800	12	8.67	6,410	N	8.16	5,420	12	7.70	4,740
4	9.00	7,150		May 14		4	8.08	5,290		May 22	
6	9.17	7,560	2	8.64	6,340	8	8.02	5,190	4	7.67	4,700
8	9.22	7,680	4	8.62	6,300	12	7.96	5,100	8	7.62	4,640
10	9.24	7,730	6	8.58	6,220		May 18		N	7.57	4,570
12	9.24	7,730	8	8.57	6,200	4	7.87	4,970	4	7.54	4,540
	May 12		10	8.55	6,160	8	7.77	4,830	8	7.54	4,540
2	9.22	7,680	N	8.57	6,200	N	7.76	4,740	12	7.50	4,490
4	9.13	7,460	2	8.64	6,340	4	7.69	4,730		May 23	
6	9.15	7,510	4	8.81	6,710	8	7.74	4,790	6	7.40	4,370
8	9.10	7,390	6	8.98	7,100	12	7.77	4,830	N	7.32	4,270
10	9.05	7,270	8	9.08	7,340		May 19		6	7.28	4,230
N	9.02	7,200	10	9.01	7,170	4	7.65	4,680	12	7.23	4,170
2	9.00	7,150	12	9.10	7,390	8	7.58	4,590		May 24	
4	9.00	7,150		May 15		N	7.53	4,530	6	7.18	4,120
6	8.99	7,130	4	9.07	7,320	4	7.57	4,570	N	7.13	4,060
8	8.98	7,100	8	9.02	7,200	8	7.66	4,690	6	7.12	4,050
10	8.96	7,060	N	9.00	7,150	12	7.68	4,710	12	7.06	3,990
12	8.91	6,940	4	9.01	7,170		May 20			May 25	
	May 13		8	9.03	7,220	4	7.66	4,690	6	6.98	3,900
2	8.87	6,850	12	8.98	7,100	8	7.64	4,660	N	6.90	3,820
4	8.80	6,690		May 16		N	7.62	4,640	6	6.83	3,750
6	8.73	6,540	4	8.86	6,830	4	7.69	4,730	12	6.76	3,680
8	8.67	6,410	8	8.75	6,580	8	7.75	4,800		May 26	
10	8.61	6,280	N	8.66	6,390	12	7.74	4,790	6	6.67	3,590
N	8.55	6,160	4	8.60	6,260		May 21		N	6.57	3,490
2	8.51	6,080	8	8.57	6,200	4	7.71	4,750	6	6.51	3,430
									12	6.42	3,340

St. Louis River near Aurora, Minn.

Location.--Lat 47°29'30", long. 92°14'20", in SW¼ sec. 22, T. 58 N., R. 15 W., at highway bridge three-quarters of a mile downstream from Partridge River and 1½ miles south of Aurora.
Drainage area.--312 sq mi.
Gage-height record.--Water-stage recorder graph.
Discharge record.--Stage-discharge relation defined by current-meter measurements and shape of previous curve. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1 to May 3.
Maxima.--April-June 1950: Discharge, 5,380 cfs 4 a.m. May 14 (gage height, 8.37 ft).
1942 to March 1950: Discharge observed, 3,960 cfs June 6, 1944 (gage height, 7.30 ft).
Remarks.--Some regulation by lakes above station. No diversions.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	42	550	1,380	11	46	4,780	542	21	300	2,540	343
2	44	600	1,370	12	50	4,970	501	22	400	2,590	347
3	44	700	1,320	13	48	5,180	478	23	450	2,480	359
4	42	748	1,230	14	48	5,310	439	24	500	2,410	336
5	42	1,210	1,110	15	50	4,940	402	25	550	2,240	343
6	42	2,290	998	16	60	4,360	394	26	500	2,010	418
7	42	3,280	890	17	75	3,840	378	27	500	1,770	483
8	40	4,250	784	18	100	3,360	351	28	480	1,540	519
9	40	4,950	696	19	150	2,900	328	29	480	1,340	524
10	42	4,980	615	20	220	2,540	343	30	500	1,250	524
								31			
Monthly mean discharge, in cfs									198	2,815	625
Runoff, in acre-feet									11,780	173,100	37,190
Runoff, in inches									0.71	10.40	2.23

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 17			Apr. 23 (Con.)			Apr. 30 (Con.)			May 8 (Con.)	
4	1.91		6	3.79		12	3.38		8	7.13	4,010
8	1.93		8	3.83			May 1		N	7.30	4,200
N	1.97		10	3.86		6	3.35		4	7.49	4,410
4	2.06		N	3.91		N	3.34		8	7.71	4,650
8	2.04		2	4.05		6	3.30		12	7.74	4,680
12	2.05		4	4.54		12	3.24			May 9	
	Apr. 18		6	3.82			May 2		4	7.87	4,830
4	2.07		8	3.85		6	3.21		8	7.97	4,940
8	2.12		10	3.93		N	3.23		N	8.01	4,980
N	2.20		12	3.92		6	3.22		4	8.05	5,020
4	2.31			Apr. 24		12	3.20		8	8.09	5,070
8	2.37		6	3.89			May 3		12	8.09	5,070
12	2.41		N	3.89		6	3.17			May 10	
	Apr. 19		6	4.11		N	3.16		6	8.02	4,990
4	2.44		12	4.22		6	3.17		N	7.95	4,920
8	2.46			Apr. 25		12	3.18		6	8.01	4,980
N	2.47		6	4.23			May 4		12	8.00	4,970
4	2.49		N	4.25		6	3.17	728		May 11	
8	2.51		6	4.26		N	3.17	728	6	7.83	4,780
12	2.54		12	4.23		6	3.25	772	N	7.72	4,660
	Apr. 20			Apr. 26		12	3.29	794	6	7.82	4,770
4	2.61		6	4.18			May 5		12	7.86	4,820
8	2.71		N	4.15		4	3.40	860		May 12	
N	2.73		6	3.96		8	3.54	944	6	7.90	4,860
4	2.81		12	3.87		N	3.79	1,090	N	8.00	4,970
8	2.88			Apr. 27		4	4.23	1,400	6	8.09	5,070
12	3.15		6	3.83		8	4.58	1,660	12	8.14	5,120
	Apr. 21		N	3.77		12	4.79	1,830		May 13	
4	3.30		6	3.77			May 6		6	8.13	5,110
8	3.36		12	3.75		4	4.95	1,960	N	8.15	5,140
N	3.13			Apr. 28		8	5.11	2,090	6	8.24	5,230
4	3.20		6	3.74		N	5.27	2,220	12	8.34	5,340
8	3.25		N	3.76		4	5.54	2,470		May 14	
12	3.31		6	3.84		8	5.78	2,680	6	8.36	5,370
	Apr. 22		12	3.80		12	5.95	2,840	N	8.32	5,320
4	3.34			Apr. 29			May 7		6	8.28	5,280
8	3.37		6	3.77		4	6.03	2,910	12	8.21	5,200
N	3.42		N	3.75		8	6.11	2,980		May 15	
4	3.49		6	3.82		N	6.29	3,160	8	8.06	5,040
8	3.65		12	3.51		4	6.64	3,510	4	7.89	4,850
12	3.75			Apr. 30		8	6.91	3,780	12	7.71	4,650
	Apr. 23		6	3.47		12	7.02	3,890		May 16	
2	3.75		N	3.42			May 8		8	7.53	4,450
4	3.77		6	3.41		4	7.05	3,920	4	7.35	4,260

St. Louis River near Aurora, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 16 (Con.)			May 19 (Con.)			May 22			May 24 (Con.)	
12	7.20	4,090	4	5.94	2,830	8	5.69	2,600	4	5.48	2,410
	May 17		12	5.82	2,720	4	5.67	2,580	8	5.44	2,380
8	7.04	3,910		May 20		12	5.63	2,550	12	5.41	2,350
4	6.90	3,770	8	5.68	2,590		May 23			May 25	
12	6.74	3,610	4	5.57	2,490	8	5.57	2,490	8	5.34	2,290
	May 18		12	5.45	2,380	4	5.52	2,450	4	5.25	2,200
8	6.57	3,440		May 21		12	5.50	2,430	12	5.16	2,130
4	6.41	3,280	8	5.61	2,530		May 24			May 26	
12	6.24	3,110	4	5.70	2,610	4	5.52	2,450	8	5.06	2,050
	May 19		12	5.70	2,610	8	5.50	2,430	4	4.96	1,970
8	6.09	2,960				N	5.49	2,420	12	4.85	1,880

Partridge River near Aurora, Minn.

Location.--Lat 47°31'00", long. 92°11'20", on line between secs. 12 and 13, T. 58 N., R. 15 W., at highway bridge 1 mile downstream from unnamed tributary, 1½ miles east of Aurora, and 2½ miles upstream from mouth.

Drainage area.--156 sq mi.

Gage-height record.--Water-stage recorder graph except period of faulty float operation, 3 p.m. Apr. 26 to 5 p.m. Apr. 28, for which graph was drawn based on trend of record and shape of graph as recorded.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 1,800 cfs and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-4, 6-25.

Maxima.--April-June 1950: Discharge, 3,230 cfs 4 a.m. May 10 (gage height, 7.86 ft).
1942 to March 1950: Discharge observed, 2,930 cfs June 6, 1944 (gage height, 7.51 ft).

Remarks.--Flow partly regulated by storage in lakes above station. No diversion.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	20	533	605	11	28	3,040	203	21	100	1,170	161
2	22	504	630	12	28	3,100	179	22	160	1,230	174
3	24	486	630	13	28	2,990	172	23	300	1,230	183
4	24	481	600	14	28	2,770	157	24	480	1,240	167
5	24	676	533	15	28	2,460	148	25	550	1,180	174
6	24	1,150	459	16	32	2,100	156	26	577	1,060	208
7	24	1,580	384	17	40	1,820	156	27	568	900	246
8	24	2,390	322	18	50	1,550	148	28	560	760	275
9	24	3,070	272	19	70	1,320	136	29	553	625	284
10	26	2,190	232	20	80	1,170	156	30	553	561	284
								31	-	576	-
Monthly mean discharge, in cfs									168	1,513	281
Runoff, in acre-feet									10,000	93,030	16,720
Runoff, in inches									1.20	11.18	2.01

Partridge River near Aurora, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 25 (Con.)			May 8 (Con.)			May 13	
6	2.08		8	4.39		4	7.15	2,620	4	7.66	3,050
N	2.06		12	4.38		6	7.24	2,690	8	7.62	3,020
6	2.22			Apr. 26		8	7.31	2,750	N	7.58	2,980
12	2.27		8	4.38	580	10	7.36	2,790	4	7.55	2,960
	Apr. 17		4	4.37	576	12	7.43	2,850	8	7.52	2,930
6	2.28		12	4.36	571		May 9		12	7.51	2,920
N	2.30			Apr. 27		2	7.48	2,890		May 14	
6	2.41		8	4.36	571	4	7.53	2,940	8	7.39	2,810
12	2.43		4	4.35	566	6	7.58	2,980	4	7.27	2,720
	Apr. 18		12	4.34	561	8	7.63	3,030	12	7.16	2,630
6	2.46			Apr. 28		10	7.68	3,070		May 15	
N	2.53		8	4.34	561	N	7.71	3,100	8	7.01	2,510
6	2.67		4	4.34	561	2	7.72	3,110	4	6.87	2,400
12	2.68		12	4.33	556	4	7.74	3,130	12	6.73	2,280
	Apr. 19			Apr. 29		6	7.77	3,150		May 16	
6	2.69		8	4.32	552	8	7.80	3,180	8	6.58	2,160
N	2.68		4	4.32	552	10	7.83	3,210	4	6.39	2,010
6	2.68		12	4.32	552	12	7.85	3,220	12	6.33	1,960
12	2.70			Apr. 30			May 10			May 17	
	Apr. 20		8	4.32	552	2	7.86	3,230	8	6.21	1,870
4	2.70		4	4.33	556	4	7.86	3,230	4	6.10	1,780
8	2.67		12	4.32	552	6	7.85	3,220	12	5.97	1,680
N	2.70			May 4		8	7.84	3,220		May 18	
4	2.82		8	4.16	477	10	7.82	3,200	8	5.85	1,580
8	2.82		4	4.16	477	N	7.80	3,180	4	5.75	1,510
12	2.83		12	4.20	495	2	7.79	3,170	12	5.63	1,420
	Apr. 21			May 5		4	7.79	3,170		May 19	
4	2.84		6	4.31	547	6	7.79	3,170	8	5.53	1,340
8	2.88		N	4.47	625	8	7.79	3,170	4	5.45	1,280
N	2.97		6	4.75	795	10	7.78	3,160	12	5.38	1,240
4	3.07		12	4.98	956	12	7.77	3,150		May 20	
8	3.18			May 6			May 11		8	5.31	1,190
12	3.23		4	5.06	1,010	2	7.75	3,140	4	5.24	1,140
	Apr. 22		8	5.15	1,080	4	7.71	3,100	12	5.18	1,100
4	3.26		N	5.24	1,140	6	7.67	3,060		May 21	
8	3.31		4	5.36	1,220	8	7.63	3,030	8	5.28	1,170
N	3.39		8	5.46	1,290	10	7.61	3,010	4	5.33	1,200
4	3.57		12	5.52	1,340	N	7.59	2,990	12	5.36	1,220
8	3.69			May 7		2	7.58	2,980		May 22	
12	3.72		2	5.57	1,370	4	7.60	3,000	8	5.37	1,230
	Apr. 23		4	5.61	1,400	6	7.63	3,030	4	5.38	1,240
4	3.76		6	5.60	1,400	8	7.64	3,040	12	5.37	1,230
8	3.82		8	5.65	1,430	10	7.65	3,040		May 23	
N	3.87		10	5.80	1,540	12	7.66	3,050	8	5.37	1,230
4	4.06		N	5.81	1,550				4	5.38	1,240
8	4.08		2	5.87	1,600		May 12		12	5.38	1,240
12	4.06		4	5.95	1,660	2	7.67	3,060		May 24	
	Apr. 24		6	6.05	1,740	4	7.69	3,080	8	5.39	1,240
4	4.07		8	6.13	1,800	6	7.68	3,070	4	5.38	1,240
8	4.13		10	6.21	1,870	8	7.68	3,070	12	5.36	1,220
N	4.33		12	6.29	1,930	10	7.70	3,090		May 25	
4	4.39			May 8		N	7.71	3,100	8	5.33	1,200
8	4.50		2	6.36	1,990	2	7.71	3,100	4	5.27	1,160
12	4.48		4	6.41	2,030	4	7.72	3,110	12	5.22	1,120
	Apr. 25		6	6.44	2,050	6	7.72	3,110		May 26	
4	4.43		8	6.50	2,100	8	7.76	3,140	8	5.17	1,090
8	4.42		10	6.78	2,320	10	7.75	3,140	4	5.09	1,030
N	4.41		N	6.91	2,430	12	7.72	3,110	12	5.01	977
4	4.41		2	7.03	2,520						

Embarrass River at Embarrass, Minn.

Location.--Lat 47°39'30", long. 92°11'50", in NW¼ sec. 25, T. 60 N., R. 15 W., at Embarrass, 30 ft upstream from highway bridge and 100 ft upstream from railway bridge.
Drainage area.--93.8 sq mi.
Gage-height record.--Water-stage recorder graph except periods, 7 p.m. Apr. 25 to 11 a.m. Apr. 26, 5 p.m. Apr. 27 to 5 p.m. Apr. 28, for which a graph was drawn based on fragmentary record.
Discharge record.--Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1 to May 2.
Maxima.--April-June 1950: Discharge, 1,740 cfs 8 p.m. May 8 to 8 a.m. May 9; gage height, 10.92 ft 4-8 a.m. May 9.
1942 to March 1950: Discharge, 1,490 cfs Apr. 21, 1948 (gage height, 10.44 ft).
Remarks.--No diversion or regulation above station.

Mean discharge, in cubic feet per second, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	10	320	235	11	9.0	1,430	92	21	190	499	70
2	11	300	234	12	9.0	1,410	82	22	240	575	64
3	11	295	226	13	9.5	1,360	81	23	340	606	69
4	11	302	211	14	10	1,160	78	24	380	563	73
5	10	531	194	15	22	1,000	70	25	420	516	70
6	10	1,290	174	16	40	874	69	26	440	453	115
7	10	1,610	155	17	65	771	69	27	440	395	140
8	9.5	1,720	136	18	90	687	64	28	420	346	144
9	9.5	1,720	118	19	120	601	58	29	380	306	138
10	9.5	1,560	104	20	160	524	65	30	360	274	132
								31	-	247	-
Monthly mean discharge, in cfs									142	782	118
Runoff, in acre-feet									8,450	48,080	7,020
Runoff, in inches									1.68	9.61	1.40

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 15			Apr. 21 (Con.)			Apr. 26 (Con.)			May 4 (Con.)	
6	2.18		8	6.43		8	8.07		8	4.95	290
N	2.19		12	6.51		N	8.01		10	4.96	291
6	2.31			Apr. 22		4	8.01		N	5.00	294
12	2.42		4	6.56		8	8.12		2	5.09	300
	Apr. 16		8	6.58		12	8.15		4	5.17	306
4	2.47		N	6.70			Apr. 27		6	5.26	312
8	2.50		4	7.12		6	8.15		8	5.39	321
N	2.57		8	7.48		N	8.14		10	5.49	329
4	2.73		12	7.51		6	8.11		12	5.59	337
8	2.98			Apr. 23		12	8.05			May 5	
12	3.18		2	7.51			Apr. 28		2	5.82	356
	Apr. 17		4	7.52		6	7.96		4	6.09	380
4	3.31		6	7.52		N	7.89		6	6.25	396
8	3.40		8	7.53		6	7.82		8	6.37	408
N	3.42		10	7.55		12	7.71		10	6.71	445
4	3.29		N	7.62			Apr. 29		N	7.02	483
8	3.18		2	7.74		6	7.61		2	7.39	532
12	3.11		4	8.07		N	7.46		4	7.79	591
	Apr. 18		6	8.32		6	7.43		6	8.16	655
4	3.10		8	8.55		12	7.29		8	8.47	719
8	3.16		10	8.71			Apr. 30		10	8.76	790
N	3.24		12	8.82		6	7.12		12	9.09	887
4	3.47			Apr. 24		N	6.97			May 6	
8	3.96		2	8.86		6	6.75		2	9.32	968
12	4.43		4	8.89		12	6.54		4	9.55	1,060
	Apr. 19		6	8.90			May 1		6	9.76	1,150
4	4.74		8	8.93		6	6.39		8	9.93	1,220
8	4.94		10	8.98		N	6.23		10	10.09	1,300
N	4.99		N	9.03		6	6.02		N	10.19	1,340
4	5.06		2	9.07		12	5.79		2	10.27	1,380
8	5.19		4	9.14			May 2		4	10.34	1,420
12	5.23		6	9.19		6	5.61		6	10.42	1,460
	Apr. 20		8	9.20		N	5.43		8	10.49	1,500
4	5.26		10	9.19		6	5.33		10	10.55	1,520
8	5.28		12	9.17		12	5.21		12	10.60	1,550
N	5.29			Apr. 25			May 3			May 7	
4	5.54		4	9.03		6	5.05	298	4	10.66	1,590
8	5.75		8	8.88		N	4.98	293	8	10.65	1,580
12	5.82		N	8.72		6	4.94	290	N	10.66	1,590
	Apr. 21		4	8.59		12	4.94	290	4	10.70	1,610
4	5.82		8	8.45			May 4		8	10.76	1,650
8	5.81		12	8.32		2	4.94	290	12	10.83	1,690
N	5.76			Apr. 26		4	4.94	290		May 8	
4	6.11		4	8.18		6	4.95	290	4	10.87	1,710

Embarrass River at Embarrass, Minn.--Con.

Gage height, in feet, and discharge, in cubic feet per second, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 8 (Con.)			May 12 (Con.)			May 20			May 26	
8	10.86	1,710	12	10.31	1,400	8	7.42	536	8	6.86	463
N	10.85	1,700		May 13		4	7.25	512	4	6.69	443
4	10.88	1,730	4	10.30	1,400	12	7.08	490	12	6.50	422
8	10.91	1,740	8	10.27	1,380		May 21			May 27	
12	10.91	1,740	N	10.24	1,370	4	7.02	483	8	6.33	404
	May 9		4	10.18	1,340	8	7.07	489	4	6.15	386
4	10.92	1,740	8	10.12	1,310	N	7.14	498	12	5.97	369
8	10.92	1,740	12	10.01	1,260	4	7.20	506		May 28	
N	10.90	1,730		May 14		8	7.25	512	8	5.79	353
4	10.86	1,710	8	9.87	1,200	12	7.34	525	4	5.60	338
8	10.81	1,680	4	9.73	1,130		May 22		12	5.43	324
12	10.77	1,650	12	9.58	1,070	4	7.46	541		May 29	
	May 10			May 15		8	7.60	562	8	5.27	313
4	10.73	1,630	8	9.46	1,020	N	7.74	583	4	5.09	300
8	10.67	1,590	4	9.35	980	4	7.80	593	12	4.92	288
N	10.62	1,560	12	9.24	939	8	7.87	604		May 30	
4	10.56	1,530		May 16		12	7.91	611	8	4.77	278
8	10.49	1,500	8	9.12	897		May 23		4	4.67	271
12	10.44	1,470	4	8.97	849	4	7.93	614	12	4.50	259
	May 11		12	8.86	817	8	7.93	614		May 31	
4	10.41	1,460		May 17		N	7.91	611	8	4.37	250
8	10.39	1,440	8	8.74	784	4	7.87	604	4	4.27	243
N	10.36	1,430	4	8.63	756	8	7.81	595	12	4.19	237
4	10.33	1,420	12	8.51	728	12	7.78	590		June 1	
8	10.31	1,400		May 18			May 24		8	4.17	236
12	10.30	1,400	8	8.38	700	8	7.70	577	4	4.14	234
	May 12		4	8.25	673	4	7.50	547	12	4.14	234
4	10.31	1,400	12	8.11	646	12	7.47	543		June 2	
8	10.33	1,420		May 19			May 25		8	4.17	236
N	10.34	1,420	8	7.94	616	8	7.35	526	4	4.14	234
4	10.34	1,420	4	7.75	585	4	7.21	507	12	4.09	230
8	10.32	1,410	12	7.59	560	12	7.03	484			

SUMMARY OF FLOOD STAGES AND DISCHARGES

The results of the determinations of maximum flood flows at existing stream-gaging stations and other points on streams in the area covered by this report are presented in summarized form in table 9, "Summary of flood stages and discharges." The reference number in the first column of this table is applicable to plate 21 (in pocket) and will aid in identifying the place where the discharge was determined.

The maximum discharges at existing gaging stations were obtained as a part of the station record--usually from a stage-discharge relationship. At some gaging stations, and at miscellaneous points--that is, points where records of discharge have not been collected systematically--the maximum discharge was not obtained from a stage-discharge relationship, but instead, it was determined by indirect methods. Where an indirect method was used, the method of determination of the peak discharge for the floods of 1950 is indicated by a symbol, which refers to a headnote in the table. Gaging stations and miscellaneous points can be identified in the table by the entry in the column "Period of record"--a period of record is shown for all gaging stations, whereas a dash in the column indicates that the point is miscellaneous.

The maximum flood previously known may include a flood antedating the period of record; the objective is to list the highest flood for which the discharge is known.

Figure 109 shows the flood discharges listed in table 9, presented in cubic feet per second per square mile plotted against the corresponding drainage area. These discharges may be affected by storage or regulation as mentioned in the station description in the section, "Stages and discharges at stream-gaging stations".

Table 9. --Summary of flood stages and discharges in Upper Mississippi River and Lake Superior basins for floods of 1950

[Maximum discharges for the floods of 1950 were obtained from gaging-station records, except as otherwise indicated by the following symbols: C, contracted-opening determination; D, computed flow over dam]

No. on pl 21	Stream and place of determination	Drainage area (square miles)	Period of record	Maximum flood previously known				Maximum during present flood			
				Date	Gage height (feet)	Discharge (cfs)	Cfs per square mile	Date and hour	Gage height (feet)	Discharge (cfs)	Cfs per square mile
1	Mississippi River at Winnibigoshish Dam, near Deer River, Minn.	1,442	a1884-1941, b1941-	Aug. 6, 1905	-	c4,370	3.03	June 30	-	c,d2,670	1.85
2	Mississippi River near Deer River, Minn.	3,190	1945-	Mar. 17-19, 1945	e14.86	c,d4,200	1.32	May 10 May 13, 4:30 p.m.	- f14.30	c,d3,070 -	.96 -
3	Mississippi River at Grand Rapids, Minn.	3,370	a1883-1941, 1941-	1888 Sept. 3, 1948	- h15.2	g20,000 d,i12,500	- 3.71	May 13 May 29	f,j14.76 -	- c,j4,160	- 1.23
4	Mississippi River below Sandy River, near Libby, Minn.	5,060	1930	Apr. 28, 1948	15.70	d8,060	1.59	May 17, 5:30 a.m.	20.02	d,f16,000	3.16
5	Mississippi River at Aitkin, Minn.	6,140	1945-	Apr. 27, 28, 1948	15.77	d12,000	1.95	May 20, 4-12 p.m.	19.49	d20,000	3.26
6	Mississippi River near Royalton, Minn	11,600	1924-	Apr. 5, 1943	-	c,d24,000	2.07	May 9	-	c,d28,000	2.41
7	Mississippi River at Elk River, Minn.	14,500	1915-	kApr. 5, 1917 Apr. 6, 1943	- 12.63	k34,000 d37,700	- 2.60	May 10, 3 p.m.	13.00	d39,000	2.69
8	Mississippi River near Anoka, Minn.	19,100	1931-	Apr. 6, 1943	14.11	d47,000	2.46	May 11, 12 m.	13.82	d50,700	2.65
9	Mississippi River at St. Paul, Minn.	36,800	1887-	Apr. 29, 1881 Apr. 6, 1897	m703.86 m702.16	n107,000 d80,800	- 2.19	May 13, 3 p.m.	m697.11	d53,900	1.46
10	Mississippi River at Prescott, Wis.	44,800	1928-	Mar. 23, 1945	m684.17	d87,500	1.95	May 10, 12 p.m. to May 11, 2 a.m.	m685.21	101,000	2.25
11	Mississippi River at Winona, Minn.	59,200	1928-	June 22, 1943	14.79	d135,000	2.28	May 14, 7:30 p.m.	14.06	d122,000	2.06
12	Big Turtle River above Rice Lake, near Cass Lake, Minn.	-	-		-	-	-	-	-	655C	-
13	Little Turtle River above Rice Lake, near Cass Lake, Minn.	-	-		-	-	-	-	-	669C	-
14	Leech Lake River at Federal Dam, Minn.	1,163	a1884-1941, b1941-	July 1904 Feb. 1, 1945	-	f1,530 c,d1,254	- 1.08	June 26	-	c,d1,329	1.14

15	Sandy River at Sandy Lake Dam, at Libby, Minn.	421	a1893-1916, b1941-	July 12, 1897	-	d,f3,738	8.88	May 23	-	c,d3,400	8.08
16	Section Five Brook near East Lake, Minn.	-	-	-	-	-	-	-	-	660C	-
17	Pine River at Pine River Dam, at Cross Lake, Minn.	562	a1886-1941. 1895-1916, 1929, b1941-	June 1896	-	p2,246	4.00	May 15-19	-	c,d1,610	2.86
18	Crow Wing River at Nimrod, Minn.	1,010	1910-14, 1930-	Apr. 7, 1943 Apr. 8, 1947	- f,q6.44	f2,330 -	2.31 -	Apr. 20 May 7, 4-8 a.m.	q7.64 5.46	- d2,200	- 2.18
19	Fishhook Creek at Park Rapids, Minn.	-	-	-	-	-	-	-	-	583C	-
20	Gull River at Gull Lake Dam, near Brainerd, Minn.	287	a1911-41, 1929, b1941-	May 15, 1938 June 4, 1943	- -	c,d1,123 c,d1,080	- 3.76	May 10	-	c,d1,115	3.89
21	Sauk River near St. Cloud, Minn.	925	1909-13, 1929-	Apr. 2, 1943 Apr. 5, 1943	q7.67 -	- c,d4,540	- 4.91	Apr. 5, 6:30 p.m. Apr. 8, 5:15 p.m.	q6.60 -	- d2,940	- 3.18
22	Elk River near Big Lake, Minn.	615	1911-17, 1931-	May 7, 1912	10	5,100	8.29	Apr. 2, 11 a.m. May 9, 12 m.	q8.45 -	- 2,730	- 4.44
23	North Fork Crow River near Regal, Minn.	215	1943-	Mar. 14, 1946 Apr. 11, 1947	f,q5.86 -	- f760	- 3.53	Mar. 27	r5.73	c,q550	2.56
24	Crow River at Rockford, Minn.	2,520	1909-17, 1929-	Apr. 2, 3, 1916	s15.90	f10,600	4.21	Apr. 3, 7:30 a.m.	q10.78	5,680	2.25
25	Middle Fork Crow River near Spicer, Minn.	179	1949-	Mar. 10, 1949 Apr. 24-29, May 2, 7, 1949	f,q3.83 -	- f44	- .25	May 18-20	t4.44	c,f188	1.05
26	South Fork Crow River at Cosmos, Minn.	221	1945-	Mar. 24, 1948	u7.45	f400	1.81	Mar. 27, 11:30 a.m. May 5, 11:10 a.m.	f,q7.11 5.38	- f268	- 1.21

a In files of St. Paul Office, Corps of Engineers.
b Records furnished by Corps of Engineers; published by Geological Survey.
c Daily mean discharge.
d Affected by storage.
e Observed Mar. 17, 1945, affected by ice backwater.
f Observed.
g Estimated; from House Document 66, 73d Congress, 1st session.
h From floodmark.
i Caused by failure of dam.
j Affected by backwater.
k Estimated.
m Elevation above mean sea level, adjustment of 1912.
n Determined by Corps of Engineers.
p Daily mean discharge; affected by storage; does not include flow bypassing dam through crevasse.
q Affected by ice backwater.
r Occurred Mar. 28, 1 p.m., affected by ice backwater.
s Former datum.
t Observed May 20, 7:42 a.m.
u Observed Mar. 23, 1948, affected by ice backwater.

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Table 9. --Summary of flood stages and discharges in Upper Mississippi River and Lake Superior basins for floods of 1950--Continued

No. on pl 21	Stream and place of determination	Drainage area (square miles)	Period of record	Maximum flood previously known				Maximum during present flood			
				Date	Gage height (feet)	Discharge (cfs)	Cfs per square mile	Date and hour	Gage height (feet)	Discharge (cfs)	Cfs per square mile
27	South Fork Crow River near Mayer, Minn.	1,170	1934-	Mar. 27, 1948	12.11	f4,620	3.95	Apr. 2, 4 p.m.	v9.34	f2,280	1.95
28	Rum River near St. Francis, Minn.	1,360	1929-	June 19, 1944	9.35	d6,780	4.99	May 11, 1 p.m.	9.45	d7,540	5.54
29	Little Minnesota River near Peever, S. Dak.	447	1939-	Mar. 25, 1943 Mar. 31, 1943	h,q13.35 -	- 3,660	- 8.18	Apr. 1, 7:30 p.m. Apr. 6, 7	q13.05 -	- c950	- 2.13
30	Minnesota River at Ortonville, Minn.	1,160	1938-	Apr. 16, 1947	11.00	w1,660	1.43	Mar. 5, 9 p.m.	9.02	w930	.80
31	Minnesota River near Odessa, Minn.	1,340	1909-12, 1944-	Apr. 19-23, 1947	x13.25	1,540	1.15	Apr. 11, 4 p.m.	f10.97	813	.61
32	Minnesota River near Lac qui Parle, Minn.	4,050	1942-	Apr. 4, 5, 1943	y36.34	d7,950	1.96	Apr. 10, 9 p.m. Apr. 25, 2:45 p.m.	q33.06 -	- d3,280	- .81
33	Minnesota River at Montevideo, Minn.	6,180	1909-	June 25, 1919	17.45	d,z22,000	3.56	Apr. 10, 5-8 p.m.	11.58	d2,910	.47
34	Minnesota River at Judson, Minn.	11,200	1938-	May 8, 1944	82.43	16,100	1.44	Mar. 31, 5 p.m. Apr. 4, 8:30 a.m.	f,q75.38 -	- f7,600	- .68
35	Minnesota River at Mankato, Minn.	14,900	1903-	1881 June 26, 1908	aa27 ab21.2	aa65,000 43,800	- 2.94	Mar. 31, 7 p.m.	13.90	12,200	.82
36	Minnesota River near Carver, Minn.	16,200	1934-	Apr. 5, 1949	23.59	32,600	2.01	Apr. 1, 10 p.m.	ac18.10	12,600	.78
37	Whetstone River near Big Stone City, S. Dak.	389	1910-12, 1931-	June 1919 Apr. 11, 1947	ad26 13.95	- 5,500	- 14.1	Mar. 27, 6 p.m. Apr. 1, 10 p.m.	q9.49 -	- 1,260	- 3.24
38	Yellow Bank River near Odessa, Minn.	398	1939-	Apr. 11, 1947	16.61	5,090	12.8	Mar. 28, Apr. 2	ae14.59	c1,100	2.76
39	Pomme de Terre River near Appleton, Minn.	885	1931-	Mar. 31, 1943 Mar. 30, 1948	- h,q9.52	d3,140 -	3.55 -	Mar. 28, 9 a.m. Apr. 1	f,q7.76 -	- c,d950	- 1.07
40	Lac qui Parle River near Lac qui Parle, Minn.	983	1910-14, 1931-	Mar. 25, 1948	af18.52	7,490	7.62	Mar. 30, 6 p.m. Apr. 2	f14.02 -	- c2,800	- 2.85
41	Chippewa River near Milan, Minn.	1,870	1937-	Apr. 1, 1943	ag9.95	d5,170	2.76	Apr. 3, 12:30 p.m. May 13, 7-9 p.m.	8.13 -	- d1,340	- .72

42	Yellow Medicine River near Granite Falls, Minn.	653	1931-38, 1939-	Mar. 27, 1943 Mar. 23, 1948 Mar. 25, 1948	f,q7.00 - -	- f, 3, 510	- 5.38	Apr. 3, 4	ah4.00	955	1.52
43	Redwood River at Marshall, Minn.	307	1940-	April 1937 June 10, 1947	h9.5 f9.64	- 1,800	- 5.86	Mar. 27 Apr. 3	f,q8.40 -	- c550	- 1.79
44	Redwood River at Redwood Falls, Minn.	697	1909-14, 1930-	May 21, 1944 Mar. 23, 1948	- q8.05	f2, 800 -	4.02 -	Apr. 3, 5:15 p.m. Apr. 5, 5:45 p.m.	f,q5.03 -	- f910	- 1.31
45	Cottonwood River near New Ulm, Minn.	1, 280	1909-13, 1931-	July 9, 1947	16.94	i13, 800	10.8	Mar. 29, 9 a.m.	9.11	d3, 320	2.59
46	St. Croix River near Danbury, Wis.	1, 550	1914-	June 6, 1944 Mar. 19, 1945	- q7.95	ai8, 990 -	5.80 -	May 6, 10 p.m.	8.22	ai10, 200	6.58
47	St. Croix River near Grantsburg, Wis.	2, 820	1923-	June 7, 1944	12.79	15, 900	5.64	May 7, 9 a.m. to 12 m.	h15.06	26; 300	9.33
48	St. Croix River near Rush City, Minn.	5, 120	1923-	June 7, 1944 Mar. 19, 1945	- q18.8	38, 900 -	7.60 -	May 8, 2 a.m.	19.04	f60, 600	11.8
49	St. Croix River at St. Croix Falls, Wis.	5, 930	1902-5, 1908-	Mar. 20, 1945	h20.53	ai44, 600	7.52	May 8, 6 p.m.	25.19	ai54, 900	9.26
50	Namekagon River near Trego, Wis.	489	1927-	Sept. 2, 1941	-	c,ai5, 200	10.6	Apr. 19, 20	-	c,ai2, 160	4.42
51	Snake River at Moro, Minn.	422	1909-13	-	-	-	-	May	-	15, 300C	36.3
52	Sunrise River near Stacy, Minn.	94.7	1949-	Mar. 28, 29, 1949	5.24	f162	1.71	May 7, 6 a.m. to 2 p.m.	6.77	384	4.06
53	Apple River near Somerset, Wis.	550	1901-	June 17, 1943	-	c,ai2, 460	4.47	Apr. 3, May 8	-	c,ai1, 290	2.35
54	Cannon River at Welch, Minn.	1, 320	1909-14, 1930-	Mar. 23, 1936	12.04	11, 300	8.57	Mar. 27, 1 p.m.	10.17	9, 200	6.97

c Daily mean discharge.
d Affected by storage.
f Observed.
h From floodmark.
i Caused by failure of dam.
q Affected by ice backwater.
v Observed Apr. 1, 6:15 p.m., affected by ice backwater.
w Completely regulated.
x Observed Apr. 20, 1947.
y Present datum, occurred Apr. 4, 1943.
z Computed from cross-section and floodmarks by A. F. Meyer, consulting engineer.
aa About.
ab Site and datum then in use.
ac Occurred Apr. 1, 9 a.m., affected by ice backwater.
ad About, present site and datum, from information by local residents.
ae Occurred Mar. 28, 2 a.m., affected by ice backwater.
af Occurred Mar. 24, 1948, affected by ice backwater.
ag Occurred Mar. 31, 1943, affected by ice backwater.
ah Observed Apr. 4, 8:30 a.m.
ai Regulated by power plants.

Table 9. --Summary of flood stages and discharges in Upper Mississippi River and Lake Superior basins for floods of 1950--Continued

No. on pl 21	Stream and place of determination	Drainage area (square miles)	Period of record	Maximum flood previously known				Maximum during present flood			
				Date	Gage height (feet)	Discharge (cfs)	Cfs per square mile	Date and hour	Gage height (feet)	Discharge (cfs)	Cfs per square mile
55	Zumbro River at Zumbro Falls, Minn.	1,130	1909-17, 1929-	April 1888 Apr. 4, 1934	ad30.5 26.26	- 21,800	- 19.3	Mar. 27, 10 a. m.	24.82	21,200	18.8
56	Zumbro River at Theilman, Minn.	1,320	1938-	Mar. 15, 1945	40.10	f22,000	16.7	June 13	h42.09	23,000	17.4
57	Whitewater River at Beaver, Minn.	288	1939-	September 1938 Aug. 5, 1947 Mar. 4, 1949	aj92.75 - 9.01	n7,600 5,350 -	- 18.6 -	June 13, 10 a.m.	h10.75	10,500	36.5
58	South Fork Whitewater River near Altura, Minn.	76.8	1939-	Aug. 31, 1947	10.61	3,880	50.5	Mar. 26, 3 p. m.	9.84	3,460	45.1
59	Gilmore Creek at Winona, Minn.	8.95	1939-	July 27, 1947	6.97	2,460	275	Mar. 26, 12:30 p.m.	3.00	330	36.9
60	Root River near Lanesboro, Minn.	615	1910-17, 1940-	June 29, 1942	14.53	am15,000	24.4	Mar. 27, 3-4 a. m.	15.55	20,500	33.3
61	Root River near Houston, Minn.	1,270	1909-17, 1929-	Mar. 31, 1933 Mar. 11, 1936	- 14.9	26,600 -	20.9 -	Mar. 27, 2 p. m.	14.15	26,200	20.6
62	Root River below South Fork, near Houston, Minn.	1,560	1938-	Sept. 10, 11, 1938 June 30, 1942	ak18.05 -	- 23,600	- 15.1	Mar. 27, 6 a. m.	h16.56	31,100	19.9
63	South Branch Root River at Lanesboro, Minn.	-	-	-	-	-	-	Mar. 26	-	22,100D	-
64	Rush Creek near Rushford, Minn.	129	1942-	June 28, 29, 1942 Jan. 5, 1946	- 13.10	am11,000 7,130	- 55.3	Mar. 26, 4 p. m.	h13.54	11,600	89.9
65	South Fork Root River near Houston, Minn.	-	-	-	-	-	-	Mar. 26	-	16,200C	-
66	Cedar River near Austin, Minn.	425	1909-14, 1949-	Mar. 15, 1945	16.62	7,750	18.2	Mar. 26, 8:30 p. m.	17.81	8,800	20.7
67	West Fork Des Moines River at Jackson, Minn.	1,220	1909-13, 1930-	Sept. 3, 1942	an12.2	3,410	2.80	Apr. 2, 11 p. m.	8.14	1,340	1.10
68	Pigeon River at Middle Falls, below International Bridge, Minn.	600	1923-	May 5, 1934	ab7.6	f11,000	18.3	May 11, 11 p. m.	9.25	7,760	12.9

69	Baptism River near Beaver Bay, Minn.	140	1928-29, 1930-47, 1949-	Aug. 9, 1939	8.11	9,350	66.8	May 14, 6:15 p.m.	7.27	6,060	43.3
70	St. Louis River near Aurora, Minn.	312	1942-	June 6, 1944	7.30	f3,960	12.7	May 14, 4 a.m.	8.37	5,380	17.2
71	Partridge River near Aurora, Minn.	156	1942-	June 6, 1944	7.51	f2,930	18.8	May 10, 4 a.m.	7.86	3,230	20.7
72	Embarrass River at Embarrass, Minn.	93.8	1942-	Apr. 21, 1948	10.44	1,490	15.9	May 8, 8 p.m. to May 9, 8 a.m.	ap10.92	1,740	18.6

f Observed
h From floodmark.
n Determined by Corps of Engineers.
ab Site and datum then in use.
ad About, present site and datum, from information by local residents.
aj Original site and datum, from floodmark.
ak Observed at high-water staff gage 1,000 ft upstream.
am By slope-area method.
an Site and datum then in use, from graph based on gage readings.
ap Occurred May 9, 4-8 a.m.

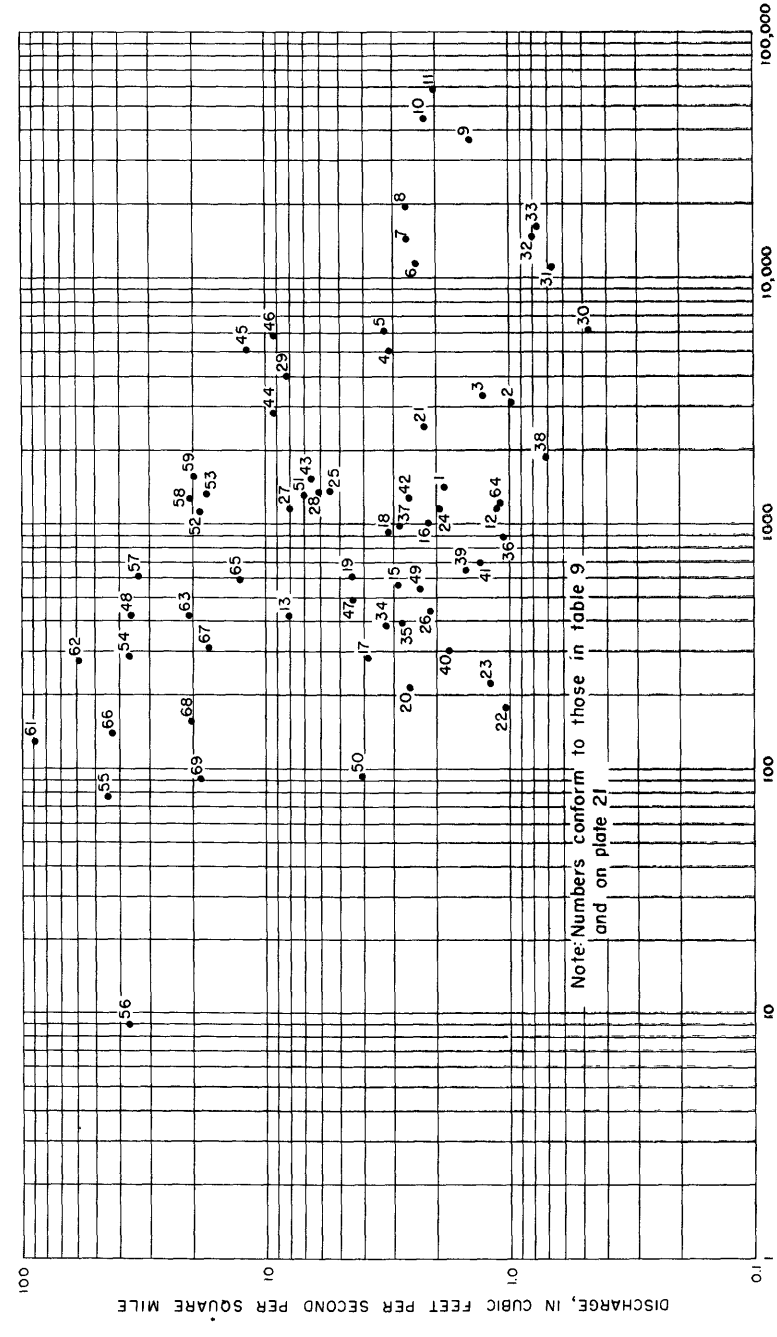

Figure 109.--Relation of unit discharge to size of drainage basin during floods of 1950.

FLOOD-CREST STAGES

Records of flood-crest stages observed at various bridges of the following railroads are shown in table 10: Chicago, Milwaukee, St. Paul and Pacific R. R.; Minneapolis, St. Paul & Sault Ste. Marie R. R. Co. ("Soo Line"); Northern Pacific Railway; and Great Northern Railway.

Other determinations of flood-crest stage were made by the Corps of Engineers and are shown in table 11. Figure 110 is the flood profile of the Mississippi River from Winnibigoshish Dam to Winona, Minn., as determined by the Corps of Engineers.

Table 10. --Flood stages observed at railway bridges during floods of 1950.

Railroad	Bridge no.	River	Location	1950 maximum		Previous maximum	
				Elevation in feet	Date	Elevation in feet	Date
C., M., St. P. & P.	L-206 N	Cannon	Near Red Wing	a-7.2	May 21	a-12.4	1897
C., M., St. P. & P.	L-210 N	Vermilion	Near Hastings	a-9.2	Apr. 24		
Soo Line	82-A	North Fork Crow	At Paynesville	1,148.57	Mar. 28		
Do.	90-A	North Fork Crow	Near Regal	1,211.21	Mar. 28	1,213.83	1915
Northern Pacific	93	Kettle	At Rutledge	1,027.96	-	1,023.61	May 6, 1938
Great Northern	44	Stoney Brook	At Brookston	1,227.2	-	1,217.2	1898
Do.	62	Savannah	At Floodwood	1,247.8	-		
Do.	74	Ball Club	Near Ball Club			1,282.4	1905
Do.	75	Mississippi	Near Ball Club			1,288.0	1905
Do.	87.6	Straight	Near Park Rapids			1,401.8	Mar. 1913
Do.	98.4	Sauk	Near Melrose	1,205.1	-	1,205.9	1941
Do.	25	Minnesota	Near Appleton			942.0	1948
Do.	42	Yellow Bank	Near Nassau			1,095.0	1919
Do.	133.8	Chippewa	At Benson			1,032.0	1943
Do.	154.4	Pomme de Terre	Near Morris			1,074.9	1897
Do.	624	Kettle	At Sandstone			1,011.0	1944
Do.	79.7	Pokegama	At Brook Park			1,013.2	1935
Do.	7	Elk	Near Parent			1,019.6	1882
Do.	3	Mayhew Creek	Near St. Cloud			1,030.0	1881
Do.	43.3	Yellow Medicine	At Hanley Falls			1,030.8	1919
Do.	44.7	Yellow Medicine	At Hanley Falls			1,042.8	1919
Do.	49.8	Yellow Medicine	Near Cottonwood			1,071.0	1919
Do.	91.8	Snake	At Grasston			948.4	1898
Do.	21	South Fork Crow	Near Mayer			945.4	1948
Do.	27	South Fork Crow	At Hutchinson			1,033.6	1948

a This reading indicates measurement, in feet, from reference point on bridge to water surface.

Table 11. --Flood-crest stages
[Furnished by Corps of Engineers, except as noted]

Point of determination	Miles above Ohio River	May 1950	Elevation (in feet)a/
Winnibigoshish Dam - tailwater b/	1,247.9	11	1,284.59
Leech Lake River, mouth of c/	1,223.8	13	1,280.20
Ball Club River, mouth of, near Ball Club, Minn. d/	1,221.5	13	1,280.10
White Oak Lake near Deer River, Minn. e/	1,213.0	13	1,279.20
Day's Highlanding Highway Bridge	1,203.8	13	1,278.61
Collinge Highway Bridge near Cohasset, Minn.	1,196.5	13	1,277.95
Pokegama Lake gage	1,183.9	13,14	1,277.86
Pokegama Dam - pool	1,183.8	21	1,277.52
Pokegama Dam - tailwater	1,183.8	12	1,270.35
Grand Rapids Dam - tailwater f/	1,180.5	13	1,256.76
Grand Rapids Dam - pool	1,180.5	13	1,257.25
Jacobson, Minn., at State Highway 34 bridge	1,137.5	14,15	1,240.50
Libby, Minn. gage f/	1,105.6	17	1,224.57
Palisade, Minn., at Highway bridge	1,086.6	17	1,216.92
4 miles southwest of Palisade	1,080.1	18	1,213.07
U. S. Highway 169 bridge, near Aitkin, Minn.	1,073.2	17	1,209.27
14.0 miles upstream from Aitkin	1,069.9	18	1,207.47
7.3 miles upstream from Aitkin	1,063.2	18	1,205.54
5.3 miles upstream from Aitkin	1,061.2	18	1,205.54
Aitkin, Minn.	1,055.9	20	1,205.21
Sec. 7, T. 136 N., R. 27 W., 12.7 miles downstream from Aitkin.	1,043.2	19	1,205.06
15.4 miles downstream from Aitkin	1,040.5	19	1,204.62
15.8 miles downstream from Aitkin (Pine Knoll)	1,040.1	19	1,204.47
0.7 mile downstream from Pine Knoll	1,039.4	19	1,204.31
1.0 mile downstream from Pine Knoll	1,039.1	19	1,204.01
1.3 miles downstream from Pine Knoll	1,038.8	19	1,203.86
2.0 miles downstream from Pine Knoll	1,038.1	19	1,203.69
2.2 miles downstream from Pine Knoll	1,037.9	19	1,203.35
SE corner, sec. 20, T. 126 N., R. 25 W., 4.3 miles below Pine Knoll.	1,035.8	19	1,202.29
4.3 miles upstream from State Highway 6 bridge near Crosby, Minn.	1,033.5	19	1,201.37
State Highway 6 bridge near Crosby	1,029.2	19	1,196.81
Northwest Paper Co. Dam, Brainerd, Minn. - pool.	1,003.7	13	1,187.20
Northwest Paper Co. Dam, Brainerd - tailwater	1,003.7	13	1,176.00
Highway bridge at Fort Ripley, Minn.	982.1	22	1,148.01
Minn. Power & Light Co. Dam, Little Falls, Minn. - pool.	965.3	15	1,108.08
Minn. Power & Light Co. Dam, Little Falls, Minn. - tailwater.	965.3	15	1,090.30
Minn. Power & Light Co. Blanchard Dam near Royalton, Minn. - pool.	956.4	8	1,081.70
Minn. Power & Light Co. Blanchard Dam near Royalton, Minn. - tailwater	956.4	8	1,045.40
Watab Dam near Sartell, Minn. - pool	932.5	10	1,017.60
Watab Dam near Sartell - tailwater	932.5	10	1,003.80
Northern States Power Dam at St. Cloud, Minn. - pool.	926.4	12	981.00
Northern States Power Dam at St. Cloud - tailwater	926.4	12	968.80
Elk River, Minn. f/	884.6	10	860.92
Northern States Power Co. Coon Rapids Dam, near Anoka, Minn. - pool.	866.2	11	830.30
Northern States Power Co. Coon Rapids Dam, near Anoka - tailwater.	866.2	11	820.85

Note. --See footnotes at end of table on following page.

Table 11.--Flood-crest stages--Continued

Point of determination	Miles above Ohio River	May 1950	Elevation (in feet)a/
Near Anoka, Minn. f/	864.7	11	818.84
City Pumping Station, Minneapolis	858.6	11	810.85
St. Anthony Falls Upper Dam, Minneapolis - pool	853.9	11	801.20
St. Anthony Falls Upper Dam, Minneapolis - tailwater.	853.9	11	751.40
St. Anthony Falls Lower Dam, Minneapolis - pool	853.5	11	751.40
St. Anthony Falls Lower Dam, Minneapolis - tailwater.	853.5	11	734.70
Minneapolis barge terminal, Minneapolis	852.6	11	733.00
Lock and dam 1, Minneapolis - pool	847.5	11,12	730.72
Lock and dam 1, Minneapolis - tailwater	847.5	11	703.92
St. Paul, (Robert St.) f/	839.3	13	697.11
St. Paul barge terminal, St. Paul	837.3	13	696.50
South St. Paul	833.7	13	694.88
Lock and dam 2, Hastings, Minn. - pool	815.4	12	686.46
Lock and dam 2, Hastings - tailwater	815.0	12	686.12
Chicago, Milwaukee, St. Paul & Pacific R.R. bridge near Hastings.	813.7	11	685.25
Prescott, Wis. f/	811.4	10,11	685.21
Lock and dam 3, near Red Wing, Minn. - pool	797.1	12	681.01
Lock and dam 3, near Red Wing - tailwater	796.7	12	680.55
Red Wing	790.9	13	678.75
Lake City, Minn.	772.6	13	677.41
At mouth of Chippewa River	763.5	13	676.85
Reads, Minn.	762.7	13	675.92
Wabasha, Minn.	760.4	13	673.61
Lock and dam 4, Alma, Wis. - pool	753.0	13	669.62
Lock and dam 4, Alma - tailwater	752.6	13	669.20
Control Point Pool 5, downstream from Alma	748.5	13	666.05
Lock and dam 5, at Minnesota City, Minn. - pool	738.3	14	660.42
Lock and dam 5, at Minnesota City - tailwater	737.90	14	659.81
Fountain City, Wis.	733.5	14	657.60
Lock and dam 5A, near Winona, Minn. - pool	728.7	14	656.15
Lock and dam 5A, near Winona - tailwater	728.3	14	655.73
Winona	725.7	14	654.18
Rice River at Kimberly, Minn.		12	1,219.80
Rice River at Hassman, Minn.		15	1,206.37
Big Willow River 1½ miles north of Palisade, Minn.		12	1,223.67
Big Willow River 3 miles west of Palisade		11,12	1,217.83

a Elevation above mean sea level, adjustment of 1912.
b Elevation 1,292.97 ft on Aug. 8, 9.
c Elevation 1,282.84 ft on Aug. 15, 17.
d Elevation 1,282.12 ft on Aug. 15.
e Elevation 1,280.20 ft on Aug. 24.
f Geological Survey record.

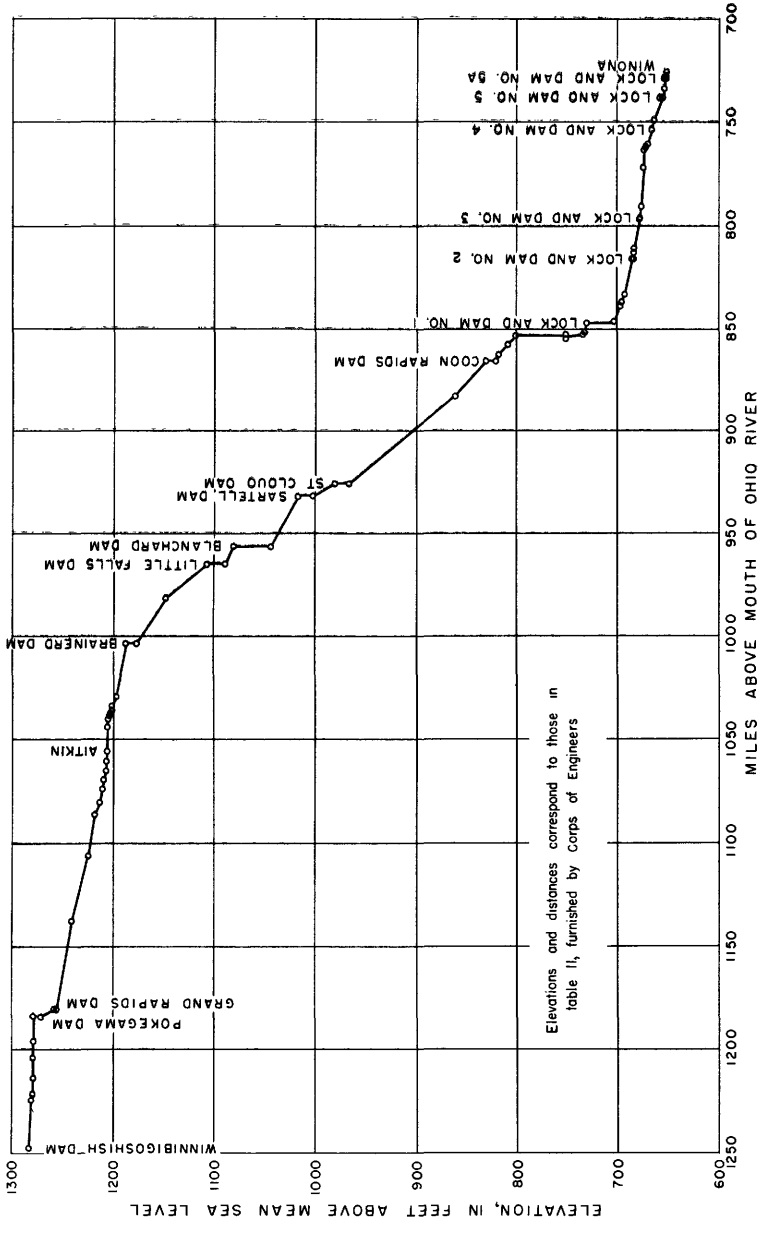

Figure 110.--Profile of crest stages on the Mississippi River from Winnibigoshish Dam to Winona, Minn. during May 1950.

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