DEPARTMENT OF THE INTERIOR
Hubert Work, Secretary

U. S. GEOLOGICAL SURVEY
George Otis Smith, Director

WATER-SUPPLY PAPER 565

# SURFACE WATER SUPPLY OF THE UNITED STATES

## 1923

## PART V. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS

NATHAN C. GROVER, Chief Hydraulic Engineer
W. A. LAMB, S. B. SOULÉ, J. B. SPIEGEL, H. E. GROSBACH
E. L. WILLIAMS, and H. C. BECKMAN
District Engineers

Prepared in cooperation with the States of
NORTH DAKOTA, MINNESOTA, WISCONSIN, IOWA
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## ILLUSTRATIONS

# SURFACE WATER SUPPLY OF HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS, 1923

## AUTHORIZATION AND SCOPE OF WORK

This volume is one of a series of 14 reports presenting results of measurements of flow made on streams in the United States during the year ending September 30, 1923.

The data presented in these reports were collected by the United States Geological Survey under the following authority contained in the organic law (20 Stat. L., p. 394):

*Provided*, That this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

The work was begun in 1888 in connection with special studies relating to irrigation in the arid West. Since the fiscal year ending June 30, 1895, successive appropriation bills passed by Congress have carried the following item:

For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

*Annual appropriations for the fiscal years ending June 30, 1895–1924*

| | |
|---|---|
| 1895 | $12,500.00 |
| 1896 | 20,000.00 |
| 1897 to 1900, inclusive | 50,000.00 |
| 1901 to 1902, inclusive | 100,000.00 |
| 1903 to 1906, inclusive | 200,000.00 |
| 1907 | 150,000.00 |
| 1908 to 1910, inclusive | 100,000.00 |
| 1911 to 1917, inclusive | 150,000.00 |
| 1918 | 175,000.00 |
| 1919 | 148,244.10 |
| 1920 | 175,000.00 |
| 1921 to 1923, inclusive | 180,000.00 |
| 1924 | 170,000.00 |

In the execution of the work many private and State organizations have cooperated either by furnishing data or by assisting in collecting data. Acknowledgments for cooperation of the first kind are made in connection with the description of each station affected; cooperation of the second kind is acknowledged on page 5.

Measurements of stream flow have been made at about 5,600 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1923, 1,590 gaging stations were being maintained by the Survey and the cooperating organizations. Many miscellaneous discharge measurements are made at other points. In connection with this work data were also collected in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country and will be made available in water-supply papers from time to time. Information in regard to publications relating to water resources is presented in the appendix to this report.

## DEFINITION OF TERMS

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those that represent a rate of flow, as second-feet, gallons per minute, miner's inches, and discharge in second-feet per square mile, and (2) those that represent the actual quantity of water, as run-off in inches, acre-feet, and millions of cubic feet. The principal terms used in this series of reports are second-feet, second-feet per square mile, and run-off in inches and acre-feet. They may be defined as follows:

"Second-feet" is an abbreviation for "cubic feet per second." A second-foot is the rate of discharge of water flowing in a channel of rectangular cross section 1 foot wide and 1 foot deep at an average velocity of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Second-feet per square mile" is the averge number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

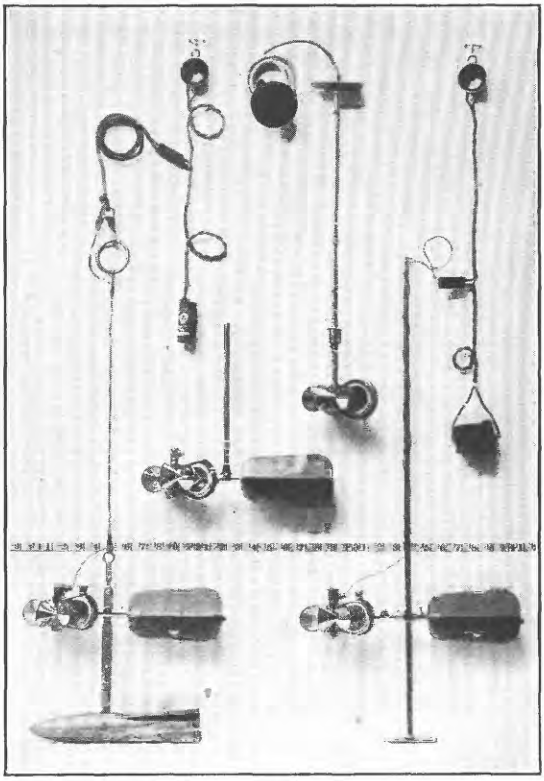
"Run-off in inches" is the depth to which an area would be covered if all the water flowing from it in a given period were uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

An "acre-foot," equivalent to 43,560 cubic feet, is the quantity required to cover an acre to the depth of 1 foot. The term is commonly used in connection with the storage for irrigation.

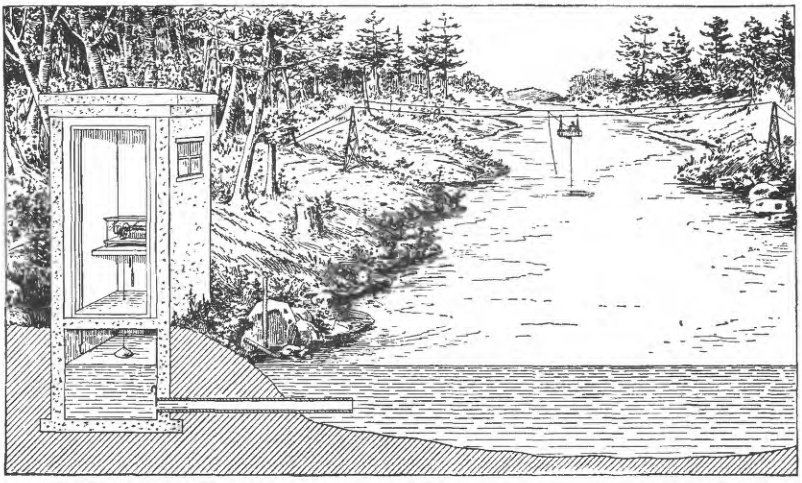
The following terms not in common use are here defined:

"Stage-discharge relation," an abbreviation for the term "relation of gage height to discharge."

"Control," a term used to designate the section or sections of the stream below the gage which determine the stage-discharge relation at the gage. It should be noted that the control may not be the same section or sections at all stages.

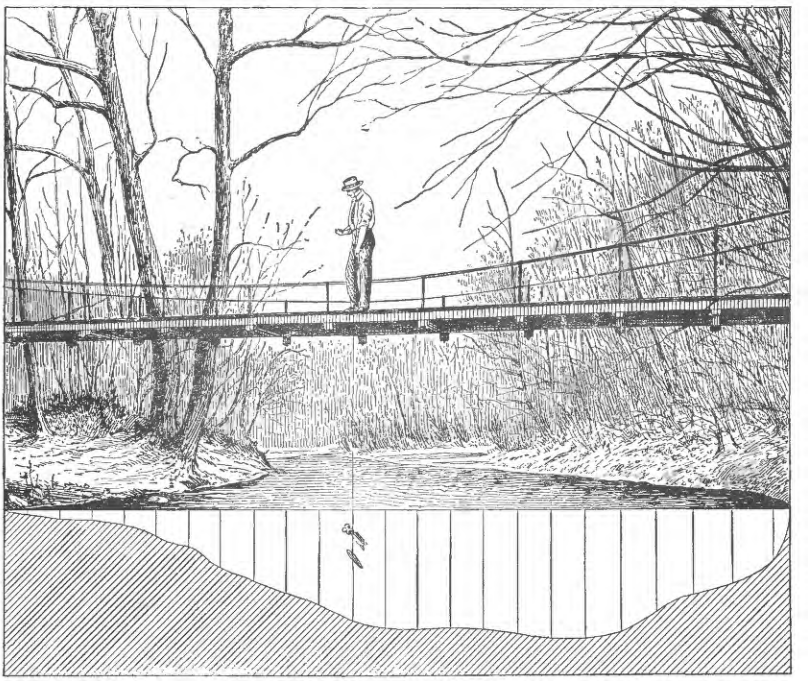


*A*. PRICE CURRENT METERS



*B*. TYPICAL GAGING STATION

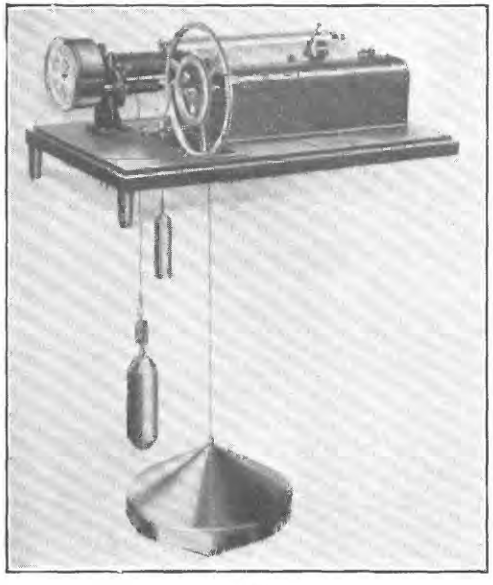
*A*



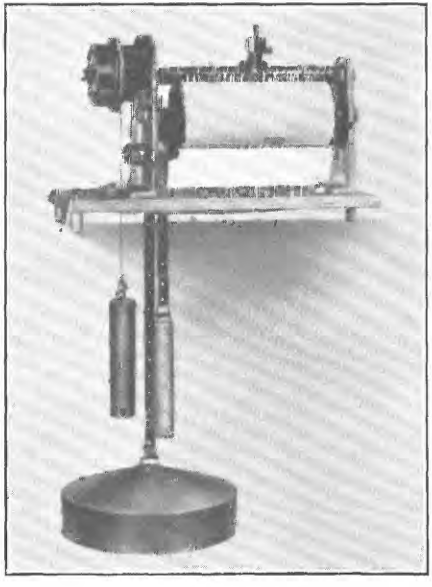
*B*

TYPICAL GAGING STATIONS

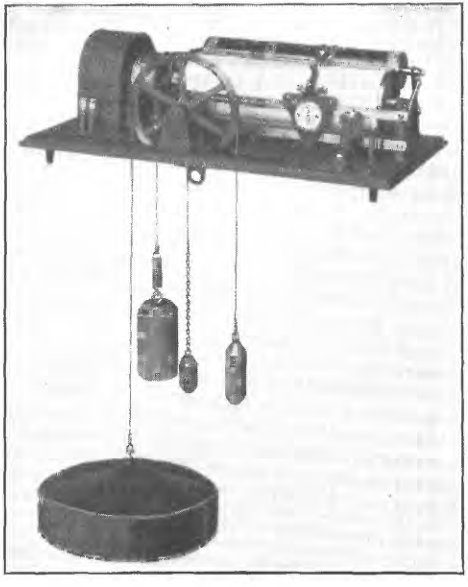
*A*, For wading measurement; *B*, for bridge measurement



*A*



*B*



*C*

WATER-STAGE RECORDERS

*A*, Au; *B*, Gurley; *C*, Stevens

The "point of zero flow" for a gaging station is that point on the gage—the gage height—at which water ceases to flow over the control.

## EXPLANATION OF DATA

The data presented in this report cover the year beginning October 1, 1922, and ending September 30, 1923. At the beginning of January in most parts of the United States much of the precipitation in the preceding three months is stored as ground water in the form of snow or ice, or in ponds, lakes, and swamps, and this stored water passes off in the streams during the spring break-up. At the end of September, on the other hand, the only stored water available for run-off is possibly a small quantity in the ground; therefore the run-off for the year beginning October 1 is practically all derived from precipitation within that year.

The base data collected at gaging stations consist of records of stage, measurements of discharge, and general information used to supplement the gage heights and discharge measurements in determining the daily flow. The records of stage are obtained either from direct readings on a staff gage or from a water-stage recorder that gives a continuous record of the fluctuations. Measurements of discharge are made with a current meter. (See Pls. I–III.) The general methods are outlined in standard textbooks on the measurement of river discharge.

From the discharge measurements rating tables are prepared that give the discharge for any stage. The application of the daily gage heights to these rating tables gives the daily discharge from which the monthly and yearly mean dischage is computed.

The data presented for each gaging station in the area covered by this report comprise a description of the station, a table giving results of discharge measurements, a table showing the daily discharge of the stream, and a table of monthly and yearly discharge and run-off.

If the base data are insufficient to determine the daily discharge, tables giving daily gage heights and results of discharge measurements are published.

The description of the station gives, in addition to statements regarding location and equipment, information in regard to any conditions that may affect the constancy of the stage-discharge relation covering such subjects as the occurrence of ice, the use of the stream for log driving, shifting of control, and the cause and effect of backwater; it gives also information as to diversions that decrease the flow at the gage, artificial regulation, maximum and minimum recorded stages, and the accuracy of the records.

The table of daily discharge gives, in general, the discharge in second-feet corresponding to the mean of the gage heights read

76612—26—WSP 565——2

each day. At stations on streams subject to sudden or rapid diurnal fluctuation the discharge obtained from the rating table and the mean daily gage height may not be the true mean discharge for the day. If such stations are equipped with water-stage recorders the mean daily discharge may be obtained by averaging discharge at regular intervals during the day, or by using the discharge integrator, an instrument operating on the principle of the planimeter and containing as an essential element the rating curve of the station.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest. As the gage height is the mean for the day it does not indicate correctly the stage when the water surface was at crest height and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column headed "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet per second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 2, are based.

## ACCURACY OF FIELD DATA AND COMPUTED RESULTS

The accuracy of stream-flow data depends primarily (1) on the permanence of the stage-discharge relation and (2) on the accuracy of observation of stage, measurements of flow, and interpretation of records.

A paragraph in the description of the station gives information regarding the (1) permanence of the stage-discharge relation, (2) precision with which the discharge rating curve is defined, (3) refinement of gage readings, (4) frequency of gage readings, and (5) methods of applying daily gage heights to the rating table to obtain the daily discharge.[1]

For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The monthly means for any station may represent with high accuracy the quantity of water flowing past the gage, but the figures showing discharge per square mile and depth of run-off in inches may be subject to gross errors caused by the inclusion of large noncontributing districts in the measured drainage area, by lack of information concerning water diverted for irrigation or other use, or by inability to interpret the effect of artificial regulation of the

[1] For a more detailed discussion of the accuracy of stream-flow data see Grover, N. C., and Hoyt, J. C., Accuracy of stream-flow data: U. S Geol. Survey Water-Supply Paper 400, pp. 53–59, 1916

flow of the river above the station. "Second-feet per square mile" and "run-off in inches" are therefore not computed if such errors appear probable. The computations are also omitted for stations on streams draining areas in which the annual rainfall is less than 20 inches. All figures representing "second-feet per square mile" and "run-off in inches" published by the Survey in earlier reports should be used with caution because of possible inherent sources of error not known to the Survey.

Many gaging stations on streams in the irrigated areas of the United States are located above most of the diversions from those streams, and the discharge recorded does not show the water supply available for further development as prior appropriations below the stations must first be satisfied. To give an idea of the amount of prior appropriations a paragraph on diversions is presented in each station description. The figures given can not be considered exact but represent the best information available.

The table of monthly discharge gives only a general idea of the flow at the station and should not be used for other than preliminary estimates; the tables of daily discharge allow more detailed studies of the variation in flow. It should be borne in mind, however, that the observations in each succeeding year may be expected to throw new light on data previously published.

## COOPERATION

The work in Montana was carried on in cooperation with the United States Bureau of Reclamation. With the exception of the station on St. Mary River near Babb, all stations in Montana were maintained jointly with the Dominion Water Power Branch, Department of the Interior, Canada.

In North Dakota, the work was done in cooperation with W. H. Robinson, State engineer, and at certain stations in cooperation with the Bureau of Public Roads, Department of Agriculture, and the Flood Control Commission of North Dakota.

The work in Minnesota was carried on in the Red River drainage basin in cooperation with the Minnesota State Drainage Commission, E. V. Willard, commissioner. The following organizations also cooperated: United States Weather Bureau (Mississippi River at St. Paul and Minnesota River near Mankato) and United States Engineer Corps (Mississippi River at Elk River and Minnesota River near Montevideo).

The work in Wisconsin was done in cooperation with the Railroad Commission of Wisconsin, C. M. Larson, chief engineer, and with Northern States Power Co. (Red Cedar River near Colfax, Red Cedar River at Cedar Falls, and Red Cedar River at Menomonie).

In Iowa the work was carried on in cooperation with the Iowa Geological Survey, George F. Kay, director; the Iowa Highway Commission, F. R. White, chief engineer; Mississippi River Power Co., of Keokuk, Iowa, Albion Davis, hydraulic engineer. The United States Weather Bureau paid the salaries of gage observers for stations on Cedar River at Cedar Rapids and part of the salaries of observers for stations on Des Moines River near Boone and Tracy and Raccoon River at Van Meter. Interstate Power Co., of Chicago, paid the salary of the observer for the station on Upper Iowa River near Decorah.

In Illinois work was carried on in cooperation with the Illinois Department of Public Works and Buildings, Division of Waterways, W. L. Sackett, superintendent, and with Central Illinois Public Service Co. (South Fork of Sangamon River at power plant near Taylorville).

The work in Missouri was carried on in cooperation with the Missouri Geological Survey, through H. A. Buehler, State geologist.

## DIVISION OF WORK

The data for stations in the Hudson Bay basin in Montana and North Dakota were collected and prepared for publication under the direction of W. A. Lamb, district engineer, assisted by E. F. Chandler and A. H. Tuttle.

The data for stations in the Hudson Bay basin in Minnesota were collected and prepared for publication under the direction of S. B. Soulé, district engineer, by E. F. Chandler, assisted by R. V. Tilley, Arthur Johnson, and R. B. Black.

For stations in the Mississippi River basin in Wisconsin and Minnesota the data were collected and prepared for publication under the direction of S. B. Soulé, district engineer, assisted by E. E. Foster and J. H. Olson.

The data for stations in Iowa were collected and prepared for publication under the direction of J. B. Spiegel, district engineer, assisted by three employees of Mississippi River Power Co.—Albion Davis, C. Herlofson, and P. L. Mercer.

The data for stations in Illinois were collected and prepared for publication under the direction of H. E. Grosbach, district engineer, assisted by A. M. Wahl.

The data for stations in Missouri were collected and prepared for publication under the direction of E. L. Williams and H. C. Beckman, district engineers, assisted by V. L. Austin, W. R. Denison, W. S. Frame, and H. E. Zoller.

The records were reviewed and the manuscript assembled by O. D. Mussey.

# GAGING-STATION RECORDS

## HUDSON BAY DRAINAGE BASIN

### ST. MARY RIVER NEAR BABB, MONT.

[Including diversion from Swiftcurrent Creek]

LOCATION.—In SE. ¼ sec. 27, T. 36 N., R. 14 W., above headworks of St. Mary Canal and 1 mile east of Babb, Glacier County, on Blackfeet Indian Reservation.

DRAINAGE AREA.—278 square miles (including area of Swiftcurrent Creek above point of diversion into St. Mary Lake); measured on topographic maps.

RECORDS AVAILABLE.—April 9, 1902, to September 30, 1923. Records for years 1902 to 1917 containing revisions of previously published records are published in Water-Supply Paper 491.

GAGE.—Stevens water-stage recorder on right bank 20 feet above diversion dam and referenced to staff gage which reads the head over the crest. Recorder inspected and staff gage read by W. J. Dorrington.

DISCHARGE MEASUREMENTS.—Made from a cable 480 feet above dam.

CHANNEL AND CONTROL.—Channel practically permanent. Banks high and not subject to overflow. Concrete diversion works for St. Mary Canal form the control.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year, 3,230 second-feet, June 11; minimum stage, 0.32 foot March 8–21 (discharge, 96 second-feet).

1902–1923: Maximum stage recorded, estimated 9.4 feet June 5, 1908 (discharge, 7,980 second-feet); minimum discharge, 30 second-feet, April 3–7, 1904.

ICE.—Stage-discharge relation affected by ice during severe winters.

DIVERSIONS.—None.

REGULATION.—Swiftcurrent Creek was diverted into St. Mary Lake October 1, 1915, the flow being regulated by gate operations at Sherburne Lake reservoir.

ACCURACY.—Stage-discharge relation permanent; not affected by ice during year. Rating curve well defined between 300 and 3,500 second-feet. Mean daily gage height obtained from recorder graph October 1 to November 3 and April 19 to September 30. Staff gage read to hundredths once daily during remainder of year. Daily discharge ascertained by applying mean daily gage height to rating table and adding daily flow in canal for period May 11 to September 10. Records good.

*Discharge measurements of St. Mary River near Babb, Mont., during the year ending September 30, 1923*

[Made by W. A. Lamb]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| June 7 | 1.95 | [a] 2,950 |
| Aug. 13 | .74 | [b] 792 |
| Sept. 10 | 1.28 | [c] 1,100 |

[a] Canal carrying 509 second-feet. [b] Canal carrying 438 second-feet. [c] Canal carrying 68 second-feet.

NOTE.—Measurements made above intake of St. Mary Canal. Flow of canal should be subtracted to obtain flow over diversion dam.

*Daily discharge, in second-feet, of St. Mary River near Babb, Mont., for the year ending September 30, 1923*

| | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 369 | 344 | 168 | 179 | 156 | 124 | 115 | 700 | 2,470 | 1,590 | 715 | 970 |
| 2 | 336 | 328 | 168 | 179 | 156 | 134 | 115 | 740 | 2,680 | 1,620 | 695 | 972 |
| 3 | 313 | 321 | 179 | 179 | 156 | 134 | 115 | 740 | 2,800 | 1,660 | 669 | 917 |
| 4 | 313 | 313 | 190 | 179 | 156 | 124 | 124 | 688 | 2,790 | 1,620 | 677 | 964 |
| 5 | 313 | 298 | 190 | 179 | 145 | 115 | 124 | 688 | 2,700 | 1,620 | 668 | 1,010 |
| 6 | 298 | 298 | 179 | 179 | 145 | 105 | 134 | 700 | 2,700 | 1,550 | 668 | 1,080 |
| 7 | 291 | 284 | 168 | 179 | 134 | 105 | 134 | 755 | 2,760 | 1,480 | 666 | 1,060 |
| 8 | 284 | 284 | 145 | 179 | 134 | 96 | 145 | 815 | 2,810 | 1,430 | 649 | 1,050 |
| 9 | 276 | 269 | 134 | 179 | 134 | 96 | 145 | 958 | 2,990 | 1,340 | 648 | 1,030 |
| 10 | 269 | 216 | 156 | 179 | 134 | 96 | 156 | 1,130 | 3,110 | 1,320 | 708 | 1,070 |
| 11 | 269 | 216 | 168 | 179 | 134 | 96 | 156 | 1,500 | 3,230 | 1,320 | 734 | 1,010 |
| 12 | 241 | 216 | 168 | 179 | 134 | 96 | 168 | 1,630 | 3,040 | 1,310 | 772 | 974 |
| 13 | 214 | 216 | 168 | 179 | 134 | 96 | 168 | 1,850 | 2,980 | 1,280 | 799 | 958 |
| 14 | 214 | 216 | 168 | 179 | 134 | 96 | 168 | 2,000 | 2,910 | 1,300 | 813 | 924 |
| 15 | 235 | 216 | 168 | 179 | 134 | 96 | 179 | 2,010 | 2,680 | 1,300 | 829 | 908 |
| 16 | 235 | 203 | 168 | 168 | 134 | 96 | 190 | 1,930 | 2,450 | 1,270 | 840 | 924 |
| 17 | 235 | 203 | 168 | 168 | 134 | 96 | 228 | 1,860 | 2,280 | 1,240 | 819 | 941 |
| 18 | 222 | 190 | 168 | 168 | 134 | 96 | 284 | 1,800 | 2,130 | 1,220 | 829 | 941 |
| 19 | 190 | 190 | 168 | 168 | 124 | 96 | 328 | 1,740 | 1,990 | 1,210 | 830 | 941 |
| 20 | 168 | 190 | 168 | 168 | 124 | 96 | 369 | 1,740 | 1,920 | 1,170 | 857 | 974 |
| 21 | 222 | 179 | 168 | 168 | 124 | 96 | 402 | 1,760 | 1,870 | 1,010 | 946 | 974 |
| 22 | 216 | 179 | 168 | 168 | 124 | 105 | 419 | 1,890 | 1,940 | 1,030 | 1,080 | 958 |
| 23 | 222 | 168 | 168 | 168 | 115 | 105 | 428 | 2,120 | 1,910 | 965 | 1,090 | 924 |
| 24 | 209 | 156 | 156 | 168 | 115 | 105 | 428 | 2,410 | 1,830 | 927 | 1,090 | 875 |
| 25 | 254 | 156 | 156 | 168 | 115 | 105 | 419 | 2,580 | 1,780 | 912 | 1,070 | 755 |
| 26 | 228 | 156 | 168 | 168 | 115 | 105 | 419 | 2,750 | 1,780 | 861 | 1,040 | 650 |
| 27 | 222 | 156 | 168 | 168 | 115 | 115 | 446 | 2,970 | 1,650 | 835 | 1,030 | 550 |
| 28 | 261 | 156 | 168 | 168 | 124 | 115 | 500 | 2,940 | 1,590 | 815 | 1,020 | 491 |
| 29 | 306 | 168 | 179 | 156 | ------- | 115 | 590 | 2,770 | 1,580 | 785 | 1,020 | 410 |
| 30 | 328 | 179 | 179 | 156 | ------- | 115 | 662 | 2,540 | 1,550 | 745 | 1,060 | 394 |
| 31 | 369 | ------- | 179 | 156 | ------- | 115 | ------- | 2,470 | ------- | 734 | 986 | ------- |

*Monthly discharge of St. Mary River near Babb, Mont., for the year ending September 30, 1923*

| Month | Discharge in second-feet | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum | Minimum | Mean | |
| October | 369 | 168 | 264 | 16,200 |
| November | 344 | 156 | 222 | 13,200 |
| December | 190 | 134 | 168 | 10,300 |
| January | 179 | 156 | 172 | 10,600 |
| February | 156 | 115 | 133 | 7,390 |
| March | 134 | 96 | 106 | 6,520 |
| April | 662 | 115 | 275 | 16,400 |
| May | 2,970 | 688 | 1,720 | 106,000 |
| June | 3,230 | 1,550 | 2,360 | 140,000 |
| July | 1,660 | 734 | 1,210 | 74,400 |
| August | 1,090 | 648 | 849 | 52,200 |
| September | 1,080 | 394 | 887 | 52,800 |
| The year | 3,230 | 96 | 699 | 506,000 |

### ST. MARY RIVER NEAR KIMBALL, ALBERTA

LOCATION.—In SW. ¼ sec. 25, T. 1 N., R. 25 W. fourth meridian, 1 mile south and 1 mile west of Kimball, Alberta, and 5 miles north of international boundary.

DRAINAGE AREA.—472 square miles (measured on topographic maps).

RECORDS AVAILABLE.—January 1, 1913, to September 30, 1923. September 1, 1902, to December 31, 1912, records were obtained at point half a mile north of boundary line. Records were also obtained by the Irrigation Branch, Department of Interior, Canada, at a point half a mile below present station, from 1905 to 1912. The discharge at the three points is practically the same.

GAGE.—A Stevens continuous water-stage recorder on right bank used during open-water season. During winter a chain gage located on highway bridge 3 miles below station is used.

DISCHARGE MEASUREMENTS.—Made from cable 1,200 feet above gage and by wading near gage.

CHANNEL AND CONTROL.—Bed of stream at gage and at control composed of boulders and sandstone ledges. Control formed by an outcropping ledge of sandstone covered with boulders near left bank. Shifts occasionally during high stage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.56 feet at 1 p. m. June 11 (discharge, 3,510 second-feet); minimum discharge, 88 second-feet March 6–9 (stage-discharge relation affected by ice).

1902–1923: Maximum stage recorded, 12.75 feet June 5, 1908 (discharge, 18,000 second-feet, estimated by comparison with record for station near Babb); minimum discharge, 46 second-feet December 1, 1919 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation affected by ice. Discharge determined from study of discharge measurements, observer's notes, and temperature records.

DIVERSIONS.—St. Mary Canal diverts water from St. Mary River near Babb, Mont., to North Fork of Milk River. Alberta Railway & Irrigation Co.'s. canal diverts from St. Mary River 2 miles below station.

REGULATION.—Flow of Swiftcurrent Creek regulated by gate operation at the Sherburne Lake reservoir.

ACCURACY.—Stage-discharge relation not permanent; affected by ice and by shift of control. Two rating curves used for open-water periods. Curve used October 1 to November 2 well defined between 350 and 5,000 second-feet; April 14 to September 30 well defined between 300 and 3,500 second-feet. Mean daily gage height October 1 to November 6 and April 14 to September 30 determined by inspection of recorder graph. Chain gage read to hundredths once daily November 7 to April 13. Daily discharge ascertained by applying mean daily gage height to rating table except as shown in footnote to table of daily discharge. Records good.

COOPERATION.—Maintained in cooperation with the Department of Interior, Canada.

*Discharge measurements of St. Mary River near Kimball, Alberta, during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 3 | A. W. P. Lowrie [a] | 2.65 | 331 | Mar. 19 | W. G. Stuart | 5.30 | [b] 100 |
| 29 | H. J. McLean [a] | 2.66 | 341 | Apr. 13 | A. W. P. Lowrie | 4.00 | [b] 284 |
| Nov. 13 | do | 3.90 | [b] 259 | 25 | do | 3.05 | 541 |
| 28 | do | 3.69 | [b] 165 | May 12 | do | 4.72 | 2,130 |
| Dec. 12 | do | 5.47 | [b] 131 | June 8 | W. A. Lamb | 5.35 | 3,150 |
| 29 | W. G. Stuart [a] | 5.07 | [b] 164 | 25 | A. W. P. Lowrie | 4.60 | 2,070 |
| Jan. 15 | do | 4.71 | [b] 179 | Aug. 15 | W. A. Lamb | 3.00 | 547 |
| Feb. 1 | do | 5.20 | [b] 155 | Sept. 8 | A. W. P. Lowrie | 3.90 | 1,230 |
| 16 | do | 5.50 | [b] 110 | 10 | do | 3.92 | 1,250 |
| Mar. 7 | do | 5.23 | [b] 88 | | | | |

[a] Engineer, Department of the Interior, Canada. [b] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of St. Mary River near Kimball, Alberta, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 375 | 396 | 137 | 161 | 155 | 109 | 219 | 1,000 | 3,300 | 1,560 | 657 | 795 |
| 2 | 357 | 389 | 134 | 161 | 155 | 100 | 241 | 1,050 | 3,320 | 1,590 | 604 | 742 |
| 3 | 330 | 363 | 131 | 164 | 155 | 94 | 231 | 1,040 | 3,240 | 1,630 | 585 | 750 |
| 4 | 345 | 340 | 131 | 168 | 158 | 92 | 228 | 1,040 | 3,200 | 1,570 | 592 | 889 |
| 5 | 342 | 316 | 128 | 168 | 158 | 90 | 223 | 1,050 | 3,220 | 1,490 | 585 | 1,000 |
| 6 | 330 | 291 | 128 | 168 | 161 | 88 | 219 | 1,120 | 3,320 | 1,380 | 585 | 1,080 |
| 7 | 318 | 272 | 128 | 171 | 151 | 88 | 219 | 1,200 | 3,290 | 1,280 | 543 | 1,230 |
| 8 | 316 | 272 | 126 | 171 | 142 | 88 | 231 | 1,280 | 3,170 | 1,140 | 525 | 1,240 |
| 9 | 312 | 250 | 128 | 174 | 137 | 88 | 241 | 1,450 | 3,150 | 1,090 | 513 | 1,210 |
| 10 | 308 | 250 | 131 | 174 | 128 | 90 | 250 | 1,720 | 3,320 | 1,020 | 467 | 1,260 |
| 11 | 298 | 250 | 131 | 171 | 123 | 90 | 259 | 2,150 | 3,440 | 932 | 366 | 1,240 |
| 12 | 295 | 228 | 131 | 171 | 118 | 92 | 272 | 2,190 | 3,200 | 864 | 416 | 1,180 |
| 13 | 289 | 259 | 137 | 175 | 113 | 94 | 286 | 2,360 | 2,960 | 841 | 456 | 1,140 |
| 14 | 287 | 228 | 137 | 175 | 111 | 96 | 473 | 2,370 | 2,630 | 826 | 490 | 1,090 |
| 15 | 284 | 223 | 140 | 179 | 111 | 96 | 410 | 2,360 | 2,500 | 788 | 525 | 1,070 |
| 16 | 268 | 208 | 140 | 179 | 109 | 98 | 366 | 2,300 | 2,330 | 834 | 531 | 1,110 |
| 17 | 284 | 192 | 142 | 175 | 111 | 98 | 375 | 2,180 | 2,080 | 1,260 | 508 | 1,180 |
| 18 | 282 | 181 | 148 | 175 | 113 | 100 | 461 | 2,100 | 1,900 | 1,260 | 502 | 1,190 |
| 19 | 266 | 181 | 155 | 171 | 116 | 100 | 508 | 2,000 | 1,740 | 1,240 | 508 | 1,100 |
| 20 | 238 | 185 | 161 | 168 | 118 | 100 | 513 | 1,960 | 1,600 | 1,210 | 549 | 1,090 |
| 21 | 277 | 189 | 168 | 168 | 120 | 100 | 555 | 2,010 | 1,730 | 1,140 | 898 | 1,060 |
| 22 | 273 | 192 | 174 | 164 | 123 | 105 | 567 | 2,120 | 2,480 | 1,070 | 949 | 1,030 |
| 23 | 266 | 196 | 181 | 161 | 123 | 105 | 561 | 2,400 | 2,220 | 1,020 | 906 | 924 |
| 24 | 271 | 196 | 185 | 158 | 126 | 105 | 555 | 2,640 | 2,140 | 958 | 872 | 872 |
| 25 | 278 | 189 | 185 | 158 | 126 | 107 | 549 | 2,870 | 2,020 | 898 | 881 | 772 |
| 26 | 289 | 181 | 181 | 155 | 126 | 109 | 567 | 3,090 | 1,830 | 857 | 881 | 685 |
| 27 | 277 | 171 | 174 | 151 | 123 | 123 | 631 | 3,250 | 1,700 | 795 | 841 | 585 |
| 28 | 302 | 165 | 168 | 151 | 120 | 140 | 720 | 3,200 | 1,630 | 772 | 841 | 496 |
| 29 | 335 | 155 | 164 | 151 | ------- | 161 | 810 | 3,000 | 1,530 | 742 | 826 | 444 |
| 30 | 366 | 148 | 164 | 155 | ------- | 181 | 915 | 2,810 | 1,530 | 713 | 841 | 401 |
| 31 | 400 | ------- | 161 | 155 | ------- | 204 | ------- | 2,990 | ------- | 692 | 810 | ------- |

NOTE.—Stage-discharge relation affected by ice Nov. 3 to Apr. 13; daily discharge determined from gage heights and discharge measurements referred to chain gage, temperature records, and observer's notes.

*Monthly discharge of St. Mary River near Kimball, Alberta, for the year ending September 30, 1923*

| Month | Discharge in second-feet | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum | Minimum | Mean | |
| October | 400 | 238 | 305 | 18,800 |
| November | 396 | 148 | 235 | 14,000 |
| December | 185 | 126 | 149 | 9,160 |
| January | 179 | 151 | 166 | 10,200 |
| February | 161 | 109 | 130 | 7,220 |
| March | 204 | 88 | 107 | 6,580 |
| April | 915 | 219 | 422 | 25,100 |
| May | 3,250 | 1,000 | 2,070 | 127,000 |
| June | 3,440 | 1,530 | 2,520 | 150,000 |
| July | 1,630 | 692 | 1,080 | 66,400 |
| August | 949 | 366 | 647 | 39,800 |
| September | 1,260 | 401 | 963 | 57,200 |
| The year | 3,440 | 88 | 735 | 531,000 |

### ST. MARY CANAL AT INTAKE, NEAR BABB, MONT.

LOCATION.—In NW. ¼ NE. ¼ sec. 27, T. 36 N., R. 14 W., 600 feet below intake of St. Mary Canal on Blackfeet Indian Reservation, 1 mile east of Babb, Glacier County.

RECORDS AVAILABLE.—June 1, 1918, to September 30, 1923.

GAGE.—Gurley printing water-stage recorder on right bank. Prior to April 17, 1919, a staff gage 300 feet above present gage was read. The two gages were set to read the same but are not at same datum on account of slope in canal between the two points.

DISCHARGE MEASUREMENTS.—Made from cable 10 feet above gage. Current is evenly distributed throughout cross section and has a moderate velocity at all stages.

CHANNEL AND CONTROL.—Bed composed of gravel.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined between 60 and 650 second-feet. Mean daily gage-height obtained by averaging the gage-height record of Gurley printing gage. Daily discharge ascertained by applying mean daily gage height to rating table or for days of considerable fluctuation by averaging the hourly discharge. Records excellent.

COOPERATION.—Maintained in cooperation with Department of the Interior, Canada.

Water is diverted from St. Mary River for irrigation of lands in Milk River Valley east of Havre, Mont. Water may be returned to St. Mary River at St. Mary siphon.

*Discharge measurements of St. Mary Canal at intake, near Babb, Mont., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| May 16 | A. W. P. Lowrie [a] | 3.77 | 223 | July 29 | W. A. Lamb | 4.02 | 245 |
| June 7 | W. A. Lamb | 6.04 | 497 | Aug. 13 | do | 5.64 | 426 |
| 27 | A. W. P. Lowrie | 5.59 | 435 | Sept. 6 | S. G. Dawson | 3.76 | 199 |
| July 12 | do | 6.72 | 612 | 7 | do | 2.44 | 103 |
| 27 | S. G. Dawson [a] | 4.06 | 230 | 8 | do | 1.92 | 75 |

[a] Engineer, Department of the Interior, Canada.

*Daily discharge, in second-feet, of St. Mary Canal at intake, near Babb, Mont., for the year ending September 30, 1923*

| Day | May | June | July | Aug. | Sept. | Day | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ------- | 453 | 511 | 233 | 370 | 16 | 191 | 496 | 607 | 435 | ------- |
| 2 | ------- | 482 | 512 | 231 | 422 | 17 | 250 | 499 | 281 | 434 | ------- |
| 3 | ------- | 480 | 511 | 232 | 357 | 18 | 292 | 501 | 283 | 435 | ------- |
| 4 | ------- | 474 | 512 | 231 | 239 | 19 | 349 | 504 | 284 | 436 | ------- |
| 5 | ------- | 476 | 511 | 231 | 213 | 20 | 387 | 509 | 274 | 438 | ------- |
| 6 | ------- | 477 | 507 | 231 | 176 | 21 | 408 | 504 | 244 | 446 | ------- |
| 7 | ------- | 495 | 506 | 229 | 90 | 22 | 442 | 428 | 242 | 450 | ------- |
| 8 | ------- | 488 | 506 | 230 | 74 | 23 | 466 | 362 | 240 | 444 | ------- |
| 9 | ------- | 488 | 509 | 229 | 71 | 24 | 476 | 360 | 239 | 431 | ------- |
| 10 | ------- | 488 | 515 | 355 | 62 | 25 | 471 | 370 | 237 | 431 | ------- |
| 11 | 69 | 490 | 575 | 436 | ------- | 26 | 479 | 405 | 237 | 429 | ------- |
| 12 | 79 | 488 | 618 | 436 | ------- | 27 | 490 | 432 | 236 | 428 | ------- |
| 13 | 127 | 496 | 631 | 438 | ------- | 28 | 511 | 444 | 235 | 426 | ------- |
| 14 | 185 | 498 | 659 | 436 | ------- | 29 | 504 | 488 | 235 | 426 | ------- |
| 15 | 194 | 498 | 689 | 435 | ------- | 30 | 501 | 507 | 235 | 425 | ------- |
| | | | | | | 31 | 474 | ------- | 234 | 374 | ------- |

*Monthly discharge of St. Mary Canal at intake, near Babb, Mont., for the year ending September 30, 1923*

| Month | Discharge in second-feet | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum | Minimum | Mean | |
| May 11–31 | 511 | 69 | 350 | 14,600 |
| June | 509 | 360 | 469 | 27,900 |
| July | 689 | 234 | 407 | 25,000 |
| August | 450 | 229 | 371 | 22,800 |
| September 1–10 | 422 | 62 | 207 | 4,110 |
| The period | ---------- | ---------- | ---------- | 94,400 |

### ST. MARY CANAL AT ST. MARY CROSSING, NEAR BABB, MONT.

LOCATION.—In NE. ¼ sec. 30, T. 37 N., R. 13 W. Montana meridian, 500 feet east of outlet of St. Mary River siphon, 10 miles below intake, and 9 miles north of Babb, Glacier County.

RECORDS AVAILABLE.—July 6, 1918, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on right bank.

DISCHARGE MEASUREMENTS.—Made from cable 70 feet above gage.

CHANNEL AND CONTROL.—Control is located at head of steel flume 50 feet below gage. Subject to shift on account of silting of canal.

ACCURACY.—Stage-discharge relation affected by shifting control during June and July. Two rating curves, both well defined, used May 5 to July 26 and July 27 to September 12. Mean daily gage height obtained from recorder graph by straight-line method. Daily discharge ascertained by applying mean daily gage height to rating table except June 10 to July 26 when indirect method was used. Discharge for days of considerable fluctuation obtained by averaging the hourly discharge. Records good.

COOPERATION.—Maintained in cooperation with Department of the Interior, Canada.

*Discharge measurements of St. Mary Canal at St. Mary crossing, near Babb, Mont., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 1 | A. W. P. Lowrie[a] | 0.84 | 16.8 | July 27 | S. G. Dawson[a] | 3.02 | 205 |
| May 16 | do | 2.88 | 188 | Aug. 15 | W. A. Lamb | 4.06 | 391 |
| June 9 | W. A. Lamb | 4.36 | 417 | Sept. 6 | S. G. Dawson | 2.82 | 183 |
| 27 | A. W. P. Lowrie | 4.14 | 387 | 7 | do | 1.93 | 85 |
| July 12 | do | 4.76 | 503 | 8 | do | 1.14 | 27.3 |
| 16 | A. H. Tuttle | 5.01 | 552 | | | | |

[a]Engineer, Department of the Interior, Canada.

*Daily discharge, in second-feet, of St. Mary Canal at St. Mary crossing, near Babb, Mont., for the year ending September 30, 1923*

| Day | Oct. | May | June | July | Aug. | Sept. | Day | Oct. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | ------ | 390 | 438 | 206 | 336 | 16 | ------ | 186 | 424 | 546 | 390 | ------ |
| 2 | 1 | ------ | 408 | 440 | 206 | 374 | 17 | ------ | 230 | 424 | 347 | 388 | ------ |
| 3 | ------ | ------ | 408 | 440 | 204 | 358 | 18 | ------ | 265 | 424 | 275 | 386 | ------ |
| 4 | ------ | ------ | 401 | 441 | 204 | 216 | 19 | ------ | 308 | 425 | 276 | 386 | ------ |
| 5 | ------ | 2.8 | 403 | 440 | 201 | 183 | 20 | ------ | 340 | 428 | 270 | 386 | ------ |
| 6 | ------ | .4 | 403 | 438 | 201 | 172 | 21 | ------ | 358 | 436 | 236 | 390 | ------ |
| 7 | ------ | 3.6 | 414 | 438 | 200 | 86 | 22 | ------ | 382 | 412 | 229 | 396 | ------ |
| 8 | ------ | 10.2 | 412 | 438 | 200 | 35.0 | 23 | ------ | 401 | 334 | 223 | 398 | ------ |
| 9 | ------ | 19.0 | 416 | 441 | 200 | 45.1 | 24 | ------ | 409 | 328 | 217 | 386 | ------ |
| 10 | ------ | 23.0 | 417 | 441 | 274 | 5.6 | 25 | ------ | 403 | 329 | 214 | 382 | ------ |
| 11 | ------ | 85 | 419 | 466 | 388 | 1.2 | 26 | ------ | 404 | 352 | 210 | 382 | ------ |
| 12 | ------ | 137 | 417 | 500 | 394 | .1 | 27 | ------ | 414 | 382 | 207 | 380 | ------ |
| 13 | ------ | 149 | 424 | 510 | 394 | ------ | 28 | ------ | 428 | 382 | 204 | 382 | ------ |
| 14 | ------ | 165 | 428 | 519 | 392 | ------ | 29 | ------ | 427 | 417 | 204 | 380 | ------ |
| 15 | ------ | 167 | 424 | 529 | 390 | ------ | 30 | ------ | 422 | 433 | 206 | 345 | ------ |
| | | | | | | | 31 | ------ | 417 | ------ | 206 | 334 | ------ |

*Monthly discharge of St. Mary Canal at St. Mary crossing, near Babb, Mont., for the year ending September 30, 1923*

| Month | Discharge in second-feet | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum | Minimum | Mean | |
| October 1–2 | 14 | 1 | 7.5 | 30 |
| May 5–31 | 428 | 0.4 | 243 | 13,000 |
| June | 436 | 328 | 404 | 24,000 |
| July | 546 | 204 | 354 | 21,800 |
| August | 398 | 200 | 327 | 20,100 |
| September 1–12 | 374 | .1 | 151 | 3,590 |

### ST. MARY CANAL AT HUDSON BAY DIVIDE, NEAR BROWNING, MONT.

LOCATION.—In sec. 5, T. 37 N., R. 11 W., 3 miles above canal outlet, 30 miles north of Browning, Glacier County, on Blackfeet Indian Reservation.

RECORDS AVAILABLE.—July 3, 1917, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on right bank 50 feet above first drop.

DISCHARGE MEASUREMENTS.—Made from cable 500 feet above gage.

CHANNEL AND CONTROL.—Canal uniform in section. Control is a V-shaped notch in concrete drop 50 feet below gage.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined between 15 and 500 second-feet. Mean daily gage height determined from recorder graph by straight-line method. Daily discharge ascertained by applying mean daily gage height to rating table, except for days of considerable fluctuation for which it was obtained by averaging hourly discharge. Records excellent.

COOPERATION.—Maintained in cooperation with Department of the Interior, Canada.

*Discharge measurements of St. Mary Canal at Hudson Bay divide, near Browning, Mont., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 1 | S. G. Dawson [a] | 2.93 | 69 | Sept. 5 | S. G. Dawson | 4.42 | 202 |
| 2 | A. W. P. Lowrie [a] | 1.78 | 21.0 | 6 | A. W. P. Lowrie | 4.24 | 185 |
| May 10 | W. A. Lamb | 1.80 | 21.5 | 7 | do | 3.95 | 151 |
| 16 | A. W. Lowrie | 4.04 | 160 | 7 | do | 3.70 | 133 |
| June 9 | W. A. Lamb | 5.79 | 435 | 8 | do | 2.98 | 78 |
| July 6 | A. W. P. Lowrie | 5.77 | 447 | 9 | do | 2.10 | 33.3 |
| Aug. 14 | W. A. Lamb | 5.53 | 390 | 11 | do | 1.63 | 15.8 |

[a] Engineer, Department of the Interior, Canada.

*Daily discharge, in second-feet, of St. Mary Canal at Hudson Bay divide, near Browning, Mont., for the year ending September 30, 1923*

| Day | Oct. | May | June | July | Aug. | Sept. | Day | Oct. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 67 | | 432 | 425 | 205 | 338 | 16 | | 167 | 430 | 510 | 391 | |
| 2 | 23 | | 421 | 432 | 208 | 340 | 17 | | 187 | 430 | 492 | 391 | |
| 3 | 8 | | 426 | 437 | 202 | 367 | 18 | | 232 | 430 | 326 | 389 | |
| 4 | 5 | | 432 | 430 | 205 | 318 | 19 | | 274 | 430 | 262 | 389 | |
| 5 | 3 | | 430 | 432 | 203 | 216 | 20 | | 316 | 428 | 247 | 392 | |
| 6 | | | 432 | 430 | 203 | 190 | 21 | | 350 | 449 | 235 | 398 | |
| 7 | | | 433 | 430 | 205 | 148 | 22 | | 372 | 456 | 210 | 399 | |
| 8 | | | 438 | 430 | 203 | 76 | 23 | | 394 | 406 | 205 | 401 | |
| 9 | | 1.8 | 432 | 432 | 205 | 35.6 | 24 | | 404 | 350 | 202 | 398 | |
| 10 | | 19.2 | 432 | 430 | 210 | 34.0 | 25 | | 418 | 335 | 201 | 391 | |
| 11 | | 33.4 | 430 | 435 | 315 | 17.4 | 26 | | 420 | 326 | 199 | 387 | |
| 12 | | 94 | 430 | 454 | 381 | 6.6 | 27 | | 430 | 353 | 199 | 386 | |
| 13 | | 134 | 433 | 477 | 387 | 2.9 | 28 | | 428 | 381 | 196 | 386 | |
| 14 | | 144 | 430 | 495 | 389 | 1.0 | 29 | | 438 | 389 | 201 | 386 | |
| 15 | | 159 | 425 | 502 | 391 | | 30 | | 445 | 410 | 205 | 384 | |
| | | | | | | | 31 | | 454 | | 205 | 348 | |

*Monthly discharge of St. Mary Canal at Hudson Bay divide, near Browning, Mont., for the year ending September 30, 1923*

| Month | Discharge in second-feet | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum | Minimum | Mean | |
| October 1–5 | 67 | 3 | 21.2 | 210 |
| May 9–31 | 454 | 1.8 | 275 | 12,500 |
| June | 456 | 326 | 415 | 24,700 |
| July | 510 | 196 | 347 | 21,300 |
| August | 401 | 202 | 327 | 20,100 |
| September 1–14 | 367 | 1.0 | 149 | 4,140 |

### SWIFTCURRENT CREEK AT MANY GLACIER, MONT.

LOCATION.—In sec. 12, T. 35 N., R. 16 W., at outlet of McDermott Lake at Many Glacier, Glacier County, in Glacier National Park, and 14 miles southwest of Babb.

DRAINAGE AREA.—31.4 square miles (measured on Glacier National Park topographic map).

RECORDS AVAILABLE.—June 6, 1912, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder installed June 15, 1918, referred to two staff gages, one inside well and one outside. Gage inspected by C. N. McGillis.

DISCHARGE MEASUREMENTS.—Made from cable 1,000 feet below gage or by wading.

CHANNEL AND CONTROL.—Limestone outcrop at the outlet of the lake forms control; shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.38 feet at midnight June 1 (discharge, 815 second-feet); minimum stage, 1.58 feet October 19 and 20 (discharge, 30 second-feet).

1912–1923: Maximum stage recorded, 4.75 feet June 17, 1916 (discharge, 1,550 second-feet); minimum stage, 1.22 feet November 6 and 7, 1921 (discharge, 10 second-feet).

ICE.—Stage-discharge affected by ice. No records during winter.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during winter. Rating curve used October 1–21 well defined between 40 and 250 second-feet; curve used May 6 to September 30 well defined between 30 and 700 second-feet. Daily gage height determined from recorder graph by straight-line method. Daily discharge determined by applying mean daily gage height to rating table except for days of considerable fluctuation for which it was determined by averaging the hourly discharge. Records good.

COOPERATION.—Maintained in cooperation with Department of the Interior, Canada.

*Discharge measurements of Swiftcurrent Creek at Many Glacier, Mont., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 26 | H. J. McLean [a] | 2.46 | 228 | July 27 | S. G. Dawson [a] | 2.37 | 196 |
| May 9 | Lamb and Whyte [a] | 2.93 | 368 | Aug. 14 | W. A. Lamb | 2.09 | 120 |
| June 7 | W. A. Lamb | 3.75 | 617 | Sept. 7 | S. G. Dawson | 1.90 | 70 |
| 28 | A. W. P. Lowrie [a] | 2.89 | 357 | 10 | W. A. Lamb | 1.90 | 76 |
| July 12 | do | 2.69 | 291 | 30 | A. W. P. Lowrie | 1.65 | 36.1 |

[a] Engineer, Department of the Interior, Canada.

*Daily discharge, in second-feet, of Swiftcurrent Creek at Many Glacier, Mont., for the year ending September 30, 1923*

| Day | Oct. | May | June | July | Aug. | Sept. | Day | Oct. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 38.0 | ------ | 660 | 418 | 156 | 115 | 16 | 33.2 | 293 | 409 | 296 | 120 | 65 |
| 2 | 40.4 | ------ | 748 | 409 | 128 | 108 | 17 | 33.2 | 290 | 427 | 275 | 120 | 56 |
| 3 | 44.0 | ------ | 582 | 387 | 102 | 98 | 18 | 31.0 | 314 | 402 | 248 | 123 | 46 |
| 4 | 58 | ------ | 511 | 353 | 80 | 84 | 19 | 30.0 | 344 | 402 | 236 | 123 | 48 |
| 5 | 68 | ------ | 511 | 308 | 82 | 82 | 20 | 30.0 | 368 | 356 | 236 | 134 | 50 |
| 6 | 59 | 182 | 576 | 257 | 87 | 80 | 21 | 31.0 | 477 | 353 | 236 | 215 | 52 |
| 7 | 52 | 215 | 620 | 239 | 84 | 76 | 22 | ------ | 564 | 415 | 239 | 245 | 53 |
| 8 | 47.0 | 266 | 635 | 242 | 89 | 78 | 23 | ------ | 678 | 393 | 239 | 185 | 54 |
| 9 | 44.0 | 365 | 703 | 263 | 91 | 80 | 24 | ------ | 669 | 368 | 239 | 156 | 58 |
| 10 | 41.6 | 477 | 747 | 290 | 95 | 74 | 25 | ------ | 623 | 341 | 224 | 142 | 60 |
| 11 | 41.6 | 533 | 771 | 296 | 102 | 65 | 26 | ------ | 706 | 353 | 209 | 136 | 56 |
| 12 | 39.2 | 464 | 759 | 317 | 110 | 56 | 27 | ------ | 604 | 338 | 200 | 131 | 52 |
| 13 | 38.0 | 421 | 745 | 296 | 118 | 54 | 28 | ------ | 452 | 368 | 194 | 125 | 46 |
| 14 | 34.4 | 402 | 612 | 287 | 123 | 53 | 29 | ------ | 347 | 409 | 191 | 120 | 40 |
| 15 | 34.4 | 344 | 480 | 287 | 120 | 58 | 30 | ------ | 314 | 440 | 185 | 115 | 36 |
| | | | | | | | 31 | ------ | 399 | ------ | 185 | 118 | ------ |

NOTE.—Discharge estimated Aug. 1-3, 10-12, and Sept. 9-29; interpolated Sept. 5 and 6.

*Monthly discharge of Swiftcurrent Creek at Many Glacier, Mont., for the year ending September 30, 1923*

[Drainage area, 31.4 square miles]

| Month | Discharge in second-feet | | | | Run-off | |
|---|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | Inches | Acre-feet |
| October 1-21 | 68 | 30 | 41.3 | 1.32 | 1.03 | 1,720 |
| May 6-31 | 706 | 182 | 427 | 13.6 | 13.15 | 22,000 |
| June | 771 | 338 | 514 | 16.4 | 18.30 | 30,600 |
| July | 418 | 185 | 267 | 8.50 | 9.80 | 16,400 |
| August | 245 | 80 | 125 | 3.98 | 4.59 | 7,690 |
| September | 115 | 36 | 64.4 | 2.05 | 2.29 | 3,830 |

### SWIFTCURRENT CREEK AT SHERBURNE, MONT.

LOCATION.—In sec. 35, T. 36 N., R. 15 W., 800 feet below spillway of Sherburne Lake dam at Sherburne, Glacier County.

DRAINAGE AREA.—64 square miles (measured on Glacier National Park topographic map).

RECORDS AVAILABLE.—July 1, 1912, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder installed May 18, 1921, on left bank 800 feet below spillway of Sherburne Lake dam referred to staff gage at same site installed August 10, 1920.

DISCHARGE MEASUREMENTS.—Made from cable 450 feet above gage or by wading.

CHANNEL AND CONTROL.—An outcropping limestone ledge, somewhat broken and irregular, forms the control; subject to slight shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.31 feet at 10 a. m. June 11 (discharge, 864 second-feet); no flow June 21 and June 27–30, and July 2 and 3.

1912–1923: Maximum stage recorded, 7.85 feet June 17, 1916 (discharge, 2,280 second-feet); no flow at various times when gates were closed.

ICE.—Not seriously affected by ice.

DIVERSIONS.—None.

REGULATION.—Flow regulated by gate operations.

ACCURACY.—Stage-discharge relation changed May 15; not seriously affected by ice. Rating curves used before and after shift well defined. Mean daily gage height determined from recorder graph by straight-line method October 1–31, May 6 to June 15, June 27 to July 15, and July 19 to September 30. Outside gage read to hundredths once daily during remainder of year. Daily discharge determined by applying mean daily gage height to rating table, except for days of considerable fluctuation for which it was determined by averaging the hourly discharge. Records good.

COOPERATION.—Maintained in cooperation with Department of the Interior, Canada.

*Discharge measurements of Swiftcurrent Creek at Sherburne, Mont., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 1 | A. W. P. Lowrie [a] | 1.67 | 64 | July 26 | S. G. Dawson [a] | 1.08 | 21.1 |
| 26 | H. J. McLean [a] | 2.08 | 91 | Aug. 13 | W. A. Lamb | 3.94 | 443 |
| May 17 | A. W. P. Lowrie | 4.27 | 538 | Sept. 7 | S. G. Dawson | 5.05 | 773 |
| June 7 | W. A. Lamb | 5.08 | 784 | 8 | do | 5.05 | 763 |
| 27 | A. W. P. Lowrie | .17 | [b] Nil. | 30 | A. W. P. Lowrie | 1.65 | 47.9 |
| July 12 | do | 2.26 | 123 | | | | |

[a] Engineer, Department of the Interior, Canada.
[b] Gates of Sherburne Dam closed.

*Daily discharge, in second-feet, of Swiftcurrent Creek at Sherburne, Mont., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 64 | 105 | 41.6 | 71 | 40.4 | 29.0 | 48.8 | 309 | 682 | 0.3 | 21.6 | 545 |
| 2 | 55 | 98 | 39.2 | 67 | 27.2 | 26.4 | 53.0 | 296 | 773 | .0 | 90 | 548 |
| 3 | 56 | 89 | 44.0 | 46.4 | 28.0 | 26.4 | 46.4 | 242 | 800 | .0 | 182 | 602 |
| 4 | 70 | 87 | 45.2 | 53 | 23.2 | 20.0 | 50.0 | 213 | 787 | .7 | 182 | 703 |
| 5 | 77 | 73 | 43.4 | 64 | 32.0 | 9.8 | 56 | 209 | 770 | 1.0 | 182 | 773 |
| 6 | 71 | 68 | 42.8 | 31.0 | 31.0 | 9.8 | 54 | 250 | 756 | 1.0 | 182 | 766 |
| 7 | 69 | 65 | 42.8 | 29.0 | 21.6 | 5.8 | 54 | 296 | 776 | .7 | 182 | 763 |
| 8 | 67 | 63 | 43.4 | 64 | 33.0 | 4.6 | 53 | 353 | 790 | 21.0 | 181 | 753 |
| 9 | 63 | 62 | 44.0 | 28.0 | 35.0 | 3.8 | 57 | 439 | 807 | 79 | 277 | 736 |
| 10 | 60 | 60 | 44.6 | 26.4 | 37.0 | 3.8 | 46.4 | 544 | 838 | 79 | 380 | 723 |
| 11 | 58 | 58 | 45.2 | 68 | 35.0 | 4.2 | 48.8 | 626 | 335 | 105 | 421 | 707 |
| 12 | 56 | 53 | 44.0 | 67 | 33.5 | 5.4 | 60.0 | 674 | 3.3 | 144 | 443 | 697 |
| 13 | 56 | 49.4 | 44.0 | 30.0 | 33.0 | 20.0 | 71 | 678 | 1.2 | 200 | 443 | 682 |
| 14 | 55 | 50.0 | 45.2 | 24.8 | 32.0 | 35.0 | 76 | 667 | 1.1 | 200 | 440 | 669 |
| 15 | 48.8 | 51.0 | 17.6 | 60 | 34.0 | 53.0 | 82 | 642 | 1.0 | 203 | 440 | 671 |
| 16 | 48.2 | 53.0 | 12.2 | 57 | 30.0 | 27.2 | 98 | 577 | 1.0 | 203 | 437 | 828 |
| 17 | 50.0 | 42.8 | 11.8 | 20.0 | 31.0 | 28.0 | 184 | 538 | 1.0 | 217 | 446 | 800 |
| 18 | 47.6 | 46.4 | 12.6 | 13.6 | 34.0 | 26.4 | 213 | 517 | .3 | 207 | 456 | 773 |
| 19 | 44.6 | 51.0 | 15.4 | 11.8 | 31.0 | 22.4 | 263 | 511 | .3 | 190 | 454 | 821 |
| 20 | 45.8 | 48.8 | 13.6 | 46.4 | 31.5 | 30.0 | 250 | 517 | .3 | 88 | 487 | 821 |
| 21 | 47.6 | 46.4 | 30.0 | 50.0 | 32.0 | 39.2 | 213 | 545 | .0 | 30.0 | 511 | 770 |
| 22 | 55 | 47.6 | 31.0 | 58 | 31.0 | 38.0 | 195 | 606 | 2.0 | 30.5 | 511 | 691 |
| 23 | 55 | 46.4 | 56 | 50 | 30.0 | 33.0 | 167 | 676 | 1.8 | 24.8 | 508 | 660 |
| 24 | 42.2 | 46.4 | 51 | 51.0 | 29.0 | 32.0 | 149 | 736 | 1.2 | 20.4 | 508 | 544 |
| 25 | 81 | 45.2 | 53 | 49.4 | 28.0 | 32.0 | 140 | 763 | 1.0 | 21.2 | 506 | 268 |
| 26 | 107 | 44.6 | 54 | 50 | 28.0 | 33.0 | 135 | 787 | 1.0 | 21.2 | 503 | 132 |
| 27 | 230 | 40.4 | 53 | 50.0 | 29.0 | 33.0 | 199 | 797 | .0 | 21.2 | 528 | 87 |
| 28 | 252 | 32.0 | 65 | 45.2 | 30.0 | 34.0 | 263 | 776 | .0 | 21.2 | 559 | 68 |
| 29 | 220 | 39.2 | 67 | 41.6 | ------- | 36.0 | 335 | 740 | .0 | 21.6 | 559 | 58 |
| 30 | 204 | 41.6 | 70 | 34.0 | ------- | 38.0 | 367 | 666 | .0 | 21.6 | 554 | 53 |
| 31 | 145 | ------- | 69 | 39.2 | ------- | 40.4 | ------- | 636 | ------- | 21.2 | 554 | ------- |

*Monthly discharge of Swiftcurrent Creek at Sherburne, Mont., for the year ending September 30, 1923*

| Month | Discharge in second-feet | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum | Minimum | Mean | |
| October | 252 | 42.2 | 83.9 | 5,160 |
| November | 105 | 32.0 | 56.8 | 3,380 |
| December | 70 | 11.8 | 41.7 | 2,560 |
| January | 71 | 11.8 | 45.1 | 2,770 |
| February | 40.4 | 21.6 | 31.1 | 1,730 |
| March | 53 | 3.8 | 25.1 | 1,540 |
| April | 367 | 46.4 | 134 | 7,970 |
| May | 797 | 209 | 543 | 33,400 |
| June | 838 | .0 | 271 | 16,100 |
| July | 217 | .0 | 70.8 | 4,350 |
| August | 559 | 21.6 | 391 | 24,000 |
| September | 828 | 53 | 590 | 35,100 |
| The year | 838 | .0 | 191 | 138,000 |

### CANYON CREEK NEAR MANY GLACIER, MONT.

LOCATION.—At the edge of heavy-timber area, half a mile above mouth, in Glacier National Park, 2 miles southeast of Many Glacier, Glacier County,

DRAINAGE AREA.—7.0 square miles (measured on topographic map of Glacier National Park).

RECORDS AVAILABLE.—July 12, 1918, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on left bank.

DISCHARGE MEASUREMENTS.—Made from footbridge at gage or by wading.

CHANNEL AND CONTROL.—Bed of stream covered with heavy boulders and cobblestones. Control is riffle 20 feet below gage; may shift at high stage. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.33 feet at 2.30 p. m. June 1 (discharge, 168 second-feet); minimum stage, 0.58 foot October 17–21 (discharge, 5.2 second-feet).

1918–1923: Maximum stage, 3.34 feet May 16, 1922 (discharge estimated 500 second-feet); minimum stage, 0.56 foot October 4, 1919 (discharge, 3.3 second-feet).

ICE.—Station not operated during winter on account of severe ice conditions.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed slightly during winter. Rating curve used May 9 to September 30 fairly well defined between 2 and 90 second-feet. Daily gage heights ascertained from recorder graph by straight-line method. Daily discharge ascertained by applying mean daily gage height to rating table; indirect method used October 1–21. Records good.

COOPERATION.—Maintained in cooperation with Department of the Interior, Canada.

*Discharge measurements of Canyon Creek near Many Glacier, Mont., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 26 | H. J. McLean [a] | 1.47 | 58 | July 29 | W. A. Lamb | 1.21 | 29.1 |
| June 8 | W. A. Lamb | 1.76 | 86 | Aug. 16 | do | .97 | 17.0 |
| 28 | A. W. P. Lowrie [a] | 1.54 | 63 | Sept. 6 | S. G. Dawson | .88 | 14.0 |
| July 12 | do | 1.37 | 45.7 | 30 | A. W. P. Lowrie | .70 | 7.9 |
| 27 | S. G. Dawson [a] | 1.21 | 29.6 | | | | |

[a] Engineer, Department of the Interior, Canada.

*Daily discharge, in second-feet, of Canyon Creek near Many Glacier, Mont., for the year ending September 30, 1923*

| Day | Oct. | May | June | July | Aug. | Sept. | Day | Oct. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.4 | ------ | 142 | 71 | 23.3 | 18.3 | 16 | 5.7 | 36.7 | 57 | 43.3 | 17.9 | 11.3 |
| 2 | 7.4 | ------ | 114 | 68 | 20.8 | 17.5 | 17 | 5.2 | 40.4 | 62 | 41.4 | 17.9 | 10.5 |
| 3 | 7.0 | ------ | 81 | 66 | 18.8 | 16.7 | 18 | 5.2 | 46.2 | 54 | 41.4 | 18.3 | 10.0 |
| 4 | 11.2 | ------ | 71 | 60 | 17.9 | 15.8 | 19 | 5.2 | 48.3 | 55 | 40.4 | 18.3 | 9.5 |
| 5 | 12.6 | ------ | 69 | 50 | 17.9 | 14.6 | 20 | 5.2 | 53 | 52 | 38.5 | 39.6 | 9.2 |
| 6 | 10.8 | ------ | 82 | 43.3 | 18.8 | 14.2 | 21 | 5.2 | 65 | 63 | 38.5 | 97 | 9.8 |
| 7 | 9.4 | ------ | 88 | 41.4 | 17.1 | 13.2 | 22 | ------ | 79 | 80 | 39.4 | 56 | 10.0 |
| 8 | 9.0 | ------ | 94 | 43.3 | 17.1 | 12.9 | 23 | ------ | 93 | 69 | 38.5 | 39.4 | 9.8 |
| 9 | 8.0 | 60 | 98 | 46.2 | 16.7 | 12.9 | 24 | ------ | 81 | 62 | 36.7 | 31.3 | 9.2 |
| 10 | 7.7 | 70 | 105 | 46.2 | 16.7 | 12.6 | 25 | ------ | 84 | 57 | 34.4 | 27.1 | 9.2 |
| 11 | 7.4 | 74 | 110 | 45.3 | 16.7 | 11.3 | 26 | ------ | 93 | 56 | 33.6 | 25.9 | 9.2 |
| 12 | 7.0 | 60 | 110 | 44.3 | 17.1 | 10.8 | 27 | ------ | 64 | 57 | 32.0 | 23.3 | 9.2 |
| 13 | 6.4 | 55 | 101 | 43.3 | 17.9 | 10.5 | 28 | ------ | 48.3 | 66 | 30.5 | 22.8 | 9.0 |
| 14 | 6.0 | 48.3 | 80 | 42.4 | 18.3 | 10.2 | 29 | ------ | 40.4 | 74 | 31.3 | 21.8 | 8.5 |
| 15 | 5.7 | 39.4 | 64 | 42.4 | 18.8 | 10.5 | 30 | ------ | 44.3 | 74 | 30.5 | 21.3 | 8.5 |
| | | | | | | | 31 | ------ | 78 | ------ | 28.4 | 19.3 | ------ |

NOTE.—No record Oct. 22 to May 8.

*Monthly discharge of Canyon Creek near Many Glacier, Mont., for the year ending September 30, 1923*

[Drainage area, 7.0 square miles]

| Month | Discharge in second-feet | | | | Run-off | |
|---|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | Inches | Acre-feet |
| October 1–21 | 12.6 | 5.2 | 7.37 | 1.05 | 0.82 | 307 |
| May 9–31 | 93 | 36.7 | 60.9 | 8.70 | 7.44 | 2,780 |
| June | 142 | 52 | 78 | 11.2 | 12.50 | 4,650 |
| July | 71 | 28.4 | 43.0 | 6.14 | 7.08 | 2,640 |
| August | 97 | 16.7 | 24.9 | 3.56 | 4.10 | 1,530 |
| September | 18.3 | 8.5 | 11.5 | 1.64 | 1.83 | 684 |

### RED RIVER AT FARGO, N. DAK.

LOCATION.—Above dam half a mile above highway bridge connecting Front Street, Fargo, Cass County, N. Dak., with Moorhead, Minn., 10 miles above mouth of Sheyenne River.

DRAINAGE AREA.—6,420 square miles (revised).

RECORDS AVAILABLE.—May 27, 1901, to September 30, 1923.

GAGE.—Vertical staff attached to tree on left bank 6 rods above dam; vertical staff for convenient comparison attached to upper end of fishway, left end of dam. Gage read by R. T. Jacobsen.

DISCHARGE MEASUREMENTS.—Made from footbridge a few feet upstream from gage.

CHANNEL AND CONTROL.—Bed composed of clay and silt; nearly permanent. Control is timber and steel crib dam, rock filled, below gage; has settled a few inches since construction. At extreme low stage the fall over the dam is about 5 feet.

EXTREMES OF DISCHARGE.—Maximum stage during year, 7.9 feet June 29 (discharge, 3,960 second-feet); minimum stage, 1 foot October 7, 10, and February 10, 17, and 24 (discharge, 24 second-feet).

1901–1923: Maximum open-water stage recorded, 17.34 feet July 11,1916 discharge, 7,740 second-feet); minimum stage, 0.75 foot September 11, 1922 (discharge, 9 second-feet).

ICE.—Stage-discharge relation affected by ice.

DIVERSION.—None.

REGULATION.—No power plants or storage above the station nearer than 60 miles, and storage not great enough ordinarily to affect discharge at station.

ACCURACY.—Stage-discharge relation changed slightly due to settling of dam; slightly affected by ice during year. Rating curve used October 1 to April 10 well defined between 120 and 4,400 second-feet; curve used April 11 to September 30 fairly well defined between 80 and 4,400 second-feet. Gage read to hundredths once daily except during winter, when it was read once or twice a week. Daily discharge obtained by applying daily gage height to rating table. Open-water records fair, winter records poor.

*Discharge measurements of Red River at Fargo, N. Dak., during the year ending September 30, 1923*

[Made by E. F. Chandler]

| Date | Gage height | Discharge | Date | Gage height | Discharge |
|---|---|---|---|---|---|
| | *Feet* | *Sec.-ft.* | | *Feet* | *Sec.-ft.* |
| Nov. 4 | 1.22 | 79 | July 2 | 4.53 | 1,840 |
| June 13 | 1.86 | 244 | Sept. 5 | 1.31 | 116 |

*Daily discharge, in second-feet, of Red River at Fargo, N. Dak., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 40 | 39 | 78 | | | | 68 | 645 | 365 | 2,720 | 120 | 98 |
| 2 | 32 | 57 | | 78 | | | 78 | 645 | 386 | 1,640 | 132 | 98 |
| 3 | 39 | 57 | 57 | | 39 | | 78 | 658 | 397 | 1,300 | 98 | 98 |
| 4 | 57 | 57 | | | | | 78 | 671 | 408 | 1,120 | 98 | 98 |
| 5 | 57 | 57 | | | | | 78 | 725 | 386 | 945 | 109 | 98 |
| 6 | 39 | 57 | | 57 | | | 78 | 698 | 365 | 890 | 120 | 78 |
| 7 | 24 | 102 | | | | | 78 | 671 | 344 | 725 | 88 | 69 |
| 8 | 32 | 144 | 57 | | | | 318 | 645 | 365 | 685 | 98 | 44 |
| 9 | 39 | 129 | | | | | 568 | 645 | 304 | 645 | 88 | 40 |
| 10 | 24 | 129 | | | 24 | 57 | 808 | 619 | 276 | 568 | 78 | 37 |
| 11 | 32 | 102 | 57 | | | | 1,060 | 645 | 248 | 521 | 78 | 37 |
| 12 | 32 | 109 | | | | | 1,300 | 521 | 248 | 475 | 88 | 30 |
| 13 | 39 | 116 | | 39 | | | 1,870 | 521 | 252 | 304 | 98 | 37 |
| 14 | 39 | 116 | | | | | 1,600 | 521 | 231 | 248 | 98 | 44 |
| 15 | 39 | 102 | | | | | 2,040 | 475 | 215 | 257 | 88 | 52 |
| 16 | 39 | 90 | 57 | | | | 2,470 | 452 | 170 | 266 | 98 | 48 |
| 17 | 39 | 78 | | | 24 | 57 | 2,560 | 408 | 184 | 324 | 120 | 44 |
| 18 | 39 | 90 | 57 | | | | 2,650 | 464 | 199 | 344 | 98 | 60 |
| 19 | 57 | 110 | | | | | 2,470 | 521 | 157 | 266 | 98 | 60 |
| 20 | 57 | 129 | | 39 | | | 2,370 | 521 | 144 | 248 | 98 | 78 |
| 21 | 57 | 116 | 57 | | | | 1,970 | 521 | 365 | 222 | 88 | 78 |
| 22 | 48 | 102 | | | | | 1,690 | 545 | 545 | 196 | 78 | 72 |
| 23 | 39 | 102 | | | | | 1,400 | 545 | 569 | 170 | 60 | 66 |
| 24 | 39 | 102 | | | 24 | 57 | 1,120 | 521 | 757 | 144 | 69 | 60 |
| 25 | 39 | 102 | | | | | 835 | 498 | 945 | 144 | 69 | 68 |
| 26 | 39 | 102 | 57 | | | | 780 | 475 | 1,970 | 188 | 69 | 76 |
| 27 | 39 | 102 | | 39 | 57 | | 698 | 452 | 3,480 | 231 | 69 | 84 |
| 28 | 39 | 102 | | | | | 671 | 430 | 3,800 | 231 | 69 | 93 |
| 29 | 39 | 90 | | | | | 671 | 430 | 3,960 | 200 | 78 | 102 |
| 30 | 39 | 102 | 57 | | | | 671 | 398 | 3,800 | 170 | 98 | 100 |
| 31 | 39 | | | | | 57 | | 365 | | 144 | 88 | |

NOTE.—Discharge interpolated on account of missing gage height Oct. 1, 8, 15, 22, and 28–30; Nov. 5, 12, 19, and 24–26; Apr. 1, 3–5, 7–11, 15, 22–24, and 29; May 3, 6, 13, 18, 20, 27, and 30; June 3, 10, 17, and 24; July 1, 4, 8, 15, 21, 22, 26, and 29; Aug. 5, 12, 19, and 26; Sept. 2, 3, 9, 16, 22, 23, 25–28, and 30.

*Monthly discharge of Red River at Fargo, N. Dak., for the year ending September 30, 1923*

| Month | Discharge in second-feet | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum | Minimum | Mean | |
| October | 57 | 24 | 40.4 | 2,480 |
| November | 144 | 39 | 96.4 | 5,740 |
| December | ---------- | ---------- | [a] 55 | 3,380 |
| January | ---------- | ---------- | [a] 45 | 2,770 |
| February | ---------- | ---------- | [a] 30 | 1,670 |
| March | ---------- | ---------- | [a] 55 | 3,380 |
| April | 2,650 | 68 | 1,100 | 65,500 |
| May | 725 | 365 | 544 | 33,400 |
| June | 3,960 | 144 | 861 | 51,200 |
| July | 2,720 | 144 | 533 | 32,800 |
| August | 132 | 60 | 91.2 | 5,610 |
| September | 102 | 30 | 68.2 | 4,060 |
| The year | 3,960 | 24 | 293 | 212,000 |

[a] Estimated.

### RED RIVER AT GRAND FORKS, N. DAK.

LOCATION.—At Northern Pacific Railway bridge between Grand Forks, Grand Forks County, N. Dak., and East Grand Forks, Minn., half a mile below mouth of Red Lake River.

DRAINAGE AREA.—25,500 square miles (revised).

RECORDS AVAILABLE.—May 26, 1901, to September 30, 1923. Gage-height records at same point kept by United States Engineer Corps from 1882 to 1901 and a few discharge measurements made by them in early years.

GAGE.—Vertical staff attached to ice-breaker below center pier of bridge. Gages maintained by the United States Engineer Corps and the United States Weather Bureau at the same bridge have a datum 5.00 feet higher than the gage datum of the Geological Survey and are more convenient for use. The Weather Bureau gage is read by Alex Slattery and 5.00 feet added to observations.

DISCHARGE MEASUREMENTS.—Made from Great Northern Railway bridge a quarter of a mile above gage.

CHANNEL AND CONTROL.—Clay and silt; changes very slowly.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded during year, 26.15 feet at 7 a. m. April 22 (discharge, 16,200 second-feet); minimum discharge estimated at 267 second-feet February 21–24 and 28, March 1–3, and 7 (stage-discharge relation affected by ice).

1882–1923: Maximum stage recorded, 50.2 feet April 10, 1897 (discharge, 43,000 second-feet); minimum discharge 100 second-feet during early part of February, 1912 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice.

DIVERSIONS.—None.

REGULATION.—No power plants above with sufficient storage to cause noticeable variations in flow.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 400 and 15,000 second-feet and fairly well defined to 30,000 second-feet. Gage read to quarter-tenths twice daily except during winter period when it was read twice a week. Daily discharge ascertained by applying mean daily gage height to rating table except for periods indicated in footnote to table of daily discharge. Open-water records good, winter records fair.

*Discharge measurements of Red River at Grand Forks, N. Dak., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Dec. 22 | Tilly and Black | a4.18 | 372 | Apr. 28 | Black and Diehl | 15.97 | 7,480 |
| Jan. 20 | Tilly and Johnson | a4.74 | 454 | May 26 | do | 7.57 | 2,130 |
| Feb. 10 | Johnson and Diehl | a4.76 | 334 | June 9 | M. Diehl | 6.00 | 1,290 |
| Mar. 3 | Johnson and Black | a4.48 | 268 | July 6 | E. F. Chandler | 9.49 | 3,230 |
| Apr. 21 | do | a26.39 | 15,700 | Aug. 8 | Black and Chandler | 4.08 | 620 |

a Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Red River at Grand Forks, N. Dak., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 477 | 590 | 712 | 399 | 367 | 267 | 590 | 5,780 | 1,930 | 4,760 | 883 | 424 |
| 2 | 505 | 590 | 680 | 387 | 360 | 267 | 619 | 5,480 | 1,870 | 5,000 | 812 | 424 |
| 3 | 505 | 619 | 665 | 375 | 352 | 267 | 649 | 5,180 | 1,770 | 5,000 | 778 | 424 |
| 4 | 477 | 619 | 649 | 360 | 330 | 277 | 649 | 4,520 | 1,660 | 4,580 | 778 | 424 |
| 5 | 477 | 649 | 634 | 345 | 308 | 287 | 649 | 4,460 | 1,610 | 3,980 | 745 | 450 |
| 6 | 505 | 680 | 619 | 330 | 308 | 277 | 680 | 4,400 | 1,560 | 3,290 | 712 | 450 |
| 7 | 477 | 712 | 576 | 330 | 308 | 267 | 712 | 4,400 | 1,520 | 2,840 | 649 | 477 |
| 8 | 477 | 745 | 533 | 330 | 315 | 281 | 745 | 4,280 | 1,470 | 2,380 | 619 | 477 |
| 9 | 450 | 847 | 505 | 352 | 322 | 295 | 778 | 4,040 | 1,380 | 2,150 | 619 | 505 |
| 10 | 450 | 847 | 505 | 375 | 330 | 308 | 812 | 3,750 | 1,330 | 1,930 | 590 | 533 |
| 11 | 450 | 778 | 505 | 383 | 319 | 319 | 957 | 3,520 | 1,240 | 1,820 | 561 | 533 |
| 12 | 477 | 778 | 505 | 391 | 308 | 330 | 995 | 3,290 | 1,200 | 1,720 | 561 | 505 |
| 13 | 477 | 778 | 505 | 399 | 308 | 352 | 1,610 | 3,240 | 1,160 | 1,610 | 533 | 477 |
| 14 | 477 | 778 | 496 | 399 | 308 | 375 | 2,490 | 3,060 | 1,120 | 1,520 | 533 | 477 |
| 15 | 477 | 812 | 486 | 399 | 308 | 387 | 3,580 | 2,950 | 1,070 | 1,330 | 505 | 450 |
| 16 | 505 | 778 | 477 | 412 | 308 | 399 | 4,100 | 2,840 | 1,030 | 1,160 | 533 | 450 |
| 17 | 505 | 778 | 450 | 424 | 308 | 375 | 4,640 | 2,660 | 1,030 | 1,030 | 533 | 450 |
| 18 | 505 | 812 | 424 | 432 | 298 | 387 | 6,280 | 2,490 | 995 | 920 | 590 | 450 |
| 19 | 533 | 812 | 424 | 441 | 287 | 399 | 8,970 | 2,380 | 957 | 847 | 619 | 477 |
| 20 | 533 | 812 | 424 | 450 | 277 | 424 | 13,200 | 2,380 | 920 | 847 | 619 | 450 |
| 21 | 561 | 778 | 400 | 450 | 267 | 450 | 15,600 | 2,320 | 957 | 883 | 590 | 4.0 |
| 22 | 561 | 778 | 375 | 450 | 267 | 492 | 15,900 | 2,320 | 1,030 | 995 | 561 | 450 |
| 23 | 533 | 745 | 450 | 464 | 267 | 533 | 14,800 | 2,270 | 1,160 | 1,030 | 533 | 450 |
| 24 | 533 | 680 | 450 | 477 | 267 | 533 | 13,300 | 2,210 | 1,240 | 995 | 505 | 477 |
| 25 | 505 | 619 | 450 | 477 | 277 | 547 | 11,600 | 2,210 | 1,420 | 920 | 505 | 505 |
| 26 | 505 | 561 | 464 | 464 | 287 | 561 | 9,900 | 2,150 | 1,720 | 847 | 477 | 505 |
| 27 | 533 | 619 | 477 | 450 | 277 | 561 | 8,320 | 2,100 | 2,270 | 778 | 477 | 505 |
| 28 | 561 | 649 | 468 | 426 | 267 | 561 | 7,400 | 2,100 | 2,840 | 745 | 477 | 505 |
| 29 | 561 | 680 | 459 | 399 | ------- | 576 | 6,690 | 2,040 | 3,410 | 778 | 450 | 505 |
| 30 | 590 | 680 | 450 | 387 | ------- | 590 | 6,220 | 2,040 | 4,160 | 847 | 450 | 533 |
| 31 | 590 | ------- | 424 | 375 | ------- | 590 | ------- | 1,980 | ------- | 883 | 424 | ------- |

NOTE.—Stage-discharge relation affected by ice Nov. 29 to Apr. 21; daily discharge determined from gage heights corrected for effect of ice by means of five discharge measurements, or by interpolation for days when gage was not read.

*Monthly discharge of Red River at Grand Forks, N. Dak., for the year ending September 30, 1923*

| Month | Discharge in second-feet | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum | Minimum | Mean | |
| October | 590 | 450 | 507 | 31,200 |
| November | 847 | 590 | 720 | 42,800 |
| December | 712 | 375 | 505 | 31,100 |
| January | 477 | 330 | 404 | 24,800 |
| February | 367 | 267 | 304 | 16,900 |
| March | 590 | 267 | 404 | 24,800 |
| April | 15,900 | 590 | 5,450 | 324,000 |
| May | 5,780 | 1,980 | 3,190 | 196,000 |
| June | 4,160 | 920 | 1,570 | 93,400 |
| July | 5,000 | 745 | 1,880 | 116,000 |
| August | 883 | 424 | 588 | 36,200 |
| September | 533 | 424 | 473 | 28,100 |
| The year | 15,900 | 267 | 1,330 | 965,000 |

### BOIS DES SIOUX RIVER NEAR TENNEY, MINN.

LOCATION.—Near center of sec. 22, T. 130 N., R. 47 W. at Soo Railway bridge 5 miles west of Tenney, Wilkin County, Minn., and 2 miles east of Fairmount, N. Dak.

DRAINAGE AREA.—1,460 square miles.

RECORDS AVAILABLE.—April 1, 1919, to September 30, 1923.

GAGE.—Vertical staff attached to the piling pier of the Soo Railway bridge; read by Math Schmit and Harry Voss.

DISCHARGE MEASUREMENTS.—Made from highway bridge, from railway bridge, or by wading.

CHANNEL AND CONTROL.—Bed composed of silt and fine clay, overgrown with weeds, which clog the channel by an amount varying with the season. No considerable shifts in channel likely because normal velocities insufficient to erode.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year, 76 second-feet April 14; no flow October 1 to March 29 and July 29 to September 30.

1919–1923: Maximum discharge, 390 second-feet April 22, 1922; no flow during several long periods.

ICE.—Stage-discharge relation seriously affected by ice.

DIVERSIONS.—None.

REGULATION.—There are no reservoirs or power plants which affect the flow. The station is 15 miles below the outlet of Lake Traverse with no considerable tributaries entering between, so that abrupt changes in discharge are unlikely. Very extensive ditching and drainage work in the tributary area during the past 15 years may affect the distribution of flow.

ACCURACY.—Stage-discharge relation not permanent; affected by ice and by heavy aquatic growth. Rating curve fairly well defined below 400 second-feet. Gage read to half-tenths two or three times a week. Daily discharge ascertained by applying gage height to rating table by direct or indirect method and by interpolating for days when gage was not read. Records poor.

*Discharge measurements of Bois des Sioux River near Tenney, Minn., during the year ending September 30, 1923*

[Made by E. F. Chandler]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| June 15 | 2.22 | [a] 4.4 |
| Aug. 30 | 1.11 | 0 |

[a] Float measurement. Stage-discharge relation affected by aquatic growth.

*Daily discharge, in second-feet, of Bois des Sioux River near Tenney, Minn., for the year ending September 30, 1923*

| Day | Mar. | Apr. | May | June | July | Day | Mar. | Apr. | May | June | July |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 16 | 28 | 16 | 5 | 16 | | 64 | 16 | 6 | 2 |
| 2 | | 16 | 28 | 16 | 5 | 17 | | 54 | 18 | 4 | 2 |
| 3 | | 21 | 27 | 16 | 4 | 18 | | 44 | 20 | 3 | 2 |
| 4 | | 26 | 26 | 16 | 4 | 19 | | 38 | 24 | 3 | 2 |
| 5 | | 32 | 25 | 16 | 4 | 20 | | 33 | 23 | 3 | 2 |
| 6 | | 33 | 25 | 16 | 4 | 21 | | 28 | 22 | 3 | 2 |
| 7 | | 34 | 25 | 16 | 4 | 22 | | 28 | 22 | 4 | 2 |
| 8 | | 36 | 24 | 15 | 3 | 23 | | 28 | 22 | 4 | 1 |
| 9 | | 38 | 24 | 13 | 3 | 24 | | 28 | 22 | 6 | 1 |
| 10 | | 40 | 24 | 11 | 3 | 25 | | 28 | 22 | 7 | 1 |
| 11 | | 70 | 23 | 9 | 2 | 26 | | 27 | 19 | 7 | 1 |
| 12 | | 70 | 23 | 7 | 2 | 27 | | 26 | 19 | 6 | 1 |
| 13 | | 73 | 22 | 7 | 2 | 28 | | 25 | 19 | 6 | 1 |
| 14 | | 76 | 22 | 7 | 2 | 29 | | 26 | 19 | 5 | |
| 15 | | 70 | 19 | 7 | 2 | 30 | 5 | 27 | 19 | 5 | |
| | | | | | | 31 | 16 | | 19 | | |

NOTE.—Stage-discharge relation affected by ice Mar. 30 to Apr. 12 and by aquatic growth May 1 to July 28. Daily discharge May 1 to July 28 determined from gage heights corrected by means of one discharge measurement. No discharge on days for which no record is given.

*Monthly discharge of Bois des Sioux River near Tenney, Minn., for the year ending September 30, 1923*

| Month | Discharge in second-feet | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum | Minimum | Mean | |
| March | 16 | 0 | 0.68 | 42 |
| April | 76 | 16 | 38.5 | 2,290 |
| May | 28 | 16 | 22.3 | 1,370 |
| June | 16 | 3 | 8.67 | 516 |
| July | 5 | 0 | 2.23 | 137 |
| The year | 76 | 0 | 6.01 | 4,360 |

NOTE.—No flow during months for which no record is given.

**MUSTINKA RIVER ABOVE WHEATON, MINN.**

LOCATION.—On line between secs. 7 and 8, T. 127 N., R. 46 W., 1 mile upstream from Chicago, Milwaukee & St. Paul Railway bridge, 1½ miles northeast of Wheaton, Traverse County, and 8 miles above Lake Traverse into which the river discharges.

DRAINAGE AREA.—776 square miles.

RECORDS AVAILABLE.—March 23 to September 30, 1917, and June 25, 1919, to September 30, 1923. June 7 to September 30, 1916, at a point 3½ miles downstream.

GAGE.—Chain gage attached to bridge; read by Vernon Heggen. A staff gage is at railway bridge for convenient comparison, the datum of which is so placed that readings on staff gage are 10 feet greater numerically than on chain gage.

DISCHARGE MEASUREMENTS.—Made from highway bridge near Chicago, Milwaukee & St. Paul Railway bridge, from highway bridge at chain gage, or from highway bridge midway between them.

CHANNEL AND CONTROL.—Natural bed was composed of clay and silt, but in 1914 the channel was dredged several feet deeper, until the bottom is now in or near hardpan and almost permanent. The slope of the river from lowest stage at the gage to ordinary stage of Lake Traverse is only about 5 feet, so that in exceptional cases flood stage in the lake may affect the stage at gage.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded during the year, 8.4 feet April 15 (discharge, 746 second-feet); no flow August 15–19, September 5–15 and 22–30.

1917; 1919–1923: Maximum stage recorded, 14.7 feet April 1, 1917 (discharge, 2,340 second-feet); no flow during several periods.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation permanent. Rating curve fairly well defined between 4 and 2,400 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to table of daily discharge. Records prior to April 15 poor; subsequent to that date fair.

*Discharge measurements of Mustinka River above Wheaton, Minn., during the year ending September 30, 1923*

[Made by E. F. Chandler]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| June 14 | 1.31 | 0.3 |
| Aug. 31 | 1.18 | *.2 |

* Float measurement.

*Daily discharge, in second-feet, of Mustinka River above Wheaton, Minn., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | 0.5 | 21 | 2.2 | 21 | 0.2 | 0.03 |
| 2 | | | | | | | .5 | 21 | 1.8 | 18 | .2 | .01 |
| 3 | | | | | | | 1 | 18 | 1.4 | 7.4 | .2 | .01 |
| 4 | | | | | | | 2 | 17 | 1.0 | 9.8 | .1 | .01 |
| 5 | | | | | | | 3 | 16 | .8 | 4.3 | .2 | .00 |
| 6 | | | | | | | 5 | 9 | .7 | 4.3 | .1 | .00 |
| 7 | | | | | | | 40 | 6.7 | .6 | 2.9 | .08 | .00 |
| 8 | | | | | | | 100 | 6.0 | .5 | 2.6 | .06 | .00 |
| 9 | | | | | | | 200 | 5.4 | .5 | 2.3 | .05 | .00 |
| 10 | | | | | | | 421 | 4.7 | .4 | 1.9 | .03 | .00 |
| 11 | | | | | | | 476 | 4.1 | .3 | 2.1 | .02 | .00 |
| 12 | | | | | | | 531 | 3.9 | .3 | 1.6 | .02 | .00 |
| 13 | | | | | | | 634 | 3.7 | .3 | 1.3 | .01 | .00 |
| 14 | | | | | | | 689 | 3.1 | .3 | 1.2 | .01 | .00 |
| 15 | | | | | 0.03 | | 746 | 2.7 | .2 | 1.0 | .00 | .00 |
| 16 | 0.08 | 0.06 | 0.05 | 0.04 | | 0.04 | 564 | 2.6 | .1 | .8 | .00 | .01 |
| 17 | | | | | | | 436 | 2.5 | .2 | .5 | .00 | .03 |
| 18 | | | | | | | 252 | 2.5 | .3 | .5 | .00 | .04 |
| 19 | | | | | | | 163 | 4.0 | 1.2 | .6 | .00 | .05 |
| 20 | | | | | | | 142 | 4.0 | 2.1 | .6 | .02 | .04 |
| 21 | | | | | | | 122 | 3.7 | 1.7 | .5 | .07 | .03 |
| 22 | | | | | | | 100 | 3.1 | 1.2 | .5 | .05 | .00 |
| 23 | | | | | | | 79 | 2.5 | 2.3 | .5 | .03 | .00 |
| 24 | | | | | | | 48 | 2.4 | 3.0 | .3 | .02 | .00 |
| 25 | | | | | | | 42 | 2.3 | 2.1 | .3 | .01 | .00 |
| 26 | | | | | | | 36 | 1.9 | 2.9 | .5 | .8 | .00 |
| 27 | | | | | | | 32 | 1.8 | 24 | .4 | .2 | .00 |
| 28 | | | | | | | 28 | 1.6 | 23 | .3 | .2 | .00 |
| 29 | | | | | ------- | | 21 | 1.8 | 22 | .3 | .09 | .00 |
| 30 | | | | | ------- | | 18 | 1.9 | 22 | .3 | .05 | .00 |
| 31 | | ------- | | | ------- | | ------- | 1.9 | ------- | .3 | .04 | ------- |

NOTE.—Discharge Oct. 1 to Apr. 14 estimated from temperature and precipitation records, and comparison with records for other streams in the Red River basin.

*Monthly discharge of Mustinka River above Wheaton, Minn., for the year ending September 30, 1923*

| Month | Discharge in second-feet | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum | Minimum | Mean | |
| October | | | 0.08 | 4.9 |
| November | | | .06 | 3.6 |
| December | | | .05 | 3.1 |
| January | | | .04 | 2.5 |
| February | | | .03 | 1.7 |
| March | | | .04 | 2.5 |
| April | .746 | 0.5 | 198 | 11,800 |
| May | 21 | 1.6 | 5.90 | 363 |
| June | 24 | .1 | 3.98 | 237 |
| July | 21 | .3 | 2.87 | 176 |
| August | .8 | .00 | .0923 | 5.7 |
| September | .05 | .00 | .0087 | .5 |
| The year | 746 | .00 | 17.4 | 12,600 |

### RED LAKE RIVER AT THIEF RIVER FALLS, MINN.

LOCATION.—In sec. 33, T. 154 N., R. 43 W., one-third mile below dam at Thief River Falls, Pennington County, and 1 mile below mouth of Thief River.

DRAINAGE AREA.—3,430 square miles.

RECORDS AVAILABLE.—July 2, 1909, to September 30, 1918, and March 25, 1920, to September 30, 1923.

GAGE.—Inclined staff gage located on right bank, installed August 19, 1920; read by Dedrick Knutson and Thomas Hastad.

DISCHARGE MEASUREMENTS.—Made from cable near gage.

CHANNEL AND CONTROL.—Gravel and small boulders; nearly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.6 feet April 21 (discharge, 4,100 second-feet); minimum stage, 2.65 feet November 25 and 26 (discharge, 3 second-feet).

1909–1918; 1920–1923: Maximum open-water stage recorded, 12.2 feet April 19–21, 1916 (discharge, 7,040 second-feet); no flow July 17 and August 27, 1911.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—One-third mile above station at the dam are plants of Hanson & Barzen Milling Co. and city lighting plant, operated ordinarily in daytime and night, respectively. These plants sometimes cause large sudden fluctuations in flow at the gage, but it is the purpose to take gage observations at such times of the day that these effects will be compensating and the monthly averages accurate.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined above 20 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as shown in footnote to table of daily discharge. Open-water records at medium and high stages good; at low stages, fair. Winter records poor.

*Discharge measurements of Red Lake River at Thief River Falls, Minn., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 9 | R. V. Tilly | 4.51 | 363 | Feb. 4 | A. Johnson | *4.64 | 120 |
| Nov. 5 | A. Johnson | 4.09 | 256 | May 5 | do | 6.12 | 1,120 |
| 5 | do | 4.29 | 331 | June 26 | E. F. Chandler | 4.09 | 231 |
| Dec. 27 | R. V. Tilly | *5.20 | 270 | July 17 | Chandler and Black | 4.06 | 247 |
| 28 | do | *4.71 | 147 | 20 | do | 4.05 | 225 |
| Feb. 3 | A. Johnson | *5.16 | 309 | | | | |

* Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 150 | 353 | 243 | 44 | 140 | 215 | 129 | 1,300 | 615 | 273 | 40 | 258 |
| 2 | 258 | 229 | 216 | 69 | 112 | 175 | 134 | 1,300 | 570 | 526 | 100 | 38 |
| 3 | 288 | 288 | 189 | 94 | 85 | 135 | 140 | 1,300 | 705 | 215 | 100 | 229 |
| 4 | 237 | 258 | 199 | 119 | 32 | 95 | 123 | 176 | 615 | 406 | 100 | 229 |
| 5 | 186 | 212 | 209 | 144 | 84 | 106 | 107 | 1,110 | 570 | 484 | 336 | 128 |
| 6 | 150 | 288 | 219 | 169 | 136 | 117 | 91 | 1,110 | 570 | 548 | 100 | 229 |
| 7 | 174 | 353 | 229 | 194 | 189 | 112 | 75 | 1,050 | 615 | 215 | 100 | 229 |
| 8 | 229 | 388 | 202 | 219 | 173 | 106 | 32 | 995 | 570 | 273 | 100 | 570 |
| 9 | 214 | 229 | 230 | 243 | 156 | 101 | 117 | 795 | 526 | 370 | 288 | 258 |
| 10 | 199 | 353 | 259 | 210 | 140 | 95 | 117 | 750 | 336 | 370 | 425 | 176 |
| 11 | 174 | 353 | 288 | 177 | 44 | 66 | 300 | 615 | 548 | 406 | 100 | 106 |
| 12 | 258 | 212 | 281 | 144 | 80 | 38 | 484 | 750 | 484 | 243 | 229 | 229 |
| 13 | 353 | 336 | 273 | 110 | 116 | 58 | 795 | 750 | 406 | 215 | 140 | 229 |
| 14 | 388 | 199 | 304 | 75 | 152 | 79 | 705 | 795 | 444 | 243 | 44 | 106 |
| 15 | 320 | 353 | 336 | 96 | 189 | 99 | 570 | 772 | 484 | 273 | 353 | 85 |
| 16 | 288 | 425 | 202 | 117 | 153 | 120 | 1,050 | 750 | 505 | 215 | 370 | 258 |
| 17 | 199 | 300 | 202 | 125 | 117 | 140 | 1,800 | 750 | 526 | 353 | 205 | 229 |
| 18 | 244 | 174 | 202 | 133 | 117 | 148 | 2,730 | 750 | 548 | 229 | 44 | 258 |
| 19 | 288 | 258 | 202 | 140 | 113 | 156 | 2,550 | 795 | 273 | 388 | 210 | 152 |
| 20 | 174 | 425 | 202 | 125 | 109 | 164 | 3,900 | 750 | 304 | 229 | 229 | 128 |
| 21 | 126 | 425 | 202 | 110 | 105 | 148 | 4,100 | 750 | 253 | 388 | 258 | 336 |
| 22 | 150 | 388 | 202 | 95 | 102 | 132 | 3,600 | 750 | 202 | 548 | 152 | 229 |
| 23 | 174 | 150 | 202 | 110 | 99 | 117 | 2,910 | 772 | 189 | 288 | 304 | 229 |
| 24 | 174 | 76 | 202 | 125 | 95 | 58 | 2,430 | 795 | 336 | 202 | 425 | 353 |
| 25 | 199 | 3 | 223 | 140 | 189 | 67 | 1,950 | 750 | 484 | 229 | 258 | 85 |
| 26 | 174 | 3 | 243 | 128 | 195 | 77 | 2,030 | 750 | 273 | 258 | 425 | 38 |
| 27 | 174 | 353 | 273 | 117 | 202 | 86 | 2,030 | 795 | 406 | 100 | 229 | 85 |
| 28 | 174 | 388 | 152 | 117 | 209 | 96 | 1,430 | 705 | 273 | 100 | 38 | 229 |
| 29 | 258 | 257 | 140 | 123 | ------- | 106 | 1,640 | 705 | 370 | 258 | 320 | 85 |
| 30 | 199 | 126 | 129 | 129 | ------- | 117 | 1,430 | 705 | 484 | 100 | 229 | 229 |
| 31 | 212 | ------- | 87 | 135 | ------- | 123 | ------- | 660 | ------- | 100 | 353 | ------- |

NOTE.—Stage-discharge relation affected by ice Nov. 27 to Apr. 19 and gage read only two or three times a week; discharge determined by means of four discharge measurements, observer's notes, and temperature records. Gage not read Oct. 4, 9, 18, 22, 27, Nov. 17, 24, Apr. 24, May 2, 15, 23, June 16, 21, 24; discharge interpolated. Water below bottom of gage July 27, 28, 30, 31, Aug. 1–4, 6–8, and 11; discharge estimated.

*Monthly discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for the year ending September 30, 1923*

| Month | Maximum | Minimum | Mean | Month | Maximum | Minimum | Mean |
|---|---|---|---|---|---|---|---|
| October | 388 | 126 | 219 | May | 1,300 | 176 | 823 |
| November | 425 | 3 | 272 | June | 705 | 189 | 449 |
| December | 336 | 87 | 217 | July | 548 | 100 | 292 |
| January | 243 | 44 | 131 | August | 425 | 38 | 213 |
| February | 209 | 32 | 130 | September | 570 | 38 | 201 |
| March | 215 | 38 | 111 | | | | |
| April | 4,100 | 32 | 1,320 | The year | 4,100 | 3 | 364 |

**RED LAKE RIVER AT CROOKSTON, MINN.**

LOCATION.—In sec. 30, T. 150 N., R. 46 W., at Sampson's Addition highway bridge in Crookston, Polk County, a quarter mile below dam and power house of Crookston Light, Water & Power Co. No tributaries for several miles above or below.

DRAINAGE AREA.—5,320 square miles.

RECORDS AVAILABLE.—May 19, 1901, to September 30, 1923.

GAGE.—Chain gage attached to bridge at midspan was installed July 1, 1909, and was read during years 1909–1911 and 1920–1923. Prior to July 1, 1909, the gage was at former wooden highway bridge 300 feet above present bridge; this gage read same as present gage at ordinary stages. From September, 1911, to September, 1919, a Barrett and Lawrence water-stage recorder, located on right abutment of bridge, was in operation.

DISCHARGE MEASUREMENTS.—Made from highway bridge at gage.

CHANNEL AND CONTROL.—Bed composed of silt, gravel, and small boulders; control not well defined. Channel shifts slightly during long intervals. Flow confined to one channel at all stages.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year, 5,820 second-feet April 20; minimum discharge recorded, 22 second-feet August 2.

1901–1923: Maximum discharge recorded, 14,700 second-feet July 5, 1919; minimum discharge, 10 second-feet during current-meter measurement January 27, 1912.

ICE.—Stage-discharge relation seriously affected by ice; flow computed from gage readings by means of discharge measurements, weather records, and comparisons with records of flow of near-by streams.

REGULATION.—In some seasons, especially if the river is very low, comparatively large diurnal fluctuations in gage height are caused by operation of power plant immediately above station and another 8 miles upstream. The nearer plant has very little storage and the farther plant uses storage equivalent to only one or two days natural flow of the stream; hence the controlled mean monthly flow is very nearly equal to the natural monthly flow.

ACCURACY.—Stage-discharge relation not permanent; affected by ice and by aquatic growth. Rating curve well defined. Gage read to tenths once daily. At low stages the mean daily gage height may be considerably in error on account of regulation. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to table of daily discharge. Records fair except for periods of low water or ice effect for which they are poor.

*Discharge measurements of Red Lake River at Crookston, Minn., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 9 | R. V. Tilly | 4.03 | 366 | June 10 | R. V. Tilly | 5.65 | 1,490 |
| 28 | Tilly and Johnson | 3.12 | 145 | 27 | E. F. Chandler | [b] 5.11 | 608 |
| 28 | do | 3.22 | 177 | July 20 | Chandler and Black | [b] 5.20 | 521 |
| Dec. 29 | R. V. Tilly | [a] 3.28 | 108 | Aug. 17 | E. F. Chandler | [b] 3.59 | 139 |
| Feb. 5 | A. Johnson | [a] 4.78 | 334 | Sept. 29 | R. B. Black | [b] 3.16 | 87 |

[a] Stage-discharge relation affected by ice.
[b] Stage-discharge relation affected by aquatic growth

*Daily discharge, in second-feet, of Red Lake River at Crookston, Minn., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 280 | 280 | 410 | | | | 170 | 2,480 | 865 | 650 | 50 | 200 |
| 2 | 455 | 455 | 500 | | | | 180 | 2,410 | 755 | 650 | 22 | 160 |
| 3 | 650 | 500 | | | | | 190 | 810 | 755 | 650 | 58 | 500 |
| 4 | 700 | 410 | | | | | 200 | 2,140 | 755 | 700 | 95 | 320 |
| 5 | 700 | 240 | | | | | 200 | 1,820 | 650 | 650 | 70 | 500 |
| 6 | 650 | 500 | | | | | 220 | 2,020 | 700 | 755 | 280 | 600 |
| 7 | 200 | 410 | | | | | 250 | 1,820 | 650 | 975 | 500 | 200 |
| 8 | 200 | 500 | | | | | 320 | 1,600 | 650 | 920 | 280 | 160 |
| 9 | 160 | 600 | | | | | 500 | 1,380 | 920 | 755 | 365 | 200 |
| 10 | 160 | 700 | | | | | 280 | 1,380 | 810 | 810 | 455 | 160 |
| 11 | 160 | 410 | | | | | 160 | 1,200 | 755 | 700 | 280 | 500 |
| 12 | 200 | 500 | | | | | 280 | 1,200 | 700 | 700 | 125 | 320 |
| 13 | 200 | 500 | | | | | 365 | 1,260 | 600 | 700 | 160 | 160 |
| 14 | 240 | 500 | | | | | 365 | 1,200 | 700 | 320 | 500 | 600 |
| 15 | 240 | 600 | | | 170 | | 1,880 | 1,200 | 700 | 200 | 280 | 600 |
| 16 | 160 | 500 | | 190 | | 160 | 1,880 | 1,200 | 700 | 125 | 200 | 200 |
| 17 | 320 | 550 | 225 | | | | 2,210 | 1,080 | 600 | 95 | 365 | 200 |
| 18 | 500 | 455 | | | | | 3,910 | 1,030 | 600 | 125 | 240 | 160 |
| 19 | 240 | 500 | | | | | 5,320 | 1,080 | 600 | 365 | 200 | 160 |
| 20 | 410 | 600 | | | | | 5,820 | 1,080 | 600 | 650 | 240 | 160 |
| 21 | 95 | 500 | | | | | 5,740 | 1,080 | 550 | 650 | 160 | 160 |
| 22 | 240 | 500 | | | | | 5,400 | 1,200 | 975 | 650 | 125 | 160 |
| 23 | 280 | 410 | | | | | 4,800 | 1,080 | 600 | 810 | 280 | 160 |
| 24 | 500 | 200 | | | | | 4,150 | 1,080 | 600 | 650 | 550 | 200 |
| 25 | 455 | 280 | | | | | 3,670 | 920 | 650 | 550 | 125 | 280 |
| 26 | 200 | 410 | | | | | 3,350 | 755 | 600 | 320 | 160 | 410 |
| 27 | 240 | 500 | | | | | 3,350 | 810 | 755 | 455 | 160 | 315 |
| 28 | 240 | 550 | | | | | 3,120 | 865 | 700 | 600 | 160 | 220 |
| 29 | 125 | 500 | | | ------- | | 2,980 | 1,030 | 650 | 317 | 125 | 125 |
| 30 | 455 | 500 | | | ------- | | 2,830 | 920 | 650 | 34 | 550 | 125 |
| 31 | 500 | ------- | | | ------- | | ------- | 920 | ------- | 34 | 160 | ------- |

NOTE.—No gage readings Jan. 18 to Apr. 7 and only occasional readings Dec. 3 to Jan. 17. Mean discharge for December to March, inclusive, estimated from precipitation and temperature records and comparison with records of flow of other streams. Discharge Apr. 1–7 estimated. Effect of ice on stage-discharge relation continued to Apr. 20; discharge Apr. 8–20 obtained by applying to rating table gage heights corrected for ice effect by means of weather records and comparison with records of flow of other streams. Gage not read May 8, July 29, Aug. 3, and Sept. 27 and 28; discharge interpolated.

*Monthly discharge, in second-feet, of Red Lake River, at Crookston, Minn., for the year ending September 30, 1923*

| Month | Maximum | Minimum | Mean | Month | Maximum | Minimum | Mean |
|---|---|---|---|---|---|---|---|
| October | 700 | 95 | 328 | May | 2,480 | 755 | 1,290 |
| November | 700 | 200 | 469 | June | 975 | 550 | 693 |
| December | ------- | ------- | 240 | July | 975 | 34 | 534 |
| January | ------- | ------- | 190 | August | 550 | 22 | 236 |
| February | ------- | ------- | 170 | September | 600 | 125 | 274 |
| March | ------- | ------- | 160 | | | | |
| April | 5,820 | 170 | 2,140 | The year | 5,820 | 22 | 560 |

### THIEF RIVER NEAR THIEF RIVER FALLS, MINN.

LOCATION.—In sec. 3, T. 154 N., R. 43 W., 1,000 feet above steel highway bridge in Marshall County, 5 miles north of Thief River Falls, Pennington County, and 5 miles above mouth of Thief River.

DRAINAGE AREA.—1,010 square miles.

RECORDS AVAILABLE.—July 1, 1909, to September 30, 1917; April 1, 1920, to September 30, 1921; October 1, 1922, to September 30, 1923.

GAGE.—Chain gage on cantilever timber fastened to a tree on right bank; read by Margaret Hillyer.

DISCHARGE MEASUREMENTS.—Made from highway bridge 1,000 feet below gage or by wading near gage.

CHANNEL AND CONTROL.—Heavy gravel and boulders; nearly permanent. One channel at all stages. Stage-discharge relation never affected by backwater from dam at Thief River Falls. Banks high and not subject to overflow during ordinary floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.4 feet April 21 (discharge, 1,160 second-feet); minimum stage, 3.5 feet September 1–13 (discharge, 0.2 second-foot).

1909–1917; 1920–1923: Maximum stage recorded, 14.5 feet April 23, 1916 (discharge, 4,080 second-feet); practically no flow during several extended periods in 1910, 1911, 1912, and 1920.

Flood of July, 1919, reached a stage of about 16.3 feet (discharge, about 4,900 second-feet).

ACCURACY.—Stage-discharge relation nearly permanent. Rating curve fairly well defined below 3,800 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as shown in footnote to table of daily discharge. Records poor.

*Discharge measurements of Thief River near Thief River Falls, Minn., during the years ending September 30, 1922 and 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| 1921 | | *Feet* | *Sec.-ft.* | 1922 | | *Feet* | *Sec.-ft.* |
| Nov. 6 | K. H. Oakley | 4.54 | 6.8 | Oct. 7 | R. V. Tilly | 4.27 | 7.0 |
| | | | | Nov. 4 | A. Johnson | 4.35 | 13 |
| 1922 | | | | 1923 | | | |
| Apr. 18 | do | 6.97 | 732 | May 3 | do | 6.49 | 544 |
| 21 | do | 6.12 | 425 | | | | |
| May 13 | do | 9.72 | 1,790 | June 27 | E. F. Chandler | 4.24 | 10.3 |
| June 13 | do | 5.18 | 81 | July 19 | Chandler and Black | 4.33 | 11.2 |
| Aug. 23 | E. F. Chandler | 3.71 | .9 | Aug. 16 | E. F. Chandler | 3.68 | .6 |

*Daily discharge, in second-feet, of Thief River near Thief River Falls, Minn., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 11 | 6 | | | | | 1.0 | 810 | 29 | 11 | 5.7 | 0.2 |
| 2 | 11 | 8 | | | | | 1.0 | 743 | 29 | 11 | 5.7 | .2 |
| 3 | 11 | 8 | | | | | 1.0 | 611 | 21 | 11 | 5.7 | .2 |
| 4 | 11 | 11 | | | | | 1.0 | 546 | 21 | 11 | 4.0 | .2 |
| 5 | 11 | 11 | | | | | 1.0 | 482 | 21 | 11 | 4.0 | .2 |
| 6 | 11 | 15 | | | | | 1.0 | 418 | 21 | 11 | 4.0 | .2 |
| 7 | 8 | 15 | | | | | 1.0 | 356 | 21 | 11 | 2.6 | .2 |
| 8 | 8 | 14 | | | | | 1.0 | 356 | 21 | 11 | 2.6 | .2 |
| 9 | 8 | 12 | | | | | 1.0 | 294 | 21 | 11 | 2.6 | .2 |
| 10 | 8 | 10 | | | | | 1.0 | 233 | 15 | 11 | 1.5 | .2 |
| 11 | 8 | 9 | | | | | 1.5 | 233 | 15 | 11 | 1.5 | .2 |
| 12 | 8 | 8 | | | | | 1.5 | 173 | 15 | 11 | 1.5 | .2 |
| 13 | 8 | 7 | | | | | 2.6 | 173 | 15 | 11 | 1.5 | .2 |
| 14 | 8 | 6 | | | | | 2.6 | 145 | 15 | 11 | .8 | .4 |
| 15 | 8 | 6 | | | 0.6 | | 4.0 | 145 | 15 | 11 | .8 | .4 |
| 16 | 8 | 5 | 1.0 | 0.8 | | 0.7 | 5.7 | 145 | 15 | 11 | .8 | .8 |
| 17 | 8 | 4 | | | | | 11 | 120 | 11 | 11 | .8 | .8 |
| 18 | 8 | 2 | | | | | 15 | 120 | 11 | 11 | .8 | .8 |
| 19 | 8 | 1.5 | | | | | 120 | 120 | 11 | 11 | .4 | 1.5 |
| 20 | 8 | 1.5 | | | | | 844 | 99 | 11 | 8 | .4 | 1.5 |
| 21 | 8 | 1.5 | | | | | 1,160 | 99 | 11 | 8 | .4 | 1.5 |
| 22 | 8 | 1.5 | | | | | 1,090 | 81 | 11 | 8 | .4 | 1.5 |
| 23 | 8 | 1.5 | | | | | 1,020 | 81 | 11 | 8 | .4 | 2.6 |
| 24 | 8 | 1.5 | | | | | 947 | 51 | 11 | 8 | .4 | 2.6 |
| 25 | 8 | 1.5 | | | | | 912 | 51 | 11 | 8 | .4 | 2.6 |
| 26 | 8 | 1.5 | | | | | 878 | 39 | 11 | 8 | .4 | 2.6 |
| 27 | 8 | 1.5 | | | | | 878 | 29 | 11 | 8 | .4 | 2.6 |
| 28 | 8 | 1.5 | | | | | 878 | 29 | 11 | 8 | .4 | 2.6 |
| 29 | 6 | 1.5 | | | ------- | | 810 | 25 | 11 | 8 | .4 | 2.6 |
| 30 | 6 | 1.5 | | | ------- | | 810 | 25 | 11 | 8 | .4 | 2.6 |
| 31 | 6 | ------- | | | ------- | | -------- | 23 | ------- | 8 | .4 | ------- |

NOTE.—Stage-discharge relation affected by ice from Nov. 17 to Apr. 19; no gage readings Dec. 2 to Apr. 10. Mean monthly discharge Dec. to Mar. and daily discharge Nov. 17–30 and Apr. 1–10, estimated from temperature and precipitation records and comparison with records of flow of near-by streams. Gage not read Nov. 8–11 and 13–16; discharge interpolated.

*Monthly discharge, in second-feet, of Thief River near Thief River Falls, Minn., for the year ending September 30, 1923*

| Month | Maximum | Minimum | Mean | Month | Maximum | Minimum | Mean |
|---|---|---|---|---|---|---|---|
| October | 11 | 6 | 8.39 | May | 810 | 23 | 221 |
| November | 15 | 1.5 | 5.83 | June | 29 | 11 | 15.5 |
| December | | | [a] 1.0 | July | 11 | 8 | 9.84 |
| January | | | [a] .8 | August | 5.7 | .4 | 1.68 |
| February | | | [a] .6 | September | 2.6 | .2 | 1.05 |
| March | | | [a] .7 | | | | |
| April | 1,160 | 1.0 | 347 | The year | 1,160 | .2 | 51.1 |

[a] Estimated.

**PEMBINA RIVER AT NECHE, N. DAK.**

LOCATION.—At Great Northern Railway bridge two-thirds mile north of Neche, Pembina County.

DRAINAGE AREA.—2,960 square miles (revised).

RECORDS AVAILABLE.—April 29, 1903, to September 30, 1915, and April 1, 1919, to September 30, 1923.

GAGE.—Vertical staff bolted to concrete abutment at north end of railway bridge; read by P. J. Horgan.

DISCHARGE MEASUREMENTS.—Made from highway bridge 20 rods below railway bridge or by wading below Great Northern dam.

CHANNEL AND CONTROL.—Bed composed of clay and silt. Control is loose-rock dam about 3 feet high, a third of a mile below gage, constructed to give sufficient depth of water for the intake of Great Northern Railway water tank; shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.8 feet April 20 (discharge, 3,120 second-feet); minimum stage, 4.1 feet October 2–7 (discharge, 46 second-feet).

1903–1915; 1919–1923: Maximum stage recorded, 20.9 feet May 2, 1904 (discharge, 3,870 second-feet); minimum stage recorded, 1.3 feet September 15, 16, 18, 19, and 21–24, 1911 (discharge, 1.0 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice and by shift of control on April 15. Both rating curves fairly well defined. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as shown in footnote to table of daily discharge. Records fair.

*Discharge measurements of Pembina River at Neche, N. Dak., during the year ending September 30, 1923*

[Made by E. F. Chandler]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| July 12 | 4.22 | 94 |
| July 13 | 4.21 | 90 |

*Daily discharge, in second-feet, of Pembina River at Neche, N. Dak., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|
| 1 | 61 | 79 | 17 | 1,470 | 711 | 121 | 73 | 104 |
| 2 | 46 | 79 | 17 | 1,440 | 687 | 104 | 73 | 104 |
| 3 | 46 | 79 | 17 | 1,420 | 663 | 104 | 73 | 104 |
| 4 | 46 | 79 | 17 | 1,420 | 639 | 104 | 73 | 104 |
| 5 | 46 | 79 | 17 | 1,400 | 565 | 104 | 88 | 88 |
| 6 | 46 | 79 | 17 | 1,400 | 515 | 88 | 88 | 88 |
| 7 | 46 | 79 | 17 | 1,380 | 465 | 88 | 88 | 88 |
| 8 | 61 | 79 | 17 | 1,360 | 390 | 88 | 88 | 88 |
| 9 | 61 | 79 | 17 | 1,360 | 340 | 88 | 88 | 88 |
| 10 | 61 | 79 | 17 | 1,310 | 315 | 88 | 88 | 88 |
| 11 | 61 | 79 | 17 | 1,270 | 315 | 88 | 88 | 88 |
| 12 | 61 | 79 | 17 | 1,160 | 291 | 88 | 88 | 88 |
| 13 | 61 | 79 | 17 | 1,110 | 291 | 88 | 88 | 104 |
| 14 | 61 | 79 | 265 | 1,110 | 267 | 88 | 88 | 104 |
| 15 | 79 | 79 | 687 | 1,090 | 267 | 88 | 88 | 104 |
| 16 | 79 | 79 | 735 | 1,070 | 267 | 88 | 88 | 104 |
| 17 | 79 | 79 | 894 | 1,070 | 267 | 88 | 88 | 104 |
| 18 | 79 | 79 | 1,910 | 1,050 | 244 | 88 | 88 | 104 |
| 19 | 79 | 79 | 2,760 | 1,050 | 221 | 88 | 88 | 104 |
| 20 | 79 | | 3,120 | 1,030 | 199 | 88 | 88 | 104 |
| 21 | 79 | | 2,920 | 1,000 | 199 | 88 | 88 | 104 |
| 22 | 79 | | 2,810 | 1,000 | 178 | 73 | 88 | 104 |
| 23 | 79 | | 2,790 | 982 | 178 | 73 | 88 | 121 |
| 24 | 79 | | 2,870 | 938 | 158 | 73 | 88 | 121 |
| 25 | 79 | 65 | 2,610 | 938 | 158 | 73 | 88 | 121 |
| 26 | 79 | | 2,460 | 938 | 139 | 73 | 104 | 121 |
| 27 | 79 | | 2,150 | 916 | 139 | 73 | 104 | 121 |
| 28 | 79 | | 2,020 | 894 | 139 | 73 | 104 | 121 |
| 29 | 79 | | 1,620 | 850 | 121 | 73 | 104 | 121 |
| 30 | 79 | | 1,510 | 827 | 121 | 73 | 104 | 121 |
| 31 | 79 | | | 781 | | 73 | 104 | |

NOTE.—Stage-discharge relation affected by ice Nov. 20 to Apr. 19; discharge estimated Nov. 20–30 and Apr. 1–19. Braced figure gives mean discharge for period indicated.

*Monthly discharge of Pembina River at Neche, N. Dak., for the year ending September 30, 1923*

| Month | Discharge in second-feet | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum | Minimum | Mean | |
| October | 79 | 46 | 68.0 | 4,180 |
| November | 79 | 65 | 73.9 | 4,400 |
| April | 3,120 | 17 | 1,150 | 68,400 |
| May | 1,470 | 781 | 1,130 | 69,500 |
| June | 711 | 121 | 315 | 18,700 |
| July | 121 | 73 | 86.3 | 5,310 |
| August | 104 | 73 | 89.2 | 5,480 |
| September | 121 | 88 | 104 | 6,190 |

### ROSEAU RIVER AT CARIBOU, MINN.

LOCATION.—In sec. 34, T. 164 N., R. 45 W. at highway bridge at Caribou, Kittson County, 1 mile south of international boundary, and 3 miles upstream from crossing of boundary line by river.

DRAINAGE AREA.—1,650 square miles (revised).

RECORDS AVAILABLE.—April 1 to October 6, 1917; April 12, 1920, to September 30, 1923.

GAGE.—Chain gage fastened to downstream handrail of bridge, 60 feet from left abutment; read by James A. McKibbin.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—Channel is artificial, of trapezoidal cross-section, 100 feet wide and 10 feet deep. Bed composed of hardpan with a few scattered large boulders.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.5 feet May 1 and 2 (discharge, 2,980 second-feet); minimum stage, 3.25 feet September 2–6 (discharge, 22 second-feet).

1917; 1920–1923: Maximum stage recorded, that of May 2, 1923; minimum discharge, 4 second-feet, September 10–12, 29, and 30, 1917.

ICE.—Stage-discharge relation seriously affected by ice.

DIVERSIONS.—No diversions involving storage or loss of water. A small channel 3½ miles long was dredged some years ago from a point 4 miles above station to a point 1 mile below station. At all stages above a height of about 6 feet water flows in this channel and is measured and included as a part of the flow past the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation nearly permanent. Rating curve well defined. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except as shown in footnote to table of daily discharge. Open-water records good; winter records poor.

*Discharge measurements of Roseau River at Caribou, Minn., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge |
|---|---|---|---|
| | | *Feet* | *Sec.-ft.* |
| Oct. 8 | R. V. Tilly | 3.75 | 68 |
| May 4 | A. Johnson | 12.33 | 2,880 |
| June 26 | E. F. Chandler | 4.33 | 133 |

*Daily discharge, in second-feet, of Roseau River at Caribou, Minn., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 98 | 70 | 120 | | | | | 2,980 | 220 | 101 | 49 | 25 |
| 2 | 92 | 81 | 115 | | | | | 2,980 | 191 | 81 | 44 | 22 |
| 3 | 86 | 92 | 110 | | | | | 2,920 | 170 | 68 | 44 | 22 |
| 4 | 81 | 103 | 105 | | | | | 2,860 | 150 | 66 | 44 | 22 |
| 5 | 76 | 114 | 100 | | | | | 2,860 | 131 | 53 | 44 | 22 |
| 6 | 70 | 126 | 95 | | | | | 2,680 | 131 | 58 | 49 | 22 |
| 7 | 66 | 150 | 90 | | | | | 2,450 | 131 | 66 | 44 | 25 |
| 8 | 65 | 176 | 85 | | | | 40 | 2,450 | 125 | 90 | 44 | 28 |
| 9 | 65 | 190 | 80 | | | | | 2,450 | 113 | 113 | 44 | 32 |
| 10 | 65 | 219 | 80 | | | | | 2,400 | 101 | 137 | 40 | 32 |
| 11 | 65 | 234 | 75 | | | | | 2,350 | 90 | 150 | 36 | 32 |
| 12 | 60 | 234 | 75 | | | | | 2,290 | 84 | 163 | 36 | 28 |
| 13 | 60 | 234 | 70 | | | | | 2,240 | 79 | 163 | 44 | 28 |
| 14 | 60 | 234 | 70 | | | | | 2,190 | 79 | 156 | 44 | 28 |
| 15 | 55 | 234 | 68 | | 30 | | 49 | 2,140 | 79 | 131 | 44 | 28 |
| 16 | 55 | 234 | 65 | 50 | | 36 | 58 | 2,040 | 73 | 119 | 44 | 28 |
| 17 | 55 | 229 | 60 | | | | 79 | 1,950 | 63 | 107 | 40 | 28 |
| 18 | 55 | 224 | 60 | | | | 113 | 1,900 | 58 | 95 | 40 | 32 |
| 19 | 60 | 219 | 55 | | | | 323 | 1,850 | 53 | 95 | 36 | 32 |
| 20 | 60 | 213 | 55 | | | | 505 | 1,770 | 58 | 101 | 32 | 32 |
| 21 | 60 | 208 | 50 | | | | 599 | 1,700 | 73 | 107 | 28 | 36 |
| 22 | 60 | 202 | 50 | | | | 878 | 1,640 | 73 | 125 | 28 | 36 |
| 23 | 60 | 197 | 45 | | | | 1,600 | 1,510 | 73 | 137 | 28 | 36 |
| 24 | 60 | 191 | 45 | | | | 1,810 | 1,350 | 90 | 143 | 28 | 36 |
| 25 | 60 | 177 | 40 | | | | 2,040 | 1,080 | 119 | 137 | 28 | 36 |
| 26 | 65 | 164 | 40 | | | | 2,240 | 817 | 131 | 113 | 28 | 36 |
| 27 | 65 | 150 | 35 | | | | 2,350 | 625 | 131 | 90 | 28 | 36 |
| 28 | 65 | 135 | 32 | | | | 2,560 | 527 | 137 | 73 | 28 | 36 |
| 29 | 65 | 130 | 30 | | ------- | | 2,680 | 400 | 143 | 58 | 28 | 40 |
| 30 | 65 | 125 | 30 | | ------- | | 2,860 | 323 | 125 | 53 | 25 | 40 |
| 31 | 65 | ------- | 30 | * | ------- | | ------- | 252 | ------- | 49 | 25 | ------- |

NOTE.—Stage-discharge relation affected by ice Nov. 24 to Apr. 22; discharge estimated from a few gage heights, weather records, and a comparison with records of flow of near-by streams.

*Monthly discharge, in second-feet, of Roseau River at Caribou, Minn., for the year ending September 30, 1923*

| Month | Maximum | Minimum | Mean | Month | Maximum | Minimum | Mean |
|---|---|---|---|---|---|---|---|
| October | 98 | 55 | 65.8 | May | 2,980 | 252 | 1,870 |
| November | 234 | 70 | 176 | June | 220 | 53 | 109 |
| December | 120 | 30 | 66.5 | July | 163 | 49 | 103 |
| January | ------ | ------ | 50 | August | 49 | 25 | 36.9 |
| February | ------ | ------ | 30 | September | 40 | 22 | 30.5 |
| March | ------ | ------ | 36 | | | | |
| April | 2,860 | ------ | 710 | The year | 2,980 | ------ | 276 |

### MOUSE RIVER AT MINOT, N. DAK.

LOCATION.—At Anne Street footbridge, northeast of Great Northern Railway roundhouse, at Minot, Ward County.

DRAINAGE AREA.—10,270 square miles (revised).

RECORDS AVAILABLE.—May 5, 1903, to September 30, 1923.

GAGE.—Vertical staff gage in several sections attached to piers of Anne Street bridge; read by Ephraim Cox.

DISCHARGE MEASUREMENTS.—Made from Anne Street Bridge, North Street Bridge, South Sixth Street Bridge, or by wading.

CHANNEL AND CONTROL.—Channel in clay and silt, nearly permanent, but changed somewhat in recent years by the construction encroaching into the channel through the city. The usual control has been a dam of timber and loose rock 1 mile below gage, at the Minneapolis, St. Paul & Sault Ste. Marie Railway water tank intake, which raises the water at gage at low stage about 3 feet when the water is exactly at crest of dam. When the discharge is less than 5 second-feet, leakage allows the water-level to fall below crest. During winter of 1922–1923, the Minot Park Board completed a concrete dam with a Taintor gate 20 feet wide 4⅔ miles below gage, the crest of which is at same elevation as 9.07 foot point of Anne Street gage. During flood stages, this affects height at gage, but at ordinary and low stages it does not affect height at gage unless Taintor gate in dam is closed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 19.6 feet April 30 to May 3 (discharge, 3,460 second-feet); minimum discharge recorded, February 0.4 second-foot, February 3, 10, 17, and 25.

1903–1923: Maximum stage, 21.9 feet April 20, 1904 (discharge, 12,000 second-feet); minimum stage, 1.8 feet February 28, 1913 (discharge, 0.1 second-foot).

ICE.—Stage-discharge relation only slightly affected by ice.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation fairly permanent during year, except for slight ice effect and for backwater from city park dam. Rating curve fairly well defined between 3 and 3,500 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to daily-discharge table. Records fair.

*Discharge measurements of Mouse River at Minot, N. Dak., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Apr. 26 | R. B. Black | 18.83 | 3,050 | June 4 | R. B. Black | 5.78 | 181 |
| May 1 | do | 19.60 | 3,420 | Aug. 28 | E. F. Chandler | 4.95 | 86 |

*Daily discharge, in second-feet, of Mouse River at Minot, N. Dak., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.9 | 1.9 | | | | 44 | 194 | 3,460 | 270 | 130 | 424 | 80 |
| 2 | 1.9 | 1.1 | | | | 212 | 186 | 3,460 | 281 | 130 | 424 | 80 |
| 3 | 1.9 | 1.1 | | | 0.4 | 96 | 170 | 3,460 | 240 | 130 | 375 | 69 |
| 4 | 1.1 | 1.1 | | | | 108 | 162 | 3,340 | 221 | 300 | 375 | 69 |
| 5 | 1.9 | 1.1 | | | | 114 | 155 | 3,240 | 212 | 500 | 350 | 69 |
| 6 | 1.9 | 1.9 | | 0.9 | | 120 | 141 | 3,010 | 203 | 600 | 326 | 69 |
| 7 | 1.9 | 4.6 | | | | 140 | 128 | 2,790 | 212 | 600 | 326 | 69 |
| 8 | 1.9 | 4.6 | | | | 133 | 122 | 2,550 | 212 | 500 | 326 | 59 |
| 9 | 1.9 | 4.6 | 1.1 | | | 120 | 128 | 2,240 | 203 | 450 | 303 | 103 |
| 10 | 1.9 | 4.6 | | | .4 | 73 | 170 | 1,830 | 194 | 400 | 303 | 260 |
| 11 | .9 | 1.9 | | | | 68 | 203 | 1,550 | 203 | 300 | 326 | 260 |
| 12 | 1.9 | 1.9 | | | | 68 | 281 | 1,390 | 221 | 221 | 303 | 260 |
| 13 | 1.9 | 1.9 | | 2.0 | | 68 | 518 | 1,200 | 250 | 240 | 326 | 260 |
| 14 | 1.9 | 1.9 | | | | 53 | 585 | 1,140 | 260 | 585 | 303 | 91 |
| 15 | 1.1 | 1.1 | | | | 58 | 896 | 844 | 270 | 541 | 326 | 69 |
| 16 | 1.1 | 1.1 | .9 | | | 53 | 1,260 | 669 | 292 | 563 | 281 | 49 |
| 17 | 1.1 | 1.1 | | | .4 | 53 | 1,410 | 606 | 303 | 448 | 281 | 30 |
| 18 | 1.9 | 1.1 | | | | 53 | 1,900 | 495 | 240 | 450 | 240 | 30 |
| 19 | 1.9 | 1.1 | | | | 48 | 2,100 | 424 | 155 | 500 | 240 | 21 |
| 20 | 1.9 | 1.1 | | .6 | | 43 | 2,210 | 375 | 97 | 400 | 221 | 21 |
| 21 | 1.9 | 1.1 | | | | 38 | 2,300 | 375 | 375 | 500 | 203 | 13 |
| 22 | 1.9 | 1.1 | | | | 34 | 2,390 | 350 | 240 | 600 | 203 | 13 |
| 23 | 1.9 | 1.1 | .9 | | | 38 | 2,550 | 314 | 862 | 600 | 186 | 13 |
| 24 | 1.1 | 1.1 | | | | 43 | 2,720 | 338 | 128 | 600 | 170 | 13 |
| 25 | 1.1 | 1.1 | | | .4 | 43 | 2,860 | 314 | 115 | 600 | 170 | 13 |
| 26 | 1.1 | 1.1 | | | .6 | 53 | 3,140 | 303 | 134 | 790 | 128 | 21 |
| 27 | 1.1 | 1.1 | | | 1.1 | 84 | 3,240 | 338 | 134 | 844 | 115 | 21 |
| 28 | 1.9 | 1.1 | | .6 | 9.4 | 96 | 3,340 | 303 | 121 | 808 | 115 | 30 |
| 29 | 1.9 | 1.1 | | | | 154 | 3,400 | 314 | 130 | 648 | 91 | 30 |
| 30 | 1.9 | 1.1 | .9 | | | 170 | 3,460 | 281 | 130 | 606 | 91 | 39 |
| 31 | 1.9 | | | | | 186 | | 281 | | 648 | 91 | |

NOTE.—Stage-discharge relation affected by backwater because Taintor gate was closed June 29 to July 11, July 18–25, and Sept. 11 and 12; discharge estimated. No record for days for which no discharge is given.

*Monthly discharge of Mouse River at Minot, N. Dak., for the year ending September, 30, 1923*

| Month | Discharge in second-feet | | | Run-off in acre-feet |
|---|---|---|---|---|
| | Maximum | Minimum | Mean | |
| October | 1.9 | 0.9 | 1.66 | 102 |
| November | 4.6 | 1.1 | 1.73 | 103 |
| December | | | [a] 1.0 | 61.5 |
| January | | | [a] 1.0 | 61.5 |
| February | | | [a] .7 | 38.9 |
| March | 212 | 34 | 85.9 | 5,280 |
| April | 3,460 | 122 | 1,410 | 83,900 |
| May | 3,460 | 281 | 1,340 | 82,400 |
| June | 862 | 97 | 230 | 13,700 |
| July | 844 | 130 | 491 | 30,200 |
| August | 424 | 91 | 256 | 15,700 |
| September | 260 | 13 | 74.1 | 4,410 |
| The year | 3,460 | | 326 | 236,000 |

[a] Estimated.

## UPPER MISSISSIPPI RIVER BASIN

### MISSISSIPPI RIVER AT ELK RIVER, MINN.

LOCATION.—In sec. 3, T. 121 N., R. 23 W., at highway bridge in Elk River, Sherburne County, 2,500 feet below mouth of Elk River.

DRAINAGE AREA.—14,500 square miles.

RECORDS AVAILABLE.—July 22, 1915, to September 30, 1923.

GAGE.—Chain gage bolted to handrail of bridge, downstream side near right bank; read by Reynard Ebner.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; control not well defined. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.80 feet at 7.15 a. m. April 23 (discharge, 10,200 second-feet); minimum discharge estimated because of ice, 1,420 second-feet April 4.

1915–1923: Maximum open-water stage recorded, 10.8 feet April 7, 1916 (discharge, 27,000 second-feet); minimum discharge estimated because of ice, 1,360 second-feet January 26, 1922.

ICE.—Stage-discharge relation seriously affected by ice; discharge estimated from discharge at Coon Rapids power plant, computed by the Northern States Power Co., allowance being made for discharge of Crow and Rum Rivers, entering between Coon Rapids and station.

REGULATION.—Nearest dam above station on Mississippi River is at St. Cloud, 40 miles upstream. An observed systematic diurnal fluctuation at gage of about 0.1 foot is doubtless due to regulation at St. Cloud, but most of the effect of regulation is equalized before reaching station. The flow of the river is controlled by Government dams on the upper river for the purpose of increasing the low-water open-season flow in the interests of navigation.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined above 2,000 second-feet. Gage read to hundredths twice daily. Gage-height record prior to June 1 somewhat in doubt on account of elongation of chain. Daily discharge ascertained by applying mean daily gage height to rating table except as shown in footnote to table of daily discharge. Records prior to June 1 fair; subsequent to that date good.

COOPERATION.—Gage-height record furnished by United States Engineer Corps.

The following discharge measurement was made by S. B. Soulé:

June 8, 1923: Gage-height, 3.16 feet; discharge, 2,810 second-feet.

76612– 26—WSP 565——4

*Daily discharge, in second-feet, of Mississippi River at Elk River, Minn., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3,610 | 4,080 | 3,840 | 2,110 | 2,070 | 1,900 | 2,040 | 8,880 | 3,840 | 7,000 | 3,210 | 3,210 |
| 2 | 4,080 | 3,840 | 3,210 | 1,940 | 2,070 | 2,060 | 2,060 | 8,240 | 3,610 | 6,400 | 3,400 | 3,210 |
| 3 | 3,840 | 3,840 | 3,400 | 1,900 | 2,060 | 2,800 | 2,350 | 9,200 | 3,840 | 5,800 | 3,210 | 3,400 |
| 4 | 3,610 | 3,840 | 3,210 | 1,930 | 2,010 | 2,820 | 1,420 | 9,200 | 3,400 | 5,800 | 3,210 | 3,030 |
| 5 | 3,610 | 4,910 | 3,210 | 1,990 | 2,010 | 2,510 | 2,120 | 9,200 | 3,400 | 5,800 | 3,400 | 3,400 |
| 6 | 3,840 | 4,340 | 3,210 | 2,010 | 2,010 | 3,910 | 3,610 | 8,880 | 3,610 | 4,620 | 3,210 | 3,400 |
| 7 | 4,080 | 4,080 | 3,210 | 1,960 | 1,890 | 2,130 | 4,080 | 8,560 | 3,610 | 5,500 | 2,860 | 3,400 |
| 8 | 3,610 | 4,620 | 1,640 | 2,090 | 1,850 | 2,430 | 4,620 | 8,240 | 2,860 | 5,500 | 3,210 | 3,400 |
| 9 | 3,610 | 4,080 | 1,750 | 1,950 | 1,890 | 2,030 | 4,340 | 8,240 | 3,400 | 5,200 | 3,610 | 3,210 |
| 10 | 3,400 | 4,620 | 1,910 | 2,020 | 1,750 | 3,630 | 4,620 | 7,620 | 3,030 | 5,200 | 3,400 | 3,210 |
| 11 | 3,400 | 4,340 | 2,070 | 2,120 | 1,870 | 3,040 | 4,620 | 7,310 | 2,860 | 4,620 | 3,210 | 3,610 |
| 12 | 3,840 | 4,340 | 2,120 | 2,090 | 1,860 | 4,180 | 5,800 | 6,700 | 2,700 | 4,910 | 2,860 | 3,610 |
| 13 | 3,840 | 4,340 | 2,120 | 2,100 | 1,830 | 2,860 | 4,910 | 5,800 | 3,030 | 4,620 | 2,550 | 3,610 |
| 14 | 3,840 | 4,080 | 2,120 | 2,010 | 1,770 | 2,580 | 4,910 | 6,400 | 3,030 | 4,340 | 2,550 | 3,610 |
| 15 | 3,840 | 4,080 | 2,120 | 2,090 | 1,720 | 2,530 | 4,620 | 5,800 | 3,030 | 4,340 | 2,090 | 3,400 |
| 16 | 4,340 | 4,080 | 2,210 | 2,030 | 1,960 | 2,950 | 4,620 | 5,500 | 3,030 | 4,080 | 2,700 | 2,860 |
| 17 | 3,610 | 4,620 | 2,210 | 1,900 | 1,920 | 2,580 | 4,910 | 5,500 | 2,860 | 4,080 | 2,860 | 3,030 |
| 18 | 3,840 | 5,200 | 2,210 | 1,990 | 1,860 | 2,550 | 5,500 | 4,910 | 3,030 | 3,840 | 2,190 | 2,860 |
| 19 | 3,840 | 4,080 | 2,290 | 1,940 | 1,820 | 2,120 | 5,500 | 4,620 | 3,030 | 4,340 | 2,860 | 3,030 |
| 20 | 3,840 | 4,910 | 2,030 | 2,090 | 1,550 | 2,130 | 5,800 | 5,200 | 3,400 | 4,080 | 2,700 | 3,400 |
| 21 | 3,840 | 4,910 | 1,960 | 2,090 | 1,780 | 2,450 | 7,310 | 5,200 | 4,080 | 3,610 | 2,420 | 3,610 |
| 22 | 4,080 | 4,620 | 2,020 | 2,090 | 1,670 | 2,420 | 7,930 | 4,620 | 4,080 | 3,610 | 2,700 | 3,400 |
| 23 | 3,840 | 4,910 | 2,090 | 2,010 | 1,840 | 2,520 | 9,520 | 5,200 | 4,080 | 3,210 | 2,860 | 3,400 |
| 24 | 3,400 | 4,340 | 2,220 | 1,890 | 1,770 | 2,480 | 7,930 | 6,400 | 3,840 | 3,210 | 3,030 | 2,860 |
| 25 | 4,080, | 4,080 | 2,100 | 2,090 | 1,780 | 2,270 | 8,560 | 5,800 | 4,340 | 3,030 | 3,030 | 3,400 |
| 26 | 4,080 | 3,840 | 2,210 | 2,000 | 1,820 | 2,310 | 7,930 | 5,200 | 5,200 | 3,210 | 2,860 | 3,400 |
| 27 | 3,840 | 4,080 | 1,960 | 2,090 | 2,050 | 2,330 | 7,310 | 5,200 | 5,500 | 3,610 | 2,860 | 3,610 |
| 28 | 3,610 | 3,610 | 1,780 | 2,170 | 1,730 | 2,140 | 7,620 | 4,340 | 7,000 | 3,610 | 2,860 | 3,400 |
| 29 | 3,400 | 3,610 | 1,960 | 2,090 | ------- | 2,130 | 8,560 | 4,080 | 7,310 | 3,210 | 3,030 | 3,610 |
| 30 | 3,610 | 3,840 | 1,990 | 1,970 | ------- | 2,080 | 8,880 | 4,080 | 7,000 | 3,210 | 3,210 | 3,400 |
| 31 | 3,400 | ------- | 2,170 | 2,010 | ------- | 2,090 | ------- | 4,080 | ------- | 3,210 | 3,210 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 8 to Apr. 5; discharge based on computed flow at Coon Rapids power plant of Northern States Power Co.

*Monthly discharge of Mississippi River at Elk River, Minn., for the year ending September 30, 1923*

[Drainage area, 14,500 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 4,340 | 3,400 | 3,760 | 0.259 | 0.30 |
| November | 5,200 | 3,610 | 4,270 | .294 | .33 |
| December | 3,840 | 1,640 | 2,340 | .161 | .19 |
| January | 2,170 | 1,890 | 2,020 | .139 | .16 |
| February | 2,070 | 1,550 | 1,860 | .128 | .13 |
| March | 4,180 | 1,900 | 2,550 | .176 | .20 |
| April | 9,520 | 1,420 | 5,470 | .377 | .42 |
| May | 9,200 | 4,080 | 6,400 | .441 | .51 |
| June | 7,310 | 2,700 | 3,900 | .269 | .30 |
| July | 7,000 | 3,030 | 4,410 | .304 | .35 |
| August | 3,610 | 2,090 | 2,950 | .203 | .23 |
| September | 3,610 | 2,860 | 3,330 | .230 | .26 |
| The year | 9,520 | 1,420 | 3,610 | .249 | 3.38 |

### MISSISSIPPI RIVER AT ST. PAUL, MINN.

LOCATION.—At Chicago Great Western Railway bridge near foot of Robert Street, St. Paul, Ramsey County, 6 miles below mouth of Minnesota River.

DRAINAGE AREA.—35,700 square miles.

RECORDS AVAILABLE.—March 22, 1887, to September 30, 1923. Observations of stage were begun in 1873 by United States Signal Service and continued by United States Weather Bureau. Many discharge measurements made prior to 1900 by United States Engineer Corps.

GAGE.—Chain gage installed May 9, 1913, on handrail, downstream side, of Chicago Great Western Railway bridge near foot of Robert Street; read by United States Weather Bureau. From 1911 to May 9, 1913, a vertical staff gage attached to a piling on left bank of river 800 feet upstream from present gage. Prior to 1911 a vertical staff gage on Diamond Joe Line wharf, at foot of Jackson Street, 400 feet below chain gage, was used. The datum of all three gages is the same, allowance being made for the slight slope in the river between them.

DISCHARGE MEASUREMENTS.—Up to 1915 made from Chicago, St. Paul, Minneapolis & Omaha Railway bridge, 2 miles above station; in November, 1915, and April, 1916, measurements were made from the Chicago Great Western Railway bridge to which gage is attached. Since 1916 measurements have been made from Wabasha Street highway bridge, 1,000 feet above station.

CHANNEL AND CONTROL.—Channel fairly permanent. Control not well defined. Banks moderately high; have not been overflowed in recent years.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.3 feet May 7 and 8 (discharge, 13,200 second-feet); minimum discharge estimated, 2,500 second-feet for month of February.

1892–1923: Maximum stage recorded, 18.0 feet April 6, 1897 (discharge, 80,800 second-feet); highest known discharge occurred July 22, 1867, and amounted to 117,000 second-feet. Minimum discharge, 1,060 second-feet, February 4, 1895.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—During extreme low water regulation of the flow through turbines at nearest dam in Minneapolis may cause diurnal fluctuation of stage at St. Paul. Flow is regulated by Government reservoirs on the headwaters at Lake Winnebigoshish, Leach Lake, Pokegama Lake, Sandy Lake, Pine River, and Gull Lake to increase the low-water open-season flow in the interests of navigation, but the effect of this regulation is very gradual at St. Paul.

ACCURACY.—Stage-discharge relation fairly permanent except as affected by ice. Rating curve well defined throughout. Gage read to tenths once daily. Daily discharge ascertained by shifting-control method during entire year. Open-water records fair; winter records poor.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

*Discharge measurements of Mississippi River at St. Paul, Minn., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 30 | United States Engineer Corps | −0.13 | 3,550 | Nov. 7 | United States Engineer Corps | 0.55 | 4,640 |
| 31 | do | −.12 | 3,670 | 7 | do | .59 | 4,680 |
| Nov 1 | do | .13 | 3,980 | 8 | do | .47 | 4,460 |
| 2 | do | .16 | 4,000 | 8 | do | .57 | 4,650 |
| 3 | do | .16 | 4,000 | 9 | do | .52 | 4,520 |
| 3 | do | .15 | 3,970 | 9 | do | .58 | 4,650 |
| 4 | do | .05 | 3,890 | June 9 | S. B. Soulé | .36 | 4,570 |
| 6 | do | .52 | 4,490 | 10 | do | .39 | 4,650 |
| 6 | do | .50 | 4,510 | | | | |

NOTE.—Measurements Oct. 30 to Nov. 9 were made from a boat at a section 1.2 miles downstream and were originally referred to the United States Engineer Corps gage. The gage heights were reduced to datum of the United States Weather Bureau gage by adding 0.51 foot for difference in datum and 0.09 foot for difference in slope.

*Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3,960 | 4,090 | 4,090 | 2,720 | | 3,020 | 3,720 | 11,500 | 5,390 | 9,180 | 4,220 | 3,600 |
| 2 | 3,840 | 4,090 | 4,090 | 3,240 | | 2,920 | 3,480 | 12,600 | 5,230 | 8,950 | 3,840 | 3,720 |
| 3 | 4,090 | 4,090 | 3,360 | 3,130 | | 3,240 | 3,720 | 11,500 | 5,070 | 8,500 | 4,220 | 3,840 |
| 4 | 3,840 | 3,840 | 3,360 | 3,130 | | 3,130 | 3,960 | 12,900 | 5,070 | 8,060 | 4,090 | 3,840 |
| 5 | 3,840 | 4,630 | 3,840 | 2,920 | | 3,240 | 3,960 | 12,900 | 4,920 | 7,230 | 4,220 | 3,720 |
| 6 | 3,720 | 4,630 | 2,820 | | | 2,820 | 4,350 | 12,900 | 4,770 | 7,640 | 3,720 | 3,720 |
| 7 | 3,840 | 4,630 | 2,630 | | | 3,020 | 4,490 | 13,200 | 4,770 | 6,090 | 3,720 | 3,960 |
| 8 | 3,960 | 4,630 | 2,630 | | | 2,720 | 4,350 | 13,200 | 4,920 | 6,640 | 3,720 | 3,720 |
| 9 | 3,840 | 4,630 | 3,360 | | | 3,020 | 4,220 | 12,000 | 4,490 | 6,830 | 3,720 | 3,840 |
| 10 | 3,960 | 5,070 | 3,360 | | | 3,360 | 4,630 | 10,900 | 4,350 | 6,450 | 3,840 | 3,600 |
| 11 | 3,600 | 4,630 | 3,020 | | | 3,240 | 5,560 | 10,700 | 4,090 | 6,090 | 4,090 | 3,360 |
| 12 | 3,480 | 4,630 | | | | 3,240 | 5,910 | 10,200 | 4,490 | 5,910 | 3,960 | 3,840 |
| 13 | 3,600 | 4,630 | | | | 3,020 | 7,030 | 9,420 | 4,220 | 6,090 | 3,240 | 3,960 |
| 14 | 3,840 | 4,490 | | | | 3,840 | 8,720 | 8,280 | 3,960 | 5,910 | 3,480 | 4,090 |
| 15 | 3,840 | 4,350 | | | 2,500 | 3,480 | 8,950 | 8,060 | 3,960 | 5,730 | 3,360 | 3,960 |
| 16 | 3,600 | 4,350 | | | | 3,360 | 9,180 | 8,060 | 4,090 | 5,070 | 3,020 | 3,840 |
| 17 | 4,090 | 4,350 | | | | 3,720 | 8,280 | 7,230 | 4,350 | 5,230 | 3,130 | 3,600 |
| 18 | 3,600 | 5,230 | 2,600 | 2,550 | | 3,840 | 7,850 | 7,430 | 4,090 | 4,920 | 3,480 | 3,840 |
| 19 | 3,600 | 5,390 | | | | 3,720 | 8,950 | 7,030 | 4,490 | 4,630 | 3,360 | 3,600 |
| 20 | 3,720 | 5,230 | | | | 4,350 | 7,850 | 6,830 | 4,090 | 5,070 | 3,480 | 3,720 |
| 21 | 3,840 | 5,070 | | | | 3,840 | 8,950 | 6,640 | 4,350 | 4,920 | 4,090 | 3,960 |
| 22 | 3,720 | 5,230 | | | | 3,960 | 10,200 | 7,430 | 5,230 | 4,630 | 3,600 | 4,090 |
| 23 | 3,840 | 4,920 | | | | 3,360 | 10,700 | 6,450 | 4,920 | 4,220 | 3,600 | 3,720 |
| 24 | 3,720 | 4,920 | | | | 3,720 | 12,000 | 6,450 | 5,390 | 4,220 | 3,480 | 3,960 |
| 25 | 3,600 | 4,630 | | | | 3,480 | 10,900 | 8,060 | 6,830 | 4,090 | 3,130 | 3,600 |
| 26 | 3,720 | 3,840 | 3,240 | | | 3,360 | 11,800 | 7,230 | 7,430 | 3,720 | 3,720 | 3,600 |
| 27 | 3,720 | 3,840 | 3,360 | | | 3,240 | 10,900 | 6,830 | 7,850 | 4,220 | 3,360 | 3,720 |
| 28 | 3,720 | 4,350 | 3,240 | | | 3,600 | 10,700 | 6,830 | 8,280 | 4,220 | 3,720 | 4,090 |
| 29 | 3,720 | 4,090 | 2,820 | | ------- | 3,240 | 10,200 | 6,270 | 8,720 | 4,630 | 3,360 | 4,770 |
| 30 | 3,720 | 4,220 | 3,020 | | ------- | 3,240 | 11,500 | 5,560 | 9,180 | 4,090 | 3,600 | 4,770 |
| 31 | 3,480 | ------- | 2,920 | | ------- | 3,130 | ------- | 5,230 | ------- | 4,090 | 3,360 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 12–25 and Jan. 6 to Feb. 28; mean discharge estimated from comparison with discharge of Mississippi River at Elk River.

*Monthly discharge of Mississippi River at St. Paul, Minn., for the year ending September 30, 1923*

[Drainage area, 35,700 square miles]

| Month | Discharge in second-feet. | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 4,090 | 3,480 | 3,760 | 0.105 | 0.12 |
| November | 5,390 | 3,840 | 4,560 | .128 | .14 |
| December | 4,090 | ---------- | 2,950 | .083 | .10 |
| January | ---------- | ---------- | 2,630 | .074 | .09 |
| February | ---------- | ---------- | 2,500 | .070 | .07 |
| March | 4,350 | 2,720 | 3,370 | .094 | .11 |
| April | 12,000 | 3,480 | 7,570 | .212 | .24 |
| May | 13,200 | 5,230 | 9,030 | .253 | .29 |
| June | 9,180 | 3,960 | 5,300 | .148 | .17 |
| July | 9,180 | 3,720 | 5,720 | .160 | .18 |
| August | 4,220 | 3,020 | 3,640 | .102 | .12 |
| September | 4,770 | 3,360 | 3,860 | .108 | .12 |
| The year | 13,200 | ---------- | 4,580 | .128 | 1.75 |

**MINNESOTA RIVER NEAR MONTEVIDEO, MINN.**

LOCATION.—In sec. 17, T. 117 N., R. 40 W. at highway bridge 1 mile south of Montevideo, Chippewa County, 500 feet below mouth of Chippewa River.

DRAINAGE AREA.—6,300 square miles.

RECORDS AVAILABLE.—July 22, 1909, to September 30, 1923.

GAGE.—Chain gage attached to upstream handrail of bridge near left bank; read by Esther Hendricks. Datum of gage lowered 2 feet September 16, 1909, and 1 foot more July 29, 1910, to avoid negative readings. All gage heights referred to latest datum.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Heavy gravel and sand; fairly permanent. There is a slight riffle just below gage, but control section is not well defined. Banks are of medium height and are overflowed at a stage of 14 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.05 feet at 5 p. m. April 17 and 5.30 p. m. April 27 (discharge, 982 second-feet); minimum stage recorded, 1.58 feet at 6 p. m. August 21 (discharge, 38 second-feet).

1909–1923: Maximum stage recorded, about 18.85 feet June 25, 1919 (discharge, about 22,000 second-feet); minimum discharge, 6.8 second-feet measured by current meter February 9, 1912.

ICE.—Stage-discharge relation seriously affected by ice; discharge not determined during winter.

REGULATION.—No regulation on Minnesota River above station. Regulation of Chippewa River at plant of Chippewa Milling Co., in Montevideo produces a slight fluctuation in stage of Minnesota River at gage.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve fairly well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

The following discharge measurement was made by S. B. Soulé:

June 7, 1923: Gage height, 3.56 feet; discharge, 320 second-feet.

*Daily discharge, in second-feet, of Minnesota River at Montevideo, Minn., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 54 | 68 | 234 | | 846 | 316 | 225 | 71 | 54 |
| 2 | 50 | 71 | 207 | | 906 | 294 | 234 | 74 | 54 |
| 3 | 48 | 79 | | | 906 | 294 | 216 | 71 | 61 |
| 4 | 48 | 87 | | | 906 | 294 | 207 | 69 | 56 |
| 5 | 46 | 97 | | | 906 | 294 | 207 | 68 | 54 |
| 6 | 48 | 105 | | | 846 | 316 | 207 | 62 | 50 |
| 7 | 49 | 112 | | 362 | 846 | 316 | 216 | 67 | 60 |
| 8 | 57 | 116 | | 316 | 876 | 316 | 189 | 64 | 60 |
| 9 | 57 | 112 | | 316 | 788 | 274 | 171 | 60 | 58 |
| 10 | 47 | 109 | | 338 | 731 | 274 | 180 | 62 | 55 |
| 11 | 48 | 99 | | 410 | 675 | 254 | 171 | 58 | 52 |
| 12 | 49 | 99 | | 462 | 675 | 254 | 162 | 62 | 52 |
| 13 | 44 | 112 | | 619 | 592 | 244 | 154 | 57 | 54 |
| 14 | 39 | 123 | | 675 | 566 | 234 | 146 | 50 | 52 |
| 15 | 41 | 130 | | 788 | 566 | 225 | 146 | 52 | 47 |
| 16 | 43 | 146 | | 846 | 566 | 207 | 130 | 47 | 46 |
| 17 | 43 | 146 | | 967 | 514 | 198 | 116 | 46 | 48 |
| 18 | 46 | 171 | | 967 | 436 | 189 | 108 | 45 | 43 |
| 19 | 49 | 189 | | 906 | 436 | 216 | 103 | 49 | 67 |
| 20 | 49 | 189 | | 906 | 514 | 180 | 100 | 50 | 65 |
| 21 | 48 | 162 | | 936 | 462 | 189 | 98 | 39 | 69 |
| 22 | 49 | 154 | | 936 | 462 | 225 | 88 | 54 | 67 |
| 23 | 53 | 171 | | 906 | 462 | 234 | 84 | 49 | 59 |
| 24 | 55 | 198 | | 936 | 462 | 225 | 87 | 50 | 55 |
| 25 | 52 | 162 | | 967 | 462 | 216 | 81 | 46 | 51 |
| 26 | 56 | 189 | | 967 | 410 | 216 | 80 | 42 | 49 |
| 27 | 54 | 171 | | 967 | 386 | 216 | 75 | 46 | 63 |
| 28 | 54 | 154 | | 906 | 338 | 234 | 88 | 63 | 64 |
| 29 | 57 | 171 | | 906 | 338 | 234 | 85 | 59 | 68 |
| 30 | 59 | 225 | | 906 | 338 | 225 | 78 | 57 | 66 |
| 31 | 63 | | | | 316 | | 75 | 54 | |

NOTE.—Stage-discharge relation affected by ice from Dec. 3 to Apr. 6; discharge not determined

*Monthly discharge of Minnesota River near Montevideo, Minn., for the year ending September 30, 1923*

[Drainage area, 6,300 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 63 | 39 | 50.2 | 0.0080 | 0.01 |
| November | 225 | 68 | 137 | .0217 | .02 |
| April 7-30 | 967 | 316 | 759 | .120 | .11 |
| May | 906 | 316 | 598 | .0949 | .11 |
| June | 316 | 180 | 247 | .0392 | .04 |
| July | 234 | 75 | 139 | .0221 | .03 |
| August | 74 | 39 | 56.2 | .0089 | .01 |
| September | 68 | 43 | 56.6 | .0090 | .01 |

### MINNESOTA RIVER AT MANKATO, MINN.

LOCATION.—In sec. 7, T. 108 N., R. 26 W., at Main Street highway bridge in Mankato, Blue Earth County, 2 miles below mouth of Blue Earth River.

DRAINAGE AREA.—14,600 square miles.

RECORDS AVAILABLE.—March 15, 1922, to September 30, 1923, at present site; May 20, 1903, to October 19, 1921, at Sibley Park 2 miles upstream. Drainage area practically the same at the two sites.

GAGE.—Chain gage attached to downstream side of bridge over center of left channel; read by J. J. Pihale.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and light gravel; probably shifts during high stages. Banks moderately high and not subject to overflow. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.49 feet May 4; minimum stage recorded, 3.24 feet October 6, September 15 and 16.

1903–1923: Maximum stage recorded, 21.2 feet at old site at Sibley Park, June 26, 1908 (discharge, 43,800 second-feet); minimum discharge, 89 second-feet, August 31, to September 2, 1911.

The highest known stage of this river occurred in 1881 and is shown in Mankato by a well-marked line about 27 feet above zero of Sibley Park gage (discharge, estimated 65,000 second-feet).

ICE.—No records available during winter.

REGULATION.—The nearest dam on Minnesota River is at Minnesota Falls, 140 miles upstream. A dam on Blue Earth River at Rapidan, a few miles above mouth, controls the flow of that river, which is about 20 per cent of that at the Mankato station, and produces considerable daily fluctuation at gage amounting at times to over 1 foot.

COOPERATION.—Gage-height record furnished by the United States Weather Bureau.

Daily discharge withheld until further measurements are obtained.

*Discharge measurements of Minnesota River at Mankato, Minn., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge |
|---|---|---|---|
| | | *Feet* | *Sec.-ft.* |
| Oct. 9 | E. E. Foster | 3.29 | 135 |
| June 6 | S. B. Soulé | 4.10 | 569 |

*Daily gage height, in feet, of Minnesota River at Mankato, Minn., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.30 | 3.54 | 3.90 | | 4.92 | 5.33 | 4.29 | 4.28 | 3.52 | 3.36 |
| 2 | 3.30 | 3.66 | 3.84 | | 4.76 | 5.31 | 4.24 | 4.26 | 3.50 | 3.40 |
| 3 | 3.30 | 3.62 | 3.82 | | 4.76 | 5.35 | 4.16 | 4.20 | 3.50 | 3.38 |
| 4 | 3.28 | 3.70 | 3.80 | | 4.64 | 5.49 | 4.24 | 4.18 | 3.50 | 3.36 |
| 5 | 3.26 | 3.74 | 3.60 | | 4.66 | 5.43 | 4.18 | 4.12 | 3.52 | 3.38 |
| 6 | 3.24 | 3.70 | 3.60 | | 4.72 | 5.35 | 4.10 | 4.10 | 3.52 | 3.38 |
| 7 | 3.42 | 3.68 | 3.64 | | 4.65 | 5.35 | 4.18 | 4.12 | 3.60 | 3.36 |
| 8 | 3.34 | 3.70 | | | 4.61 | 5.37 | 4.16 | 4.10 | 3.64 | 3.34 |
| 9 | 3.32 | 3.70 | | | 4.63 | 5.29 | 4.16 | 4.08 | 3.56 | 3.32 |
| 10 | 3.32 | 3.78 | | | 4.95 | 5.15 | 4.15 | 4.04 | 3.52 | 3.32 |
| 11 | 3.30 | 3.78 | | | 5.03 | 5.13 | 4.14 | 4.02 | 3.48 | 3.30 |
| 12 | 3.28 | 3.80 | | | 4.91 | 5.13 | 4.12 | 4.00 | 3.46 | 3.38 |
| 13 | 3.28 | 3.76 | | | 4.99 | 5.09 | 4.10 | 3.94 | 3.44 | 3.35 |
| 14 | 3.26 | 4.02 | | | 5.15 | 4.91 | 4.10 | 3.92 | 3.52 | 3.34 |
| 15 | 3.26 | 3.86 | | | 5.01 | 4.89 | 4.08 | 3.88 | 3.50 | 3.24 |
| 16 | 3.26 | 3.80 | | | 5.09 | 4.83 | 4.08 | 3.86 | 3.44 | 3.24 |
| 17 | 3.28 | 3.80 | | | 5.15 | 4.76 | 4.06 | 3.78 | 3.40 | 3.25 |
| 18 | 3.28 | 4.16 | | | 5.15 | 4.74 | 4.06 | 3.64 | 3.45 | 3.30 |
| 19 | 3.32 | 4.20 | | | 5.19 | 4.74 | 4.08 | 3.60 | 3.48 | 3.28 |
| 20 | 3.32 | 3.96 | | | 5.25 | 4.76 | 4.06 | 3.58 | 3.52 | 3.40 |
| 21 | 3.32 | 3.90 | | 4.76 | 5.37 | 4.64 | 4.02 | 3.60 | 3.54 | 3.36 |
| 22 | 3.30 | 3.98 | | 4.76 | 5.40 | 4.56 | 4.00 | 3.68 | 3.50 | 3.34 |
| 23 | 3.30 | 3.92 | | 4.58 | 5.43 | 4.54 | 4.00 | 3.66 | 3.46 | 3.32 |
| 24 | 3.30 | 3.88 | | 4.60 | 5.41 | 4.50 | 4.20 | 3.64 | 3.44 | 3.30 |
| 25 | 3.28 | 3.86 | | 4.60 | 5.39 | 4.42 | 4.15 | 3.58 | 3.46 | 3.34 |
| 26 | 3.38 | 3.82 | | 4.86 | 5.41 | 4.34 | 4.10 | 3.56 | 3.50 | 3.36 |
| 27 | 3.28 | 3.80 | | 5.44 | 5.45 | 4.30 | 4.22 | 3.54 | 3.54 | 3.38 |
| 28 | 3.26 | 3.88 | | 5.36 | 5.41 | 4.28 | 4.28 | 3.54 | 3.48 | 3.40 |
| 29 | 3.26 | 3.92 | | 5.40 | 5.39 | 4.36 | 4.34 | 3.52 | 3.44 | 3.40 |
| 30 | 3.30 | 3.94 | | 5.26 | 5.35 | 4.42 | 4.30 | 3.48 | 3.42 | 3.40 |
| 31 | 3.30 | | | 5.12 | | 4.32 | | 3.46 | 3.34 | |

### ST. CROIX RIVER AT SWISS, WIS.

LOCATION.—In sec. 33, T. 42 N., R. 15 W., at highway bridge near Swiss, Burnett County, 2 miles above point where St. Croix River becomes boundary line between Wisconsin and Minnesota, and 10 miles northeast of Danbury on Minneapolis, St. Paul & Sault Ste. Marie Railway. Namakagon River enters 3½ miles above station.

DRAINAGE AREA.—1,550 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—March 20, 1914, to September 30, 1923.

GAGE.—Chain gage attached to downstream side of bridge on May 16, 1918; read by Capt. Richard Goldschmidt. Prior to that date a cast iron staff gage bolted to concrete pier at left end of bridge was used. Both gages at same datum.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of gravel, smooth. Aquatic plants during summer may cause a small amount of backwater. Left bank high and not subject to overflow; right bank of medium height and may be overflowed during extremely high water.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded, 3.40 feet at 6 p. m. April 23 and 7.40 a. m. April 24 (discharge, 3,280 second-feet); minimum discharge, estimated 610 second-feet February 21–23.

1914–1923: Maximum stage recorded, 6.73 feet at 6.45 a. m. April 22, 1916 (discharge, 8,480 second-feet). Minimum discharge that of February 21–23, 1923.

ACCURACY.—Stage-discharge relation permanent during year except as affected by growth of grass in channel and by ice. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except as shown in footnote to table of daily discharge. Record fair.

*Discharge measurements of St. Croix River at Swiss, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Dec. 14 | E. E. Foster | [a] 1.72 | 752 | July 14 | E. E. Foster | [b] 1.67 | 1,320 |
| Jan. 13 | do | [a] 1.79 | 777 | Aug. 30 | S. B. Soulé | [b] .64 | 723 |

[a] Stage-discharge relation affected by ice. [b] Stage-discharge relation affected by aquatic growth.

*Daily discharge, in second-feet, of St. Croix River at Swiss, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 780 | 780 | 975 | 820 | 955 | 870 | 970 | 2,130 | 905 | 1,860 | 870 | 725 |
| 2 | 750 | 870 | 1,010 | 790 | 940 | 915 | 940 | 2,130 | 870 | 1,770 | 870 | 750 |
| 3 | 750 | 870 | 1,010 | 775 | 925 | 960 | 1,000 | 2,130 | 870 | 1,680 | 840 | 750 |
| 4 | 750 | 870 | 1,010 | 755 | 910 | 1,020 | 1,070 | 2,040 | 905 | 1,540 | 810 | 750 |
| 5 | 750 | 870 | 1,010 | 740 | 900 | 1,090 | 1,200 | 1,950 | 975 | 1,460 | 780 | 725 |
| 6 | 750 | 905 | 925 | 730 | 840 | 1,100 | 1,330 | 1,950 | 1,010 | 1,410 | 780 | 750 |
| 7 | 750 | 905 | 875 | 735 | 775 | 1,110 | 1,400 | 1,860 | 1,050 | 1,410 | 750 | 750 |
| 8 | 750 | 905 | 845 | 735 | 735 | 1,150 | 1,460 | 1,860 | 1,010 | 1,330 | 725 | 810 |
| 9 | 750 | 905 | 865 | 740 | 690 | 1,190 | 1,620 | 1,860 | 975 | 1,330 | 725 | 810 |
| 10 | 750 | 870 | 900 | 750 | 680 | 1,150 | 1,790 | 1,820 | 940 | 1,860 | 750 | 840 |
| 11 | 750 | 870 | 905 | 760 | 675 | 1,110 | 1,970 | 1,720 | 870 | 1,860 | 750 | 810 |
| 12 | 750 | 870 | 890 | 770 | 675 | 1,110 | 2,150 | 1,680 | 905 | 1,680 | 725 | 780 |
| 13 | 750 | 870 | 865 | 775 | 675 | 1,110 | 2,450 | 1,640 | 870 | 1,540 | 725 | 780 |
| 14 | 750 | 940 | 865 | 770 | 670 | 1,120 | 2,750 | 1,590 | 840 | 1,330 | 725 | 750 |
| 15 | 750 | 940 | 810 | 790 | 660 | 1,130 | 2,870 | 1,540 | 810 | 1,210 | 725 | 750 |
| 16 | 750 | 940 | 810 | 805 | 660 | 1,130 | 2,990 | 1,500 | 750 | 1,170 | 750 | 750 |
| 17 | 810 | 905 | 790 | 830 | 660 | 1,130 | 2,400 | 1,410 | 750 | 1,050 | 750 | 780 |
| 18 | 780 | 940 | 775 | 860 | 650 | 1,120 | 1,820 | 1,410 | 725 | 975 | 780 | 810 |
| 19 | 780 | 1,130 | 750 | 880 | 640 | 1,110 | 2,130 | 1,370 | 725 | 905 | 810 | 780 |
| 20 | 750 | 1,170 | 740 | 900 | 625 | 1,080 | 2,330 | 1,540 | 780 | 870 | 780 | 780 |
| 21 | 750 | 1,130 | 730 | 920 | 610 | 1,050 | 2,630 | 1,500 | 840 | 870 | 840 | 780 |
| 22 | 780 | 1,090 | 715 | 935 | 610 | 1,030 | 2,950 | 1,460 | 940 | 870 | 840 | 750 |
| 23 | 780 | 1,010 | 710 | 945 | 610 | 1,010 | 3,280 | 1,410 | 1,010 | 1,130 | 840 | 725 |
| 24 | 780 | 940 | 720 | 955 | 625 | 980 | 3,280 | 1,330 | 1,410 | 1,250 | 810 | 725 |
| 25 | 780 | 870 | 735 | 960 | 640 | 955 | 3,060 | 1,290 | 2,330 | 1,210 | 810 | 725 |
| 26 | 750 | 870 | 745 | 970 | 665 | 950 | 2,950 | 1,210 | 2,730 | 1,170 | 780 | 725 |
| 27 | 750 | 905 | 755 | 960 | 690 | 940 | 2,950 | 1,170 | 2,430 | 1,090 | 750 | 700 |
| 28 | 750 | 940 | 785 | 955 | 780 | 940 | 2,840 | 1,090 | 2,130 | 1,010 | 750 | 700 |
| 29 | 750 | 940 | 820 | 950 | ------- | 935 | 2,530 | 1,050 | 2,040 | 940 | 750 | 700 |
| 30 | 750 | 940 | 850 | 940 | ------- | 965 | 2,230 | 1,010 | 1,950 | 905 | 750 | 675 |
| 31 | 750 | ------- | 840 | 950 | ------- | 995 | ------- | 975 | ------- | 870 | 725 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 4 to Apr. 17; daily discharge computed from gage heights corrected for ice effect by means of two discharge measurements, observer's notes and weather records. Stage-discharge relation affected by aquatic growth June 1 to Sept. 30; gage heights corrected for backwater on basis of two discharge measurements.

*Monthly discharge of St. Croix River at Swiss, Wis., for the year ending September 30, 1923*

[Drainage area, 1,550 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 810 | 750 | 759 | 0.490 | 0.56 |
| November | 1,170 | 780 | 932 | .601 | .67 |
| December | 1,010 | 710 | 840 | .542 | .62 |
| January | 970 | 730 | 844 | .545 | .63 |
| February | 955 | 610 | 720 | .465 | .48 |
| March | 1,190 | 870 | 1,050 | .677 | .78 |
| April | 3,280 | 940 | 2,180 | 1.41 | 1.57 |
| May | 2,130 | 975 | 1,570 | 1.01 | 1.16 |
| June | 2,730 | 725 | 1,180 | .761 | .85 |
| July | 1,860 | 870 | 1,280 | .826 | .95 |
| August | 870 | 725 | 776 | .501 | .58 |
| September | 840 | 675 | 754 | .486 | .54 |
| The year | 3,280 | 610 | 1,070 | .690 | 9.39 |

### ST. CROIX RIVER NEAR ST. CROIX FALLS, WIS.

LOCATION.—In sec. 18, T. 34 N., R. 18 W., at power plant of Minneapolis General Electric Co., on Wisconsin side of St. Croix River near St. Croix Falls, Polk County, 50 miles above mouth of river. Apple River, draining an area wholly in Wisconsin, enters 20 miles below station; Snake River, draining an area in Minnesota, enters 35 miles above station.

DRAINAGE AREA.—5,930 square miles.

RECORDS AVAILABLE.—January 1, 1910, to September 30, 1923. Data for 1903 published in Water-Supply Paper 98, pages 176–177, under St. Croix River near Taylors Falls, Minn. Daily and monthly discharge January 10, 1902, to June 30, 1905, and monthly estimates July, 1905, to December, 1909, published in the "Report of water resources investigations of Minnesota, 1909–1912" by the Minnesota State Drainage Commission.

DISCHARGE.—Daily discharge computed from kilowatt output of dynamo and exciters plus flow over dam and spillway, considered as a weir.

EXTREMES OF DISCHARGE.—Maximum mean daily discharge recorded during year, 8,880 second-feet April 28; minimum mean daily discharge recorded, 1,080 second-feet November 5.

1902–1923: Maximum discharge recorded, 35,800 second-feet March 26, 1920; minimum discharge, 75 second-feet July 17, 1910 (caused by regulation).

REGULATION.—Low-water flow controlled by operation of gates of power plant and by storage and release of water at Never's dam several miles upstream.

ACCURACY.—Records probably reliable; they have not been checked, nor have discharge measurements been made by engineers of United States Geological Survey.

COOPERATION.—Records furnished by Minneapolis General Electric Co.

*Daily discharge, in second-feet, of St. Croix River near St. Croix Falls, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,540 | 2,200 | 2,090 | 1,320 | 1,480 | 1,820 | 1,680 | 5,640 | 2,380 | 3,580 | 2,600 | 1,600 |
| 2 | 1,900 | 1,840 | 2,020 | 2,310 | 1,640 | 2,240 | 1,880 | 6,040 | 1,920 | 3,570 | 2,020 | 1,420 |
| 3 | 1,620 | 2,960 | 1,740 | 2,180 | 1,540 | 1,440 | 1,600 | 6,500 | 2,080 | 4,030 | 2,100 | 1,420 |
| 4 | 1,810 | 1,940 | 1,930 | 1,600 | 1,680 | 1,780 | 2,080 | 5,260 | 2,560 | 4,420 | 2,180 | 1,950 |
| 5 | 1,260 | 1,080 | 2,060 | 1,680 | 1,580 | 1,600 | 2,160 | 6,360 | 2,720 | 3,760 | 2,080 | 1,720 |
| 6 | 2,080 | 2,000 | 2,060 | 1,690 | 1,820 | 2,320 | 2,900 | 8,520 | 2,860 | 3,820 | 2,160 | 1,590 |
| 7 | 1,240 | 1,970 | 1,760 | 1,560 | 1,740 | 1,920 | 2,460 | 7,240 | 2,420 | 3,860 | 1,960 | 1,740 |
| 8 | 1,600 | 2,020 | 1,560 | 2,000 | 1,640 | 2,080 | 1,620 | 5,800 | 1,720 | 3,160 | 1,840 | 1,560 |
| 9 | 1,540 | 1,220 | 1,520 | 1,860 | 1,240 | 2,200 | 2,520 | 5,400 | 1,760 | 3,780 | 1,700 | 1,700 |
| 10 | 1,770 | 1,380 | 1,450 | 1,880 | 1,680 | 1,880 | 2,680 | 4,800 | 1,800 | 3,960 | 2,020 | 1,680 |
| 11 | 1,860 | 2,470 | 1,630 | 1,520 | 1,520 | 2,600 | 2,320 | 4,900 | 2,480 | 5,540 | 1,720 | 1,820 |
| 12 | 1,260 | 1,240 | 1,300 | 1,580 | 1,480 | 1,860 | 3,760 | 4,820 | 2,420 | 5,200 | 1,600 | 1,740 |
| 13 | 1,420 | 1,820 | 1,600 | 1,770 | 1,960 | 2,120 | 3,640 | 4,400 | 2,220 | 5,140 | 1,700 | 1,520 |
| 14 | 1,280 | 2,160 | 1,700 | 1,740 | 1,480 | 2,070 | 4,800 | 4,860 | 2,120 | 4,620 | 1,900 | 1,720 |
| 15 | 1,460 | 1,880 | 1,680 | 1,420 | 1,530 | 1,900 | 4,350 | 4,220 | 2,200 | 3,500 | 1,800 | 1,640 |
| 16 | 1,810 | 1,550 | 1,560 | 1,730 | 1,500 | 1,920 | 5,200 | 4,620 | 1,660 | 4,700 | 1,480 | 1,520 |
| 17 | 1,680 | 2,260 | 1,800 | 1,920 | 1,400 | 2,160 | 5,800 | 4,440 | 1,940 | 4,160 | 1,440 | 1,840 |
| 18 | 1,620 | 2,330 | 1,720 | 1,740 | 1,940 | 1,900 | 6,060 | 3,460 | 1,800 | 3,500 | 1,330 | 1,480 |
| 19 | 1,740 | 1,640 | 1,700 | 2,060 | 1,340 | 2,040 | 5,420 | 3,960 | 1,990 | 3,380 | 1,700 | 1,620 |
| 20 | 1,640 | 2,120 | 1,580 | 1,340 | 1,620 | 1,860 | 6,320 | 2,980 | 1,580 | 2,980 | 2,020 | 1,460 |
| 21 | 1,360 | 2,080 | 1,670 | 1,500 | 1,420 | 1,740 | 6,240 | 3,820 | 1,920 | 2,520 | 1,300 | 1,700 |
| 22 | 1,560 | 2,560 | 1,660 | 1,200 | 1,200 | 1,330 | 5,080 | 5,320 | 2,040 | 2,340 | 1,680 | 1,740 |
| 23 | 1,760 | 2,670 | 1,820 | 2,020 | 1,540 | 1,980 | 5,980 | 4,940 | 2,140 | 2,820 | 1,400 | 1,400 |
| 24 | 2,240 | 2,620 | 1,640 | 1,680 | 1,500 | 1,480 | 6,620 | 4,840 | 1,700 | 2,480 | 1,600 | 1,420 |
| 25 | 1,760 | 1,460 | 1,720 | 1,960 | 1,820 | 1,640 | 6,940 | 4,800 | 3,020 | 3,060 | 1,500 | 1,700 |
| 26 | 1,560 | 3,300 | 1,820 | 1,540 | 1,980 | 1,920 | 7,280 | 4,780 | 3,100 | 2,840 | 1,820 | 1,460 |
| 27 | 1,620 | 1,940 | 2,180 | 1,440 | 1,860 | 2,280 | 7,860 | 4,300 | 4,700 | 2,940 | 1,600 | 1,840 |
| 28 | 1,240 | 1,530 | 1,990 | 1,510 | 1,760 | 1,600 | 8,880 | 4,680 | 5,000 | 2,300 | 1,560 | 1,760 |
| 29 | 1,460 | 1,940 | 2,050 | 1,520 | ------- | 1,440 | 6,600 | 4,200 | 5,580 | 2,300 | 1,540 | 1,660 |
| 30 | 1,840 | 1,320 | 1,820 | 2,120 | ------- | 1,590 | 6,330 | 2,780 | 4,900 | 2,640 | 1,760 | 1,900 |
| 31 | 2,070 | ------- | 1,360 | 1,300 | ------- | 1,760 | ------- | 2,960 | ------- | 2,280 | 1,660 | ------- |

*Monthly discharge of St. Croix River near St. Croix Falls, Wis., for the year ending September 30, 1923*

[Drainage area, 5,930 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 2,240 | 1,240 | 1,630 | 0.275 | 0.32 |
| November | 3,300 | 1,080 | 1,980 | .334 | .37 |
| December | 2,180 | 1,300 | 1,750 | .295 | .34 |
| January | 2,310 | 1,300 | 1,710 | .288 | .33 |
| February | 1,980 | 1,200 | 1,600 | .270 | .28 |
| March | 2,600 | 1,440 | 1,900 | .320 | .37 |
| April | 8,880 | 1,600 | 4,570 | .771 | .86 |
| May | 8,520 | 2,780 | 4,890 | .825 | .95 |
| June | 5,580 | 1,580 | 2,560 | .432 | .48 |
| July | 5,540 | 2,280 | 3,520 | .594 | .68 |
| August | 2,600 | 1,300 | 1,770 | .298 | .34 |
| September | 1,950 | 1,400 | 1,640 | .277 | .31 |
| The year | 8,880 | 1,080 | 2,470 | .417 | 5.63 |

NOTE.—Monthly and yearly discharge computed by engineers of U. S. Geological Survey.

### NAMAKAGON RIVER AT TREGO, WIS.

LOCATION.—In sec. 35, T. 40 N., R. 12 W., at Chicago & Northwestern Railway bridge at Trego, Washburn County, 20 miles above confluence of Namakagon and Totogatic Rivers.

DRAINAGE AREA.—420 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—March 11, 1914, to September 30, 1923.

GAGE.—Staff gage fastened to retaining wall on left bank of river just above railroad bridge; read by Patrick Lawton.

DISCHARGE MEASUREMENTS.—Made from lower chords of railroad bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel. Banks medium high and not subject to overflow. Small island downstream with rapids on either side forms control; fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.6 feet April 22–24 (discharge, 1,040 second-feet); minimum discharge, estimated, 245 second-feet March 29.

1914–1923: Maximum stage recorded, 3.60 feet April 11, 1922 (discharge, 1,810 second-feet); minimum discharge, estimated, 235 second-feet December 19, 1916.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation permanent except as affected by ice and by aquatic growth. Rating curve well defined between 350 and 1,200 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except as shown in footnote to table of daily discharge. Open-water records good; winter records fair.

*Discharge measurements of Namakagon River at Trego, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Dec. 14 | Soulé and Foster | [a] 2.64 | 274 | July 13 | E. E. Foster | [b] 1.87 | 453 |
| Jan. 9 | E. E. Foster | [a] 2.34 | 323 | 14 | do | [b] 1.84 | 441 |
| Feb. 14 | do | [a] 2.44 | 259 | Aug. 31 | S. B. Soulé | [b] 1.56 | 325 |

[a] Stage-discharge relation affected by ice. [b] Stage-discharge relation affected by aquatic growth.

*Daily discharge, in second-feet, of Namakagon River at Trego, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 369 | 350 | 393 | 260 | 300 | 300 | 280 | 597 | 369 | 472 | 369 | 332 |
| 2 | 350 | 369 | 417 | 255 | 290 | 295 | 260 | 664 | 350 | 502 | 350 | 350 |
| 3 | 350 | 369 | 472 | 260 | 280 | 290 | 280 | 664 | 393 | 502 | 332 | 350 |
| 4 | 350 | 369 | 417 | 270 | 280 | 285 | 500 | 664 | 393 | 472 | 332 | 350 |
| 5 | 350 | 369 | 255 | 275 | 280 | 280 | 393 | 630 | 393 | 444 | 332 | 350 |
| 6 | 350 | 369 | 415 | 280 | 270 | 280 | 417 | 597 | 369 | 417 | 320 | 332 |
| 7 | 350 | 369 | 300 | 290 | 260 | 280 | 444 | 630 | 393 | 417 | 332 | 332 |
| 8 | 350 | 369 | 310 | 300 | 265 | 275 | 369 | 630 | 369 | 417 | 320 | 332 |
| 9 | 350 | 369 | 300 | 300 | 270 | 270 | 417 | 664 | 369 | 393 | 320 | 332 |
| 10 | 350 | 369 | 280 | 300 | 260 | 270 | 444 | 630 | 350 | 630 | 332 | 332 |
| 11 | 350 | 369 | 280 | 300 | 255 | 270 | 472 | 597 | 350 | 597 | 332 | 332 |
| 12 | 350 | 393 | 260 | 300 | 255 | 265 | 502 | 564 | 350 | 532 | 332 | 320 |
| 13 | 350 | 369 | 255 | 310 | 255 | 260 | 597 | 564 | 350 | 472 | 320 | 320 |
| 14 | 350 | 393 | 280 | 320 | 255 | 260 | 630 | 532 | 332 | 444 | 320 | 320 |
| 15 | 350 | 369 | 290 | 320 | 255 | 255 | 597 | 564 | 332 | 444 | 320 | 320 |
| 16 | 350 | 369 | 290 | 320 | 255 | 250 | 564 | 532 | 320 | 417 | 320 | 320 |
| 17 | 350 | 369 | 275 | 315 | 255 | 250 | 564 | 532 | 320 | 417 | 320 | 332 |
| 18 | 369 | 393 | 260 | 310 | 255 | 250 | 630 | 502 | 320 | 369 | 332 | 350 |
| 19 | 350 | 472 | 255 | 305 | 255 | 255 | 733 | 502 | 308 | 350 | 332 | 332 |
| 20 | 350 | 444 | 250 | 300 | 260 | 255 | 803 | 532 | 332 | 332 | 320 | 332 |
| 21 | 350 | 444 | 250 | 300 | 260 | 255 | 873 | 532 | 332 | 332 | 369 | 332 |
| 22 | 350 | 417 | 250 | 300 | 265 | 260 | 1,020 | 532 | 369 | 332 | 350 | 320 |
| 23 | 350 | 417 | 255 | 295 | 270 | 270 | 1,020 | 502 | 393 | 393 | 332 | 320 |
| 24 | 350 | 417 | 260 | 290 | 270 | 260 | 1,020 | 472 | 417 | 444 | 332 | 320 |
| 25 | 350 | 369 | 260 | 290 | 270 | 255 | 944 | 472 | 532 | 393 | 320 | 320 |
| 26 | 350 | 369 | 255 | 290 | 280 | 250 | 838 | 444 | 768 | 369 | 320 | 320 |
| 27 | 350 | 417 | 260 | 295 | 290 | 250 | 768 | 444 | 733 | 369 | 320 | 320 |
| 28 | 332 | 417 | 260 | 300 | 295 | 250 | 733 | 417 | 698 | 369 | 332 | 320 |
| 29 | 332 | 393 | 260 | 300 | ------- | 245 | 664 | 417 | 664 | 350 | 320 | 320 |
| 30 | 350 | 393 | 260 | 300 | ------- | 270 | 630 | 417 | 564 | 332 | 320 | 332 |
| 31 | 332 | ------- | 270 | 300 | ------- | 300 | ------- | 393 | ------- | 369 | 320 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 6 to Mar. 4; daily discharge determined from gage heights corrected for effect of ice by means of three discharge measurements, observer's notes, and weather records. Stage-discharge relation affected by aquatic growth June 1 to Sept. 30; daily discharge determined from gage heights corrected on basis of three discharge measurements.

*Monthly discharge of Namakagon River at Trego, Wis., for the year ending September 30, 1923*

[Drainage area, 420 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 369 | 332 | 349 | 0.831 | 0.96 |
| November | 472 | 350 | 389 | .926 | 1.03 |
| December | 472 | 250 | 293 | .698 | .80 |
| January | 320 | 255 | 295 | .702 | .81 |
| February | 300 | 255 | 268 | .638 | .66 |
| March | 300 | 245 | 266 | .633 | .73 |
| April | 1,020 | 260 | 614 | 1.46 | 1.63 |
| May | 664 | 393 | 543 | 1.29 | 1.49 |
| June | 768 | 308 | 418 | .995 | 1.11 |
| July | 630 | 332 | 422 | 1.00 | 1.15 |
| August | 369 | 320 | 330 | .786 | .91 |
| September | 350 | 320 | 330 | .786 | .88 |
| The year | 1,020 | 245 | 377 | .898 | 12.16 |

APPLE RIVER NEAR SOMERSET, WIS.

LOCATION.—In sec. 21, T. 31 N., R. 19 W., at power plant of St. Croix Power Co., 3½ miles below Somerset, St. Croix County, and 2 miles above mouth of river.

DRAINAGE AREA.—550 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch= 6 miles).

RECORDS AVAILABLE.—January, 1901, to September 30, 1923.

DISCHARGE.—Daily discharge of the turbines computed from hourly observations of the number of wheels in operation and the kilowatt output. To this quantity is added the leakage through the average number of wheels idle each day, the sum giving the daily flow through the power house. Water is seldom wasted over the spillway of the dam, but when it is so wasted the quantity is computed from weir formulae and added to the flow through the plant. There is a constant leakage through the gate and flashboards amounting to 3 second-feet. This quantity has not been taken into consideration in computing the published records.

EXTREMES OF DISCHARGE.—Maximum mean daily discharge recorded during year, 1,060 second-feet April 14; minimum mean daily discharge recorded, 72 second-feet September 11.

1904–1923: Maximum mean daily discharge recorded, 2,280 second-feet in June, 1905; minimum mean daily discharge, 20 second-feet June 26, 1921. Owing to regulation the minimum discharge has no bearing on the natural minimum flow. No maximum and minimum records are available for 1901–1903.

REGULATION.—There are a number of power plants on Apple River above station. The pondage of these plants is small, and though the daily flow may be controlled to some extent, the mean monthly flow probably corresponds closely to the natural flow.

ACCURACY.—From 1901 to 1909 the discharge through the plant was determined from tables computed from data collected at tests on one of the turbines made at the flume of the Holyoke Water Power Co., Holyoke, Mass. In the summer of 1909 engineers of the St. Croix Power Co. made tests on the water flowing through all the wheels as actually installed by means of a sharp-crested weir 710 inches long located 60 feet below power house. These tests gave results about 3 per cent larger than the Holyoke tests, and tables based on them have been used in determining the discharge through the plant from 1909 to September, 1920. In May, 1914, a series of current-meter measurements were made by Wisconsin Railroad Commission and United States Geological Survey, and a rating curve for the tailrace was developed. Twelve tests were then run with different wheels and loads. It was found that the discharge as determined by the current meter and the discharge as computed by the company agreed very closely, the percentage difference for the twelve tests ranging from −6.4 per cent to +1.8 per cent with an average of −2.0 per cent; the discharge as determined by the company being 2 per cent less than that determined by the current meter. During 1919 three current meter measurements were made to check the accuracy of the published records. These measurements showed that the power-plant records were about 5 per cent less than the measured discharge, due probably to increased leakage through the wheels. The records, as published for 1919 and 1920, are the power-plant records increased by 5 per cent. In September, 1920, another series of tests were made by the power company by means of a sharp-crested weir, from which the tables used in computing the flow through the power house were corrected. The records, as published for 1921 to 1923 inclusive, are the power-plant records as furnished by the company without change.

COOPERATION.—Records furnished by the St. Paul Gas Light Co. of St. Paul, Minn., D. W. Flowers, engineer.

No discharge measurements were made at this station during the year.

*Daily discharge, in second-feet, of Apple River near Somerset, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 90 | 217 | 298 | 196 | 203 | 207 | 239 | 384 | 260 | 196 | 207 | 185 |
| 2 | 216 | 212 | 263 | 238 | 195 | 301 | 255 | 408 | 281 | 240 | 141 | 194 |
| 3 | 210 | 208 | 183 | 228 | 251 | 296 | 237 | 469 | 206 | 212 | 138 | 150 |
| 4 | 215 | 219 | 242 | 227 | 174 | 205 | 248 | 612 | 262 | 239 | 145 | 168 |
| 5 | 221 | 217 | 176 | 184 | 206 | 202 | 433 | 548 | 297 | 227 | 141 | 178 |
| 6 | 227 | 190 | 159 | 214 | 233 | 222 | 496 | 431 | 222 | 213 | 163 | 236 |
| 7 | 343 | 253 | 218 | 195 | 229 | 234 | 493 | 515 | 252 | 217 | 150 | 271 |
| 8 | 105 | 204 | 197 | 234 | 189 | 239 | 613 | 505 | 235 | 200 | 159 | 140 |
| 9 | 270 | 208 | 257 | 230 | 243 | 245 | 461 | 498 | 225 | 217 | 150 | 129 |
| 10 | 235 | 266 | 187 | 225 | 217 | 245 | 464 | 446 | 201 | 225 | 166 | 258 |
| 11 | 209 | 361 | 254 | 234 | 210 | 224 | 542 | 408 | 250 | 216 | 179 | 72 |
| 12 | 206 | 299 | 176 | 229 | 210 | 273 | 521 | 279 | 175 | 200 | 162 | 155 |
| 13 | 196 | 206 | 198 | 222 | 216 | 250 | 852 | 340 | 196 | 211 | 209 | 174 |
| 14 | 212 | 214 | 256 | 224 | 190 | 228 | 1,060 | 444 | 227 | 241 | 218 | 158 |
| 15 | 212 | 217 | 223 | 200 | 195 | 264 | 825 | 360 | 184 | 130 | 159 | 173 |
| 16 | 187 | 232 | 233 | 219 | 187 | 251 | 855 | 384 | 183 | 154 | 157 | 137 |
| 17 | 246 | 228 | 192 | 237 | 213 | 200 | 816 | 308 | 169 | 209 | 124 | 173 |
| 18 | 236 | 337 | 209 | 204 | 314 | 204 | 696 | 275 | 236 | 137 | 197 | 153 |
| 19 | 225 | 478 | 161 | 218 | 198 | 263 | 692 | 409 | 281 | 151 | 166 | 162 |
| 20 | 223 | 270 | 238 | 224 | 211 | 317 | 603 | 326 | 232 | 172 | 112 | 194 |
| 21 | 309 | 240 | 205 | 171 | 208 | 325 | 569 | 511 | 240 | 163 | 186 | 177 |
| 22 | 101 | 228 | 195 | 237 | 210 | 292 | 677 | 355 | 219 | 139 | 159 | 213 |
| 23 | 216 | 243 | 249 | 226 | 160 | 265 | 653 | 369 | 294 | 132 | 126 | 150 |
| 24 | 227 | 238 | 203 | 222 | 198 | 267 | 579 | 354 | 230 | 171 | 158 | 179 |
| 25 | 200 | 292 | 202 | 246 | 171 | 259 | 509 | 264 | 438 | 201 | 180 | 194 |
| 26 | 204 | 155 | 215 | 183 | 183 | 235 | 508 | 367 | 355 | 153 | 147 | 187 |
| 27 | 208 | 221 | 233 | 253 | 226 | 233 | 533 | 239 | 414 | 168 | 94 | 186 |
| 28 | 213 | 235 | 245 | 210 | 205 | 216 | 523 | 336 | 316 | 164 | 178 | 187 |
| 29 | 188 | 219 | 232 | 216 | ------- | 227 | 446 | 260 | 311 | 178 | 174 | 233 |
| 30 | 197 | 236 | 233 | 249 | ------- | 217 | 448 | 166 | 307 | 124 | 184 | 128 |
| 31 | 223 | ------- | 188 | 215 | ------- | 222 | ------- | 275 | ------- | 136 | 137 | ------- |

NOTE.—See paragraph on "Discharge" in station description for method by which these records are obtained.

*Monthly discharge of Apple River near Somerset, Wis., for the year ending September 30, 1923*

[Drainage area, 550 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 343 | 90 | 212 | 0.385 | 0.44 |
| November | 478 | 155 | 245 | .445 | .50 |
| December | 298 | 159 | 217 | .395 | .46 |
| January | 253 | 171 | 220 | .400 | .46 |
| February | 314 | 160 | 209 | .380 | .40 |
| March | 325 | 200 | 246 | .447 | .52 |
| April | 1,060 | 237 | 562 | 1.02 | 1.14 |
| May | 612 | 166 | 382 | .695 | .80 |
| June | 438 | 169 | 257 | .467 | .52 |
| July | 241 | 124 | 185 | .336 | .39 |
| August | 218 | 94 | 160 | .291 | .34 |
| September | 271 | 72 | 176 | .320 | .36 |
| The year | 1,060 | 72 | 256 | .465 | 6.33 |

### CHIPPEWA RIVER AT BISHOP'S BRIDGE, NEAR WINTER, WIS.

LOCATION.—In sec. 23, T. 39 N., R. 6 W., at highway bridge, 3 miles downstream from mouth of East Fork of Chippewa River, and 4 miles by road northwest of Winter, Sawyer County.

DRAINAGE AREA.—775 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch= 6 miles).

RECORDS AVAILABLE.—February 23, 1912, to September 30, 1923.

GAGE.—Chain gage fastened to bridge used since May 28, 1916; read by John Edberg and William Negaard. Gages previously used as follows: February 23, 1912, to January 27, 1914, a wooden staff gage fastened to a wooden pier on the right bank just above bridge; datum 3.44 feet above that of chain gage. January 27, 1914, to May 28, 1916, a vertical cast iron staff gage fastened to the same pier; datum same as for chain gage.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge.

CHANNEL AND CONTROL.—Bed composed of gravel, free from vegetation; shifts occasionally. Control is head of rapids 1,000 feet below gage. One channel at all stages. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.75 feet at 6.30 p. m. August 15 (discharge, 3,750 second-feet); minimum stage recorded, 3.28 feet at 4 p. m. May 17 (discharge, 17 second-feet). Both maximum and minimum stages are the result of regulation and have no bearing on the natural flow.

1912–1923: Maximum stage recorded, 9.56 feet April 22, 1916 (discharge 6,940 second-feet); minimum stage recorded that of May 17, 1923.

REGULATION.—In April, 1923, the Chippewa Reservoir owned by the Wisconsin-Minnesota Light & Power Co. was put into operation. This reservoir is just below the confluence of the East and West Forks of Chippewa River 3 miles above station, and has a capacity of 10 billion cubic feet. Operation of this reservoir regulates the entire flow of the stream at the station in the interest of power developments below. There is also a reservoir 16 miles above station that has a capacity of 550 million cubic feet.

ACCURACY.—Stage-discharge relation permanent during year except as affected by ice. Rating curve well defined below 7,000 second-feet. Gage read to hundredths twice daily. Daily discharge for open-water periods ascertained by applying mean daily gage height to rating table. Open-water records good; winter records fair.

*Discharge measurements of Chippewa River at Bishop's Bridge, near Winter, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 21 | G. R. Schneider | 4.31 | 255 | Feb. 11 | G. R. Schneider | [a] 5.41 | 177 |
| 24 | do | 4.34 | 272 | 26 | do | [a] 5.46 | 191 |
| Nov. 26 | do | [a] 5.14 | 589 | Mar. 9 | do | [a] 5.51 | 213 |
| Dec. 15 | S. B. Soulé | [a] 5.93 | 278 | July 12 | E. E. Foster | 3.54 | 40 |
| Jan. 13 | G. R. Schneider | [a] 5.42 | 206 | Aug. 31 | S. B. Soulé | 4.77 | 458 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Chippewa River at Bishop's Bridge, near Winter, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 352 | 274 | 352 | 210 | 225 | 210 | 95 | 18 | 22 | 57 | 915 | 445 |
| 2 | 290 | 290 | 580 | 210 | 240 | 215 | 90 | 27 | 22 | 73 | 915 | 445 |
| 3 | 290 | 290 | 495 | 210 | 225 | 230 | 80 | 28 | 22 | 53 | 915 | 445 |
| 4 | 290 | 290 | 470 | 210 | 210 | 250 | 175 | 26 | 22 | 55 | 915 | 445 |
| 5 | 278 | 290 | 310 | 210 | 200 | 250 | 270 | 25 | 25 | 55 | 915 | 445 |
| 6 | 274 | 310 | 455 | 210 | 195 | 250 | 180 | 25 | 22 | 55 | 915 | 470 |
| 7 | 270 | 310 | 480 | 210 | 200 | 240 | 95 | 24 | 24 | 29 | 915 | 445 |
| 8 | 270 | 290 | 430 | 210 | 210 | 230 | 95 | 24 | 24 | 39 | 915 | 445 |
| 9 | 266 | 282 | 405 | 210 | 200 | 215 | 95 | 25 | 22 | 63 | 915 | 445 |
| 10 | 262 | 330 | 360 | 210 | 195 | 200 | 95 | 25 | 22 | 55 | 915 | 398 |
| 11 | 270 | 352 | 360 | 210 | 175 | 115 | 95 | 24 | 24 | 59 | 915 | 750 |
| 12 | 258 | 375 | 305 | 210 | 195 | 30 | 120 | 22 | 25 | 57 | 915 | 198 |
| 13 | 254 | 375 | 295 | 210 | 195 | 130 | 150 | 22 | 27 | 40 | 830 | 198 |
| 14 | 254 | 398 | 285 | 210 | 195 | 230 | 190 | 22 | 29 | 59 | 830 | 198 |
| 15 | 250 | 398 | 280 | 220 | 195 | 120 | 230 | 21 | 29 | 32 | 1,390 | 198 |
| 16 | 258 | 398 | 320 | 225 | 195 | 20 | 290 | 21 | 28 | 32 | 798 | 198 |
| 17 | 258 | 398 | 320 | 220 | 175 | 20 | 350 | 19 | 29 | 34 | 375 | 675 |
| 18 | 254 | 420 | 320 | 210 | 155 | 25 | 570 | 22 | 28 | 33 | 375 | 675 |
| 19 | 250 | 520 | 300 | 215 | 175 | 30 | 790 | 24 | 29 | 32 | 375 | 675 |
| 20 | 250 | 495 | 285 | 225 | 195 | 30 | 550 | 45 | 29 | 30 | 420 | 675 |
| 21 | 250 | 520 | 270 | 210 | 195 | 30 | 470 | 32 | 580 | 29 | 375 | 675 |
| 22 | 270 | 550 | 255 | 200 | 195 | 35 | 97 | 27 | 34 | 32 | 375 | 675 |
| 23 | 270 | 580 | 255 | 195 | 190 | 40 | 73 | 24 | 29 | 59 | 375 | 675 |
| 24 | 266 | 520 | 255 | 200 | 180 | 50 | 57 | 22 | 32 | 32 | 398 | 675 |
| 25 | 274 | 530 | 240 | 210 | 185 | 60 | 42 | 24 | 104 | 39 | 520 | 675 |
| 26 | 274 | 590 | 225 | 200 | 190 | 70 | 50 | 23 | 50 | 36 | 470 | 675 |
| 27 | 274 | 495 | 215 | 195 | 200 | 70 | 42 | 22 | 46 | 431 | 470 | 675 |
| 28 | 266 | 470 | 210 | 210 | 210 | 65 | 42 | 23 | 39 | 544 | 470 | 675 |
| 29 | 274 | 445 | 210 | 225 | ------- | 60 | 34 | 1 | 36 | 38 | 495 | 675 |
| 30 | 270 | 445 | 210 | 220 | ------- | 55 | 26 | 22 | 33 | 330 | 445 | 675 |
| 31 | 266 | ------- | 210 | 210 | ------- | 50 | ------- | 22 | ------- | 915 | 445 | ------- |

NOTE.—Stage-discharge relation affected by ice Nov. 25, 26, and Dec. 6 to Apr. 19; daily discharge ascertained from gage heights corrected for effect of ice by means of six discharge measurements, observer's notes, and weather records.

*Monthly discharge of Chippewa River at Bishop's Bridge, near Winter, Wis., for the year ending September 30, 1923*

[Drainage area, 775 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 352 | 250 | 269 | 0.347 | 0.40 |
| November | 590 | 274 | 408 | .526 | .59 |
| December | 580 | 210 | 321 | .414 | .48 |
| January | 225 | 195 | 211 | .272 | .31 |
| February | 240 | 155 | 196 | .253 | .26 |
| March | 250 | 20 | 117 | .151 | .17 |
| April | 790 | 26 | 185 | .239 | .27 |
| May | 45 | 18 | 24.2 | .0312 | .04 |
| June | 580 | 22 | 49.6 | .0640 | .07 |
| July | 915 | 29 | 111 | .143 | .16 |
| August | 1,390 | 375 | 684 | .883 | 1.02 |
| September | 675 | 198 | 521 | .672 | .75 |
| The year | 1,390 | 18 | 258 | .333 | 4.52 |

### CHIPPEWA RIVER NEAR BRUCE, WIS.

LOCATION.—In sec. 4, T. 35 N., R. 7 W., at Minneapolis, St. Paul & Sault Ste. Marie Railway bridge 1 mile east of Bruce, Rusk County. Thornapple River enters from left immediately above station, and Flambeau River from left 21 miles below.

DRAINAGE AREA.—1,600 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 31, 1913, to September 30, 1923.

GAGE.—Chain gage, attached to downstream side of bridge; read by M. Pavlok.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and small gravel free from vegetation; first and second channels from the west fairly permanent; third channel nearest east bank has a tendency to fill with sand carried in by Thornapple River. Flow except during extremely high stages is confined within the banks.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.8 feet at 8 a. m. April 21 (discharge, 8,780 second-feet); minimum discharge, estimated, 230 second-feet March 14.

1914–1923: Maximum stage recorded, 13.7 feet at 4.30 p. m. April 10, 1922 (discharge, 14,900 second-feet); minimum discharge, that of March 14, 1923.

REGULATION.—Flow at station is quite largely controlled by reservoirs above the gaging station at Bishop's Bridge; see page 49.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and by ice. Rating curve fairly well defined. Gage read to half-tenths once daily. Daily discharge ascertained by indirect method for shifting control except as indicated in footnote to table of daily discharge. Records fair.

*Discharge measurements of Chippewa River near Bruce, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 11 | E. E. Foster | 1.60 | 474 | Apr. 21 | E. E. Foster | 9.71 | 8,670 |
| Dec. 18 | do | [a] 2.75 | 522 | July 11 | do | 1.88 | 708 |
| Jan. 12 | do | [a] 2.67 | 507 | Sept. 1 | S. B. Soulé | 1.86 | 663 |
| Feb. 16 | do | [a] 3.06 | 405 | | | | |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Chippewa River near Bruce, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 535 | 502 | 968 | 515 | 480 | 445 | 350 | 1,100 | 382 | 642 | 1,140 | 680 |
| 2 | 535 | 570 | 800 | 515 | 480 | 480 | 350 | 1,060 | 355 | 680 | 1,140 | 680 |
| 3 | 502 | 605 | 840 | 515 | 445 | 515 | 380 | 1,060 | 355 | 720 | 1,140 | 680 |
| 4 | 502 | 570 | 865 | 515 | 410 | 515 | 410 | 1,010 | 382 | 570 | 1,140 | 642 |
| 5 | 502 | 570 | 935 | 515 | 410 | 515 | 415 | 925 | 535 | 535 | 1,140 | 605 |
| 6 | 502 | 605 | 620 | 515 | 410 | 515 | 585 | 840 | 680 | 535 | 1,140 | 605 |
| 7 | 502 | 642 | 585 | 515 | 410 | 480 | 655 | 800 | 1,280 | 470 | 1,100 | 1,010 |
| 8 | 502 | 642 | 550 | 515 | 445 | 480 | 725 | 760 | 1,370 | 410 | 1,100 | 1,190 |
| 9 | 502 | 642 | 550 | 515 | 445 | 480 | 830 | 800 | 1,140 | 382 | 1,100 | 1,190 |
| 10 | 502 | 720 | 515 | 515 | 445 | 480 | 935 | 925 | 840 | 502 | 1,100 | 1,140 |
| 11 | 502 | 925 | 480 | 515 | 445 | 480 | 970 | 925 | 642 | 760 | 1,100 | 1,100 |
| 12 | 470 | 925 | 550 | 515 | 445 | 480 | 970 | 840 | 470 | 760 | 1,100 | 1,010 |
| 13 | 470 | 882 | 550 | 515 | 410 | 380 | 1,390 | 760 | 535 | 605 | 1,100 | 882 |
| 14 | 470 | 882 | 550 | 580 | 410 | 230 | 2,030 | 680 | 470 | 502 | 720 | 882 |
| 15 | 470 | 840 | 585 | 515 | 410 | 350 | 2,700 | 605 | 410 | 440 | 1,010 | 882 |
| 16 | 470 | 800 | 620 | 550 | 410 | 515 | 3,650 | 570 | 382 | 410 | 1,660 | 882 |
| 17 | 502 | 800 | 585 | 550 | 410 | 410 | 3,870 | 535 | 355 | 382 | 1,190 | 925 |
| 18 | 502 | 882 | 550 | 515 | 410 | 445 | 5,560 | 502 | 328 | 355 | 642 | 925 |
| 19 | 502 | 1,140 | 550 | 515 | 410 | 320 | 7,300 | 470 | 300 | 328 | 605 | 925 |
| 20 | 502 | 1,370 | 550 | 515 | 410 | 320 | 7,690 | 2,320 | 355 | 300 | 605 | 882 |
| 21 | 502 | 1,240 | 480 | 480 | 380 | 320 | 8,780 | 3,420 | 382 | 275 | 642 | 840 |
| 22 | 502 | 1,140 | 480 | 480 | 380 | 320 | 7,950 | 2,520 | 382 | 275 | 605 | 840 |
| 23 | 502 | 1,060 | 515 | 480 | 380 | 350 | 7,300 | 2,220 | 410 | 410 | 605 | 840 |
| 24 | 502 | 968 | 515 | 445 | 380 | 350 | 5,310 | 1,190 | 470 | 535 | 605 | 840 |
| 25 | 502 | 720 | 515 | 445 | 380 | 350 | 3,720 | 968 | 605 | 440 | 605 | 840 |
| 26 | 502 | 760 | 515 | 445 | 410 | 350 | 2,620 | 760 | 1,280 | 382 | 680 | 840 |
| 27 | 502 | 1,010 | 515 | 410 | 410 | 350 | 2,130 | 642 | 1,840 | 355 | 720 | 840 |
| 28 | 502 | 925 | 515 | 410 | 445 | 320 | 1,750 | 535 | 1,460 | 840 | 680 | 840 |
| 29 | 502 | 925 | 515 | 445 | ------- | 320 | 1,370 | 470 | 968 | 720 | 642 | 840 |
| 30 | 470 | 925 | 515 | 480 | ------- | 320 | 1,190 | 410 | 720 | 388 | 605 | 840 |
| 31 | 470 | ------- | 515 | 445 | ------- | 350 | ------- | 382 | ------- | 642 | 642 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 4 to Apr. 18; daily discharge based on gage heights corrected for ice effect by means of three discharge measurements, observer's notes, and weather records.

*Monthly discharge of Chippewa River near Bruce, Wis., for the year ending September 30, 1923*

[Drainage area, 1,600 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 535 | 470 | 497 | 0.311 | 0.36 |
| November | 1,370 | 502 | 840 | .525 | .59 |
| December | 968 | 480 | 593 | .371 | .43 |
| January | 580 | 410 | 497 | .311 | .36 |
| February | 480 | 380 | 418 | .261 | .27 |
| March | 515 | 230 | 404 | .252 | .29 |
| April | 8,780 | 350 | 2,800 | 1.75 | 1.95 |
| May | 3,420 | 382 | 1,000 | .625 | .72 |
| June | 1,840 | 300 | 669 | .418 | .47 |
| July | 840 | 275 | 502 | .314 | .36 |
| August | 1,660 | 605 | 903 | .564 | .65 |
| September | 1,190 | 605 | 871 | .544 | .61 |
| The year | 8,780 | 230 | 831 | .519 | 7.06 |

### CHIPPEWA RIVER AT CHIPPEWA FALLS, WIS.

LOCATION.—In SE. ¼ sec. 6, T. 28 N., R. 8 W. at highway bridge at Chippewa Falls, Chippewa County, 2,500 feet below mouth of Duncan Creek coming in from right.

DRAINAGE AREA.—5,600 square miles.

RECORDS AVAILABLE.—June 22, 1888, to September 30, 1923.

GAGE.—On July 27, 1916, a Gurley graph water-stage recorder replaced a Friez water-stage recorder which was installed January, 1914, on web between caisson piers supporting first right hand span and 10 feet upstream from gage formerly used by United States Weather Bureau; gage referred to original datum.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel; fairly permanent. Banks high and are seldom overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.4 feet at 10 p. m. April 22 (discharge, 59,000 second-feet); minumum stage of about −0.22 foot at 8 p. m. August 26 (discharge, 528 second-feet).

1888–1923: Maximum stage recorded, 26.03 feet December 6, 1896; September 10, 1884, a stage of 26.94 feet was reached. The extreme high stages in 1884 and 1896 were probably caused in part by backwater from log jams and the volume of discharge was probably considerably less than the stage would indicate if the channel had been unobstructed. Exclusive of these floods, the maximum stage recorded was 17.0 feet March 27, 1920 (discharge, 78,000 second-feet); minimum discharge recorded, about 40 second-feet February 4, 1917.

ICE.—Stage-discharge relation slightly affected by ice.

REGULATION.—Flow past station controlled to a considerable extent by operation of Wissota power plant of Northern States Power Co. Large diurnal fluctuation. In April, 1923, the reservoir on Chippewa River above Bishop's Bridge was put into operation (see p. 49).

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 2,000 and 56,000 second-feet, and fairly well defined between 500 and 2,000 second-feet. Operation of automatic gage satisfactory throughout year, except as noted in footnote to table of daily discharge. Daily discharge was obtained by means of discharge integrator. Records at medium and high stages good; at low stages fair.

*Discharge measurements of Chippewa River at Chippewa Falls, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge |
|---|---|---|---|
| | | *Feet* | *Sec.-ft.* |
| Oct. 12 | E. E. Foster | 0.86 | 2,190 |
| Feb. 21 | do | a.96 | 2,070 |
| June 12 | S. B. Soulé | 3.83 | 9,680 |

a Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Chippewa River at Chippewa Falls., Wis., for the year ending September 30, 1923*

| Day | Oct | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,290 | 1,870 | 3,620 | 1,210 | 2,220 | 2,140 | 1,700 | 10,600 | 3,820 | 4,440 | 2,700 | 1,540 |
| 2 | 1,970 | 1,880 | 5,100 | 2,190 | 2,200 | 2,010 | 2,270 | 10,000 | 2,910 | 5,090 | 2,310 | 830 |
| 3 | 2,010 | 1,740 | 1,460 | 2,380 | 2,060 | 1,640 | 2,270 | 7,700 | 1,720 | 4,790 | 1,870 | 740 |
| 4 | 1,900 | 1,780 | 3,040 | 2,380 | 1,310 | 1,580 | 2,260 | 10,700 | 2,920 | 1,480 | 2,120 | 1,650 |
| 5 | 1,820 | 1,440 | 3,190 | 2,200 | 2,000 | 1,840 | 2,200 | 12,300 | 3,300 | 6,700 | 994 | 1,860 |
| 6 | 1,940 | 2,060 | 3,610 | 1,900 | 1,950 | 1,980 | 2,430 | 10,300 | 3,700 | 4,980 | 2,430 | 1,850 |
| 7 | 1,710 | 1,960 | 2,970 | 1,420 | 2,000 | 2,840 | 3,570 | 11,800 | 8,290 | 4,220 | 2,300 | 2,040 |
| 8 | 1,300 | 1,900 | 2,220 | 2,220 | 1,940 | 3,140 | 2,620 | 7,680 | 16,600 | 2,710 | 1,940 | 2,420 |
| 9 | 1,710 | 2,100 | 2,230 | 1,840 | 1,860 | 3,260 | 3,150 | 10,000 | 16,400 | 4,270 | 1,950 | 1,080 |
| 10 | 1,710 | 1,890 | 1,310 | 1,940 | 1,770 | 2,930 | 1,700 | 9,740 | 12,900 | 4,160 | 1,980 | 2,940 |
| 11 | 1,840 | 1,830 | 2,040 | 2,060 | 1,250 | 2,110 | 1,840 | 10,300 | 11,400 | 3,380 | 1,660 | 2,530 |
| 12 | 1,760 | 1,560 | 2,680 | 2,020 | 1,960 | 2,840 | 2,220 | 8,390 | 8,760 | 3,720 | 720 | 2,300 |
| 13 | 1,680 | 1,720 | 2,750 | 1,900 | 2,470 | 2,910 | 2,840 | 8,240 | 6,620 | 3,740 | 1,850 | 1,870 |
| 14 | 1,880 | 1,940 | 2,490 | 1,580 | 2,030 | 2,980 | 2,040 | 8,510 | 4,340 | 3,690 | 2,360 | 1,940 |
| 15 | 1,340 | 1,910 | 2,540 | 1,980 | 2,050 | 3,090 | 1,500 | 8,370 | 4,580 | 2,190 | 2,160 | 2,000 |
| 16 | 1,770 | 3,020 | 2,360 | 2,100 | 2,050 | 3,400 | 5,370 | 7,320 | 5,200 | 3,100 | 2,220 | 895 |
| 17 | 1,820 | 2,850 | 1,780 | 2,180 | 1,980 | 2,980 | 6,560 | 6,600 | 1,740 | 3,200 | 1,960 | 1,920 |
| 18 | 1,790 | 3,840 | 2,620 | 2,150 | 1,470 | 1,820 | 6,760 | 6,710 | 2,720 | 2,940 | 1,580 | 1,800 |
| 19 | 1,710 | 1,750 | 2,600 | 2,120 | 2,050 | 2,330 | 23,900 | 5,500 | 3,010 | 2,680 | 970 | 1,910 |
| 20 | 1,780 | 3,580 | 2,650 | 1,810 | 2,090 | 3,470 | 36,800 | 2,350 | 3,820 | 2,300 | 1,940 | 1,680 |
| 21 | 1,900 | 5,740 | 2,600 | 1,580 | 1,940 | 3,170 | 49,700 | 15,200 | 3,890 | 2,140 | 2,240 | 1,720 |
| 22 | 1,440 | 6,860 | 2,480 | 2,060 | 1,800 | 3,340 | 54,000 | 12,200 | 3,680 | 1,210 | 1,680 | 1,670 |
| 23 | 1,710 | 5,300 | 2,390 | 2,280 | 1,860 | 3,400 | 34,400 | 12,100 | 2,900 | 1,250 | 1,940 | 985 |
| 24 | 1,760 | 3,520 | 1,630 | 2,170 | 1,620 | 2,880 | 34,800 | 8,180 | 1,600 | 2,000 | 1,910 | 1,800 |
| 25 | 2,180 | 4,160 | 1,400 | 2,180 | 1,400 | 1,980 | 29,200 | 8,280 | 5,220 | 2,120 | 1,530 | 1,900 |
| 26 | 1,970 | 3,280 | 2,140 | 2,070 | 1,830 | 2,880 | 19,600 | 6,620 | 9,330 | 2,150 | 620 | 1,940 |
| 27 | 2,000 | 3,260 | 2,480 | 2,060 | 2,320 | 3,250 | 17,000 | 3,780 | 14,200 | 2,630 | 1,740 | 1,950 |
| 28 | 2,020 | 3,390 | 2,390 | 1,580 | 2,220 | 3,480 | 13,200 | 6,740 | 11,500 | 2,420 | 1,900 | 2,050 |
| 29 | 1,240 | 3,750 | 2,430 | 1,990 | ------- | 3,510 | 12,100 | 7,540 | 8,180 | 1,120 | 1,470 | 2,210 |
| 30 | 1,660 | 1,630 | 2,230 | 2,280 | ------- | 2,920 | 11,400 | 3,180 | 5,220 | 1,500 | 1,560 | 1,220 |
| 31 | 1,970 | ------- | 1,460 | 2,280 | ------- | 2,000 | ------- | 5,960 | ------- | 1,990 | 1,670 | ------- |

NOTE.—Stage-discharge relation slightly affected by ice Feb. 3–25. Recording gage not in perfect operation Oct. 27, Nov. 15–18, Dec. 6–8, Feb. 14–17, 21–24, and Apr. 23–28; discharge estimated from a study of power output of the Wissota plant.

*Monthly discharge of Chippewa River at Chippewa Falls, Wis., for the year ending September 30, 1923*

[Drainage area, 5,600 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 2,180 | 1,240 | 1,760 | 0.314 | 0.36 |
| November | 6,860 | 1,440 | 2,780 | .496 | .55 |
| December | 5,100 | 1,310 | 2,480 | .443 | .51 |
| January | 2,380 | 1,210 | 2,000 | .357 | .41 |
| February | 2,470 | 1,250 | 1,920 | .343 | .36 |
| March | 3,510 | 1,580 | 2,710 | .484 | .56 |
| April | 54,000 | 1,500 | 13,000 | 2.32 | 2.59 |
| May | 15,200 | 2,350 | 8,480 | 1.51 | 1.74 |
| June | 16,600 | 1,600 | 6,350 | 1.13 | 1.26 |
| July | 6,700 | 1,120 | 3,040 | .543 | .63 |
| August | 2,700 | 620 | 1,820 | .325 | .37 |
| September | 2,940 | 740 | 1,770 | .316 | .35 |
| The year | 54,000 | 620 | 4,000 | .714 | 9.69 |

### FLAMBEAU RIVER NEAR BUTTERNUT, WIS.

LOCATION.—In lot 10, sec. 28, T. 41 N., R. 1 E., 6 miles southeast of Butternut, Ashland County, and 7 miles upstream from Park Falls.

DRAINAGE AREA.—660 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch= 6 miles).

RECORDS AVAILABLE.—July 30, 1914, to September 30, 1923.

GAGE.—Chain gage supported by a built-up cantilever, attached to post set in right bank of river; installed May 26, 1916; read by Carl G. Elm. Vertical staff gage at same site and datum was used from July 30, 1914, until taken out by ice in spring of 1916.

DISCHARGE MEASUREMENTS.—Made from cable 1,500 feet downstream from gage.

CHANNEL AND CONTROL.—Bed at gage composed of mud and rock. Left bank is low and subject to overflow; right bank slopes back gradually to high-water mark. At cable site 1,500 feet below gage, bed is rock and banks are high. Control is at head of Schultz Rapids, 200 feet below cable and 1,700 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.80 feet afternoon April 25 (discharge, 3,320 second-feet); minimum discharge, estimated, 280 second-feet January 3, 9, and 10.

1914–1923: Maximum stage recorded, 9.0 feet April 22 and 23, 1916 (discharge, 5,430 second-feet); minimum stage, 0.90 foot August 27 and 28, 1920 (discharge, 204 second-feet).

REGULATION.—Storage reservoirs, having an effective capacity of 1.15 billion cubic feet, are maintained by the Chippewa & Flambeau Improvement Co. on the headwaters of Flambeau River.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 350 and 3,000 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as shown in footnote to table of daily discharge. Records fair.

*Discharge measurement of Flambeau River near Butternut, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge |
|---|---|---|---|
| | | *Feet* | *Sec.-ft.* |
| Dec. 28 | J. W. Harris | * 2.15 | 319 |
| July 21 | E. E. Foster | 3.23 | 946 |

* Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Flambeau River near Butternut, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 416 | 400 | 632 | 305 | 335 | 335 | 340 | 1,800 | 632 | 1,080 | 716 | 554 |
| 2 | 416 | 400 | 592 | 290 | 330 | 340 | 350 | 1,680 | 632 | 1,080 | 716 | 554 |
| 3 | 400 | 400 | 554 | 280 | 320 | 340 | 355 | 1,680 | 673 | 1,030 | 716 | 554 |
| 4 | 416 | 400 | 554 | 305 | 315 | 340 | 365 | 1,560 | 673 | 985 | 673 | 554 |
| 5 | 416 | 400 | 518 | 290 | 315 | 335 | 375 | 1,560 | 716 | 985 | 632 | 554 |
| 6 | 400 | 416 | 520 | 290 | 315 | 330 | 385 | 1,440 | 716 | 985 | 632 | 554 |
| 7 | 385 | 416 | 485 | 305 | 315 | 330 | 390 | 1,330 | 895 | 1,030 | 592 | 554 |
| 8 | 400 | 385 | 465 | 305 | 315 | 330 | 400 | 1,330 | 1,080 | 1,080 | 554 | 554 |
| 9 | 385 | 342 | 450 | 280 | 315 | 330 | 415 | 1,280 | 1,120 | 1,080 | 554 | 554 |
| 10 | 385 | 370 | 430 | 280 | 315 | 330 | 430 | 1,220 | 1,120 | 1,170 | 554 | 554 |
| 11 | 370 | 432 | 415 | 290 | 315 | 330 | 430 | 1,220 | 1,080 | 1,170 | 518 | 554 |
| 12 | 370 | 466 | 400 | 305 | 315 | 330 | 430 | 1,220 | 1,120 | 1,170 | 518 | 518 |
| 13 | 370 | 518 | 385 | 305 | 315 | 330 | 430 | 1,170 | 1,080 | 1,170 | 483 | 518 |
| 14 | 432 | 554 | 385 | 305 | 320 | 330 | 450 | 1,170 | 985 | 1,170 | 483 | 518 |
| 15 | 449 | 518 | 370 | 310 | 330 | 330 | 465 | 1,120 | 940 | 1,170 | 483 | 483 |
| 16 | 449 | 518 | 370 | 315 | 340 | 330 | 465 | 1,080 | 895 | 1,170 | 483 | 483 |
| 17 | 466 | 518 | 355 | 320 | 340 | 330 | 555 | 1,080 | 895 | 1,170 | 483 | 466 |
| 18 | 466 | 554 | 355 | 325 | 340 | 330 | 740 | 1,030 | 805 | 1,120 | 483 | 483 |
| 19 | 466 | 673 | 340 | 330 | 335 | 330 | 895 | 985 | 805 | 1,080 | 483 | 483 |
| 20 | 466 | 716 | 330 | 320 | 330 | 330 | 1,080 | 1,080 | 716 | 1,080 | 483 | 483 |
| 21 | 466 | 673 | 330 | 315 | 335 | 320 | 1,620 | 1,080 | 850 | 985 | 483 | 483 |
| 22 | 466 | 673 | 330 | 310 | 335 | 310 | 2,340 | 1,170 | 895 | 985 | 483 | 483 |
| 23 | 449 | 632 | 330 | 305 | 340 | 305 | 2,670 | 1,080 | 985 | 940 | 483 | 483 |
| 24 | 449 | 592 | 330 | 310 | 340 | 305 | 2,630 | 985 | 1,080 | 940 | 483 | 449 |
| 25 | 449 | 554 | 330 | 310 | 340 | 305 | 3,320 | 985 | 1,170 | 895 | 449 | 466 |
| 26 | 449 | 518 | 330 | 315 | 335 | 305 | 2,350 | 940 | 1,280 | 850 | 483 | 449 |
| 27 | 432 | 483 | 330 | 310 | 330 | 305 | 2,280 | 940 | 1,280 | 805 | 483 | 449 |
| 28 | 416 | 518 | 320 | 305 | 335 | 315 | 2,140 | 895 | 1,170 | 805 | 518 | 416 |
| 29 | 416 | 316 | 305 | 320 | ------- | 330 | 1,940 | 805 | 1,120 | 760 | 554 | 416 |
| 30 | 416 | 592 | 305 | 340 | ------- | 340 | 1,940 | 716 | 1,080 | 716 | 554 | 432 |
| 31 | 400 | ------- | 305 | 335 | ------- | 340 | ------- | 716 | ------- | 716 | 554 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 6 to Apr. 23; daily discharge determined from gage heights corrected for ice effect by means of one discharge measurement, observer's notes, and weather records.

*Monthly discharge of Flambeau River near Butternut, Wis., for the year ending September 30, 1923*

[Drainage area, 660 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 466 | 370 | 424 | 0.642 | 0.74 |
| November | 716 | 316 | 498 | .755 | .84 |
| December | 632 | 305 | 402 | .609 | .70 |
| January | 340 | 280 | 307 | .465 | .54 |
| February | 340 | 315 | 327 | .495 | .52 |
| March | 340 | 305 | 326 | .494 | .57 |
| April | 3,320 | 340 | 1,100 | 1.67 | 1.86 |
| May | 1,800 | 716 | 1,170 | 1.77 | 2.04 |
| June | 1,280 | 632 | 950 | 1.44 | 1.61 |
| July | 1,170 | 716 | 1,010 | 1.53 | 1.76 |
| August | 716 | 449 | 541 | .820 | .95 |
| September | 554 | 416 | 502 | .761 | .85 |
| The year | 3,320 | 280 | 631 | .956 | 12.98 |

### FLAMBEAU RIVER NEAR LADYSMITH, WIS.

LOCATION.—In SE. ¼ sec. 20, T. 35 N., R. 5 W., at farm of H. J. Cornelissen 6 miles by road northwest of Ladysmith, Rusk County, 21 miles below mouth of South Fork of Flambeau River, and 28 miles above mouth of river.

DRAINAGE AREA.—1,940 miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 2, 1914, to September 30, 1923. From February 15, 1903, to December 2, 1906, records were collected at a station in Ladysmith, three-fourths of a mile south of Minneapolis, St. Paul & Sault Ste. Marie Railway station, half a mile below dam of Menasha Pulp Co., and 6 miles below present station.

GAGE.—Chain fastened to a cantilever arm supported by two posts on left bank of river, on farm of H. J. Cornelissen; read by H. J. Cornelissen.

DISCHARGE MEASUREMENTS.—Made from cable 200 feet below gage.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; free from vegetation and not permanent. At gage section, channel is divided by a small sandy island; at cable section river flows in one channel. Banks are medium high, wooded, and not subject to overflow. Control not well defined, formed by channel below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.17 feet April 23 (discharge, 12,500 second-feet); minimum discharge estimated 380 second-feet December 19 (stage-discharge relation affected by ice).

1903–1906; 1914–1923: Maximum stage recorded, 10.2 feet April 11, 1922 (discharge, 19,500 second-feet); minimum discharge, 350 second-feet February 8, 1921.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—The Chippewa & Flambeau Improvement Co. operates storage reservoirs in the headwaters having an effective capacity of 1.15 billion cubic feet. Weekly fluctuations at gage are caused by operation of power plants at Park Falls and storage reservoirs. In the spring of 1923 the Big Falls power plant of the Lake Superior District Power Co. was put into operation. This plant causes diurnal fluctuation at gage.

ACCURACY.—Stage-discharge relation probably permanent. Rating curve fairly well defined. Gage read to quarter-tenths once every other day. Daily discharge ascertained by applying gage height to rating table except as explained in footnote to table of daily discharge. Records for October, November, August, and September fair; records for remainder of year poor.

*Discharge measurements of Flambeau River near Ladysmith, Wis., during the year ending September 30, 1923*

[Made by E. E. Foster]

| Date | Gage height | Discharge | Date | Gage height | Discharge |
|---|---|---|---|---|---|
| | *Feet* | *Sec.-ft.* | | *Feet* | *Sec.-ft.* |
| Dec. 15 | [a] 5.22 | 747 | Feb. 17 | [a] 3.45 | 563 |
| Jan. 10 | [a] 4.22 | 662 | July 11 | 3.89 | 2,640 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Flambeau River near Ladysmith, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 805 | 805 | 1,340 | 640 | 680 | 540 | 550 | 6,000 | 1,670 | 2,270 | 1,430 | 927 |
| 2 | 862 | 805 | 1,400 | 600 | 670 | 570 | 670 | 6,000 | 1,910 | 2,210 | 1,180 | 502 |
| 3 | 920 | 805 | 1,400 | 635 | 680 | 600 | 695 | 6,000 | 2,150 | 2,150 | 1,150 | 681 |
| 4 | 880 | 805 | 1,400 | 670 | 685 | 610 | 720 | 5,800 | 1,480 | 2,090 | 1,180 | 936 |
| 5 | 840 | 805 | 1,340 | 680 | 685 | 620 | 720 | 5,600 | 805 | 2,030 | 1,120 | 992 |
| 6 | 805 | 805 | 1,290 | 695 | 650 | 610 | 720 | 4,620 | 1,850 | 2,340 | 1,140 | 1,150 |
| 7 | 770 | 822 | 1,320 | 670 | 610 | 600 | 760 | 3,640 | 2,900 | 2,640 | 864 | 964 |
| 8 | 770 | 840 | 1,340 | 640 | 635 | 620 | 805 | 3,560 | 3,780 | 2,150 | 1,120 | 955 |
| 9 | 770 | 840 | 1,070 | 650 | 660 | 640 | 900 | 3,480 | 4,660 | 2,460 | 1,000 | 655 |
| 10 | 770 | 840 | 805 | 660 | 685 | 640 | 1,000 | 3,640 | 3,780 | 2,770 | 918 | 964 |
| 11 | 770 | 1,230 | 820 | 670 | 710 | 640 | 835 | 3,800 | 2,900 | 2,840 | 1,190 | 802 |
| 12 | 770 | 1,620 | 840 | 685 | 665 | 640 | 670 | 4,320 | 2,840 | 2,900 | 891 | 915 |
| 13 | 770 | 1,510 | 840 | 760 | 620 | 630 | 895 | 4,840 | 2,770 | 2,900 | 1,030 | 955 |
| 14 | 746 | 1,400 | 840 | 840 | 625 | 620 | 1,120 | 4,010 | 2,220 | 2,900 | 1,090 | 900 |
| 15 | 722 | 1,370 | 770 | 840 | 630 | 640 | 1,700 | 3,180 | 1,670 | 2,400 | 864 | 900 |
| 16 | 781 | 1,340 | 800 | 840 | 595 | 660 | 2,270 | 4,200 | 1,850 | 1,910 | 855 | 629 |
| 17 | 840 | 1,480 | 805 | 840 | 560 | 660 | 1,790 | 5,210 | 2,030 | 1,970 | 672 | 828 |
| 18 | 840 | 1,620 | 590 | 840 | 565 | 750 | 3,800 | 3,440 | 1,640 | 2,030 | 1,170 | 882 |
| 19 | 840 | 1,880 | 380 | 720 | 570 | 840 | 5,800 | 1,670 | 1,240 | 2,030 | 570 | 992 |
| 20 | 822 | 2,150 | 515 | 600 | 570 | 920 | 8,850 | 3,970 | 1,400 | 2,030 | 882 | 955 |
| 21 | 805 | 2,150 | 650 | 580 | 570 | 1,000 | 11,900 | 3,970 | 1,560 | 1,800 | 946 | 837 |
| 22 | 822 | 2,150 | 530 | 560 | 555 | 885 | 11,900 | 3,970 | 2,100 | 1,560 | 964 | 909 |
| 23 | 840 | 2,030 | 405 | 575 | 540 | 770 | 12,500 | 3,300 | 2,640 | 1,560 | 900 | 802 |
| 24 | 828 | 1,910 | 545 | 590 | 550 | 765 | 11,600 | 2,640 | 2,640 | 1,560 | 891 | 873 |
| 25 | 817 | 1,910 | 685 | 625 | 560 | 760 | 10,700 | 2,580 | 2,640 | 1,680 | 891 | 810 |
| 26 | 805 | 1,910 | 650 | 660 | 550 | 760 | 8,680 | 2,510 | 2,640 | 1,790 | 519 | 900 |
| 27 | 842 | 1,600 | 610 | 685 | 540 | 760 | 6,660 | 2,510 | 3,060 | 1,620 | 793 | 828 |
| 28 | 880 | 1,290 | 650 | 685 | 540 | 750 | 6,130 | 2,510 | 3,480 | 1,450 | 955 | 828 |
| 29 | 900 | 1,290 | 685 | 685 | ------- | 740 | 5,600 | 2,360 | 3,330 | 1,680 | 900 | 784 |
| 30 | 920 | 1,290 | 685 | 685 | ------- | 590 | 5,800 | 2,150 | 3,180 | 1,910 | 882 | 595 |
| 31 | 862 | ------- | 685 | 685 | ------- | 435 | ------- | 1,910 | ------- | 1,670 | 846 | ------- |

NOTE.—Gage read only on alternate days; discharge interpolated for days of no gage reading. Stage-discharge relation affected by ice Dec. 4 to Apr. 19; discharge ascertained by applying to rating table gage height corrected for ice effect by means of three discharge measurements, observer's notes, and weather records and by interpolation for days of no gage readings. Discharge for August and September computed from power-house records.

*Monthly discharge of Flambeau River near Ladysmith, Wis., for the year ending September 30, 1923*

[Drainage area, 1,940 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 920 | 722 | 820 | 0.423 | 0.49 |
| November | 2,150 | 805 | 1,380 | .711 | .79 |
| December | 1,400 | 380 | 861 | .444 | .51 |
| January | 840 | 560 | 684 | .353 | .41 |
| February | 710 | 540 | 613 | .316 | .33 |
| March | 1,000 | 435 | 686 | .354 | .41 |
| April | 12,500 | 550 | 4,220 | 2.18 | 2.43 |
| May | 6,000 | 1,670 | 3,790 | 1.95 | 2.25 |
| June | 4,660 | 805 | 2,430 | 1.25 | 1.40 |
| July | 2,900 | 1,450 | 2,110 | 1.09 | 1.26 |
| August | 1,430 | 519 | 961 | .495 | .57 |
| September | 1,150 | 502 | 855 | .441 | .49 |
| The year | 12,500 | 380 | 1,620 | .835 | 11.34 |

### JUMP RIVER AT SHELDON, WIS.

LOCATION.—In sec. 26, T. 33 N., R. 5 W., at highway bridge in Sheldon, Rusk County, 11 miles above mouth of river.

DRAINAGE AREA.—510 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch = 6 miles).

RECORDS AVAILABLE.—July 22, 1915, to September 30, 1923.

GAGE.—Chain gage bolted to downstream handrail of bridge; read by Elsa Dietze.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of heavy gravel, clean, and free from vegetation. Right bank high and not subject to overflow; left bank may be overflowed occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.55 feet 7.30 p. m. April 20 (discharge, 12,800 second-feet); minimum discharge, estimated 25 second-feet December 16, 17, and January 10–18.

1915–1923: Maximum stage recorded, 11.48 feet March 26, 1920 (discharge, 15,600 second-feet, revised). Minimum discharge estimated about 15 second-feet February 3–7, 1918, and February 1–4, 1922.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 75 and 13,000 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for period in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

*Discharge measurements of Jump River at Sheldon, Wis., during the year ending September 30, 1923*

[Made by E. E. Foster]

| Date | Gage height | Discharge | Date | Gage height | Discharge | Date | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|
| Oct. 11 | 3.00 | 73.4 | Feb. 19 | [a] 3.63 | 40 | Apr. 20 | 10.44 | 12,500 |
| Dec. 16 | [a] 3.60 | 28 | Apr. 20 | 9.97 | 11,000 | July 10 | 3.57 | 313 |
| Jan. 11 | [a] 3.67 | 34 | | | | | | |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Jump River at Sheldon, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 50 | 70 | 430 | 45 | 35 | 45 | 110 | 975 | 166 | 512 | 100 | 62 |
| 2 | 50 | 75 | 305 | 45 | 35 | 50 | 120 | 930 | 458 | 458 | 92 | 62 |
| 3 | 50 | 82 | 230 | 40 | 35 | 50 | 125 | 930 | 800 | 458 | 92 | 50 |
| 4 | 50 | 92 | 185 | 30 | 35 | 50 | 135 | 975 | 840 | 458 | 75 | 50 |
| 5 | 50 | 100 | 125 | 30 | 35 | 50 | 145 | 1,300 | 760 | 512 | 70 | 50 |
| 6 | 50 | 116 | 90 | 30 | 35 | 55 | 145 | 1,510 | 1,160 | 512 | 62 | 50 |
| 7 | 62 | 127 | 75 | 30 | 35 | 60 | 145 | 1,510 | 2,510 | 458 | 50 | 50 |
| 8 | 62 | 146 | 60 | 30 | 35 | 60 | 355 | 1,400 | 3,250 | 540 | 50 | 50 |
| 9 | 62 | 146 | 50 | 30 | 35 | 60 | 430 | 1,620 | 4,200 | 540 | 50 | 50 |
| 10 | 70 | 166 | 45 | 25 | 35 | 70 | 510 | 1,740 | 2,950 | 458 | 50 | 43 |
| 11 | 75 | 186 | 45 | 25 | 45 | 75 | 635 | 1,740 | 3,560 | 380 | 55 | 43 |
| 12 | 75 | 208 | 35 | 25 | 45 | 75 | 760 | 1,510 | 1,350 | 355 | 62 | 35 |
| 13 | 75 | 380 | 35 | 25 | 45 | 75 | 980 | 1,510 | 975 | 330 | 50 | 35 |
| 14 | 82 | 380 | 30 | 25 | 45 | 75 | 1,200 | 1,300 | 575 | 320 | 50 | 35 |
| 15 | 92 | 355 | 30 | 25 | 45 | 75 | 1,350 | 975 | 405 | 280 | 62 | 35 |
| 16 | 92 | 330 | 25 | 25 | 40 | 75 | 1,620 | 680 | 255 | 380 | 55 | 35 |
| 17 | 92 | 305 | 25 | 25 | 35 | 75 | 3,250 | 610 | 255 | 320 | 50 | 43 |
| 18 | 75 | 430 | 35 | 25 | 35 | 75 | 5,090 | 540 | 255 | 208 | 50 | 47 |
| 19 | 75 | 760 | 35 | 30 | 35 | 75 | 8,650 | 645 | 208 | 186 | 62 | 50 |
| 20 | 62 | 840 | 35 | 30 | 35 | 75 | 12,100 | 1,110 | 166 | 146 | 75 | 75 |
| 21 | 62 | 800 | 35 | 30 | 35 | 75 | 12,400 | 1,350 | 280 | 146 | 92 | 92 |
| 22 | 70 | 800 | 35 | 35 | 35 | 75 | 10,300 | 1,060 | 405 | 146 | 92 | 92 |
| 23 | 75 | 760 | 35 | 35 | 35 | 75 | 7,420 | 760 | 355 | 166 | 92 | 92 |
| 24 | 75 | 720 | 35 | 35 | 35 | 75 | 5,280 | 645 | 305 | 208 | 92 | 75 |
| 25 | 92 | 575 | 40 | 35 | 35 | 75 | 3,560 | 1,400 | 800 | 270 | 92 | 75 |
| 26 | 92 | 540 | 45 | 35 | 35 | 75 | 2,510 | 512 | 2,950 | 222 | 92 | 50 |
| 27 | 75 | 485 | 45 | 30 | 35 | 75 | 2,110 | 430 | 2,800 | 146 | 92 | 50 |
| 28 | 75 | 458 | 45 | 30 | 40 | 80 | 1,300 | 320 | 1,620 | 116 | 75 | 50 |
| 29 | 75 | 458 | 45 | 30 | ------- | 90 | 1,300 | 235 | 1,060 | 108 | 75 | 50 |
| 30 | 62 | 430 | 45 | 30 | ------- | 100 | 1,020 | 213 | 512 | 127 | 75 | 50 |
| 31 | 62 | ------- | 45 | 30 | ------- | 110 | ------- | 170 | ------- | 108 | 62 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 2 to Apr. 17.

*Monthly discharge of Jump River at Sheldon, Wis., for the year ending September 30, 1923*

[Drainage area, 510 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 92 | 50 | 69.9 | 0.137 | 0.16 |
| November | 840 | 70 | 377 | .739 | .82 |
| December | 430 | 25 | 76.6 | .150 | .17 |
| January | 45 | 25 | 30.6 | .0600 | .07 |
| February | 45 | 35 | 37.1 | .0727 | .08 |
| March | 110 | 45 | 71.1 | .139 | .16 |
| April | 12,400 | 110 | 2,840 | 5.57 | 6.21 |
| May | 1,740 | 170 | 987 | 1.94 | 2.24 |
| June | 4,200 | 166 | 1,210 | 2.37 | 2.64 |
| July | 540 | 108 | 309 | .606 | .70 |
| August | 100 | 50 | 70.7 | .139 | .16 |
| September | 92 | 35 | 54.2 | .106 | .12 |
| The year | 12,400 | 25 | 508 | .996 | 13.53 |

### EAU CLAIRE RIVER NEAR AUGUSTA, WIS.

LOCATION.—In sec. 12, T. 26 N., R. 6 E., at Trouble Water Bridge, 7 miles northeast of Augusta, Eau Claire County. South Fork of Eau Claire River enters from left 4 miles above station.

DRAINAGE AREA.—500 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 16, 1914, to September 30, 1923.

GAGE.—Chain gage on downstream side of bridge; read by Albert Wagner.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading at control 500 feet downstream from bridge.

CHANNEL AND CONTROL.—Bed of stream at bridge and above is sandy and shifting; a short distance below gage channel narrows and a rock outcrop overlain with large boulders forms the control. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.2 feet 9 a. m. April 14 (discharge, 3,800 second-feet); minimum discharge, estimated, 25 second-feet February 5.

1914–1923: Maximum open-water stage recorded, 12.0 feet at 9 a. m. March 27, 1920 (discharge, 8,720 second-feet); minimum discharge, 3.5 second-feet, January 27, 1918, by discharge measurement made through complete ice cover.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed somewhat during summer. Rating curve well defined. Gage read to quarter-tenths once daily except during winter when it was read three times a week. Daily discharge during open-water period ascertained by indirect method for shifting control as indicated by discharge measurements; for periods in which the stage-discharge relation was affected by ice it was obtained by applying to rating table gage height corrected for ice effect by means of two discharge measurements, observer's notes, and weather records. Gage readings only fair; records fair.

*Discharge measurements of Eau Claire River near Augusta, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 13 | E. E. Foster | —0.15 | 72 | Jan. 16 | E. E. Foster | [a]0.79 | 56 |
| Dec. 21 | do | [a].66 | 46 | June 13 | S. B. Soulé | 1.26 | 334 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Eau Claire River near Augusta, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 122 | 114 | 245 | 60 | 80 | 45 | 165 | 395 | 98 | 129 | 46 | 54 |
| 2 | 118 | 177 | 204 | 60 | 60 | 55 | 190 | 350 | 100 | 118 | 46 | 98 |
| 3 | 108 | 164 | 305 | 50 | 35 | 60 | 230 | 335 | 350 | 108 | 40 | 198 |
| 4 | 98 | 152 | 165 | 45 | 30 | 110 | 365 | 335 | 266 | 92 | 36 | 164 |
| 5 | 88 | 152 | 140 | 45 | 25 | 110 | 890 | 430 | 204 | 98 | 36 | 104 |
| 6 | 79 | 204 | 125 | 45 | 35 | 115 | 1,710 | 365 | 204 | 1,470 | 34 | 79 |
| 7 | 88 | 204 | 110 | 45 | 45 | 120 | 2,080 | 320 | 380 | 1,050 | 46 | 79 |
| 8 | 98 | 190 | 90 | 45 | 50 | 120 | 1,300 | 305 | 2,780 | 588 | 54 | 108 |
| 9 | 88 | 177 | 70 | 45 | 55 | 120 | 1,050 | 335 | 2,150 | 380 | 49 | 98 |
| 10 | 88 | 169 | 65 | 45 | 50 | 120 | 1,100 | 412 | 745 | 260 | 40 | 88 |
| 11 | 88 | 177 | 60 | 45 | 40 | 120 | 2,220 | 395 | 605 | 217 | 36 | 70 |
| 12 | 88 | 177 | 50 | 45 | 40 | 110 | 2,710 | 320 | 380 | 204 | 40 | 70 |
| 13 | 83 | 164 | 40 | 45 | 35 | 105 | 3,440 | 269 | 320 | 164 | 36 | 66 |
| 14 | 102 | 164 | 45 | 45 | 35 | 100 | 3,800 | 231 | 290 | 140 | 34 | 61 |
| 15 | 102 | 164 | 50 | 50 | 30 | 90 | 2,150 | 204 | 231 | 118 | 34 | 61 |
| 16 | 114 | 159 | 55 | 55 | 30 | 80 | 1,650 | 204 | 190 | 98 | 34 | 54 |
| 17 | 118 | 152 | 50 | 50 | 35 | 80 | 1,350 | 217 | 164 | 88 | 32 | 56 |
| 18 | 114 | 204 | 40 | 45 | 35 | 70 | 1,200 | 195 | 140 | 79 | 32 | 88 |
| 19 | 114 | 465 | 40 | 40 | 40 | 65 | 1,150 | 164 | 129 | 70 | 32 | 108 |
| 20 | 108 | 675 | 50 | 40 | 40 | 60 | 1,150 | 640 | 535 | 61 | 32 | 129 |
| 21 | 102 | 500 | 55 | 40 | 45 | 60 | 1,150 | 815 | 500 | 58 | 46 | 129 |
| 22 | 98 | 380 | 55 | 40 | 45 | 80 | 1,770 | 675 | 290 | 54 | 58 | 129 |
| 23 | 98 | 335 | 55 | 40 | 45 | 100 | 3,440 | 500 | 217 | 65 | 46 | 108 |
| 24 | 88 | 305 | 60 | 45 | 45 | 165 | 2,080 | 365 | 147 | 70 | 44 | 88 |
| 25 | 88 | 231 | 70 | 50 | 45 | 215 | 1,200 | 269 | 147 | 61 | 36 | 79 |
| 26 | 83 | 275 | 60 | 55 | 45 | 205 | 850 | 275 | 217 | 58 | 34 | 70 |
| 27 | 83 | 231 | 55 | 55 | 45 | 215 | 710 | 190 | 320 | 58 | 46 | 61 |
| 28 | 83 | 217 | 55 | 55 | 55 | 165 | 605 | 164 | 335 | 58 | 61 | 61 |
| 29 | 83 | 204 | 55 | 55 | ------- | 150 | 535 | 152 | 245 | 54 | 61 | 70 |
| 30 | 83 | 217 | 55 | 70 | ------- | 130 | 465 | 136 | 172 | 54 | 58 | 79 |
| 31 | 83 | ------- | 55 | 75 | ------- | 110 | ------- | 118 | ------- | 49 | 49 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 4 to Apr. 11.

*Monthly discharge of Eau Claire River near Augusta, Wis., for the year ending September 30, 1923*

[Drainage area, 500 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 122 | 79 | 96.1 | 0.192 | 0.22 |
| November | 675 | 114 | 237 | .474 | .53 |
| December | 305 | 40 | 84.8 | .170 | .20 |
| January | 75 | 40 | 49.2 | .0984 | .11 |
| February | 80 | 25 | 42.7 | .0854 | .09 |
| March | 215 | 45 | 111 | .222 | .26 |
| April | 3,800 | 165 | 1,420 | 2.84 | 3.17 |
| May | 815 | 118 | 325 | .650 | .75 |
| June | 2,780 | 98 | 429 | .858 | .96 |
| July | 1,470 | 49 | 199 | .398 | .46 |
| August | 61 | 32 | 42.2 | .0844 | .10 |
| September | 198 | 54 | 90.2 | .180 | .20 |
| The year | 3,800 | 25 | 259 | .518 | 7.05 |

### RED CEDAR RIVER NEAR COLFAX, WIS.

LOCATION.—In sec. 27, T. 30 N., R. 11 W., at highway bridge 4½ miles north of Colfax, Dunn County. Hay River enters from right 11 miles below, and Trout Creek, also from right, 3½ miles above station.

DRAINAGE AREA.—1,100 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—March 19, 1914, to September 30, 1923.

GAGE.—Chain gage attached to downstream side of bridge; read by Andrew Lundequam.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of rock and gravel; small amount of grass growth during summer; left bank high and not subject to overflow; right bank medium high and may be overflowed during extremely high water; control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.10 feet at 5 p. m. April 14 (discharge, 4,590 second-feet); minimum discharge, 280 second-feet January 7 and 21.

1914–1923: Maximum stage recorded, 6.95 feet at 8 a. m. March 26, 1920 (discharge, 7,610 second-feet); minimum open-water stage recorded, 0.61 foot December 18, 1921 (discharge, 233 second-feet), apparently caused by temporary holding back of water by ice.

REGULATION.[2]—The following dams and reservoirs are used to regulate flow in Red Cedar River. Owing to operation of these reservoirs, the flow at the station is not natural.

*Reservoirs used to regulate flow of Red Cedar River*

| Dam | Location | Capacity in millions of cubic feet |
|---|---|---|
| Long Lake | Sec. 24, T. 37 N., R. 11 W. | 400 |
| Cedar Lake | Sec. 21, T. 36 N., R. 10 W. | 400 |
| Birch Lake | Sec. 25, T. 37 N., R. 10 W. | 475 |
| Bear Lake | Sec. 7, T. 36 N., R. 11 W. | 150 |
| | | 1,425 |

ACCURACY.—Stage-discharge relation slightly affected by backwater from dam at Colfax. Rating curve fairly well defined, probably better at medium and high stages than at low. Gage read to quarter-tenths twice daily except during winter when it was read three times a week. Discharge ascertained by applying mean daily gage height to rating table except for period when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table gage height corrected for ice effect on basis of discharge measurements, observer's notes, and weather records. Open-water records fair; winter records subject to considerable error.

*Discharge measurements of Red Cedar River near Colfax, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Dec. 20 | E. E. Foster | [a] 4.17 | 553 | Feb. 20 | E. E. Foster | [a] 2.96 | 542 |
| Jan. 15 | do | [a] 3.10 | 578 | June 11 | S. B. Soulé | 1.72 | 756 |

[2] From data on file in Engineering Department of Railroad Commission of Wisconsin.
[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Red Cedar River near Colfax, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 495 | 745 | 820 | 335 | 665 | 665 | 965 | 782 | 422 | 820 | 580 | 380 |
| 2 | 550 | 782 | 710 | 335 | 700 | 685 | 1,050 | 1,160 | 400 | 710 | 445 | 400 |
| 3 | 550 | 745 | 745 | 335 | 550 | 700 | 1,140 | 1,350 | 445 | 710 | 470 | 380 |
| 4 | 642 | 710 | 630 | 335 | 400 | 720 | 1,220 | 1,870 | 522 | 820 | 445 | 356 |
| 5 | 550 | 820 | 400 | 335 | 365 | 740 | 1,370 | 942 | 642 | 900 | 445 | 380 |
| 6 | 675 | 860 | 455 | 310 | 335 | 760 | 1,520 | 642 | 675 | 782 | 445 | 380 |
| 7 | 745 | 900 | 515 | 280 | 325 | 775 | 1,630 | 642 | 675 | 710 | 422 | 356 |
| 8 | 675 | 820 | 570 | 320 | 315 | 720 | 1,740 | 1,030 | 642 | 745 | 422 | 353 |
| 9 | 550 | 820 | 630 | 355 | 325 | 665 | 1,980 | 942 | 550 | 745 | 470 | 350 |
| 10 | 610 | 900 | 555 | 460 | 335 | 630 | 2,420 | 745 | 550 | 710 | 495 | 346 |
| 11 | 610 | 1,250 | 480 | 565 | 360 | 600 | 1,450 | 745 | 550 | 610 | 445 | 339 |
| 12 | 610 | 1,070 | 465 | 550 | 380 | 570 | 2,200 | 745 | 610 | 550 | 422 | 342 |
| 13 | 610 | 942 | 450 | 535 | 430 | 535 | 3,900 | 642 | 610 | 610 | 422 | 422 |
| 14 | 522 | 1,070 | 510 | 550 | 480 | 480 | 4,450 | 550 | 522 | 580 | 422 | 422 |
| 15 | 495 | 942 | 565 | 565 | 510 | 425 | 4,170 | 550 | 470 | 495 | 470 | 422 |
| 16 | 445 | 1,030 | 535 | 550 | 535 | 425 | 3,640 | 642 | 470 | 445 | 445 | 422 |
| 17 | 495 | 942 | 505 | 535 | 470 | 425 | 3,250 | 610 | 445 | 445 | 495 | 422 |
| 18 | 610 | 1,030 | 465 | 520 | 400 | 460 | 2,880 | 580 | 400 | 495 | 445 | 422 |
| 19 | 610 | 1,160 | 425 | 505 | 375 | 505 | 2,420 | 580 | 710 | 470 | 422 | 422 |
| 20 | 610 | 985 | 495 | 390 | 350 | 460 | 2,640 | 1,550 | 900 | 445 | 422 | 422 |
| 21 | 610 | 900 | 565 | 280 | 325 | 425 | 2,420 | 1,160 | 782 | 580 | 422 | 495 |
| 22 | 675 | 860 | 520 | 320 | 300 | 360 | 2,760 | 985 | 710 | 745 | 422 | 380 |
| 23 | 470 | 820 | 480 | 355 | 360 | 300 | 2,420 | 900 | 495 | 495 | 422 | 445 |
| 24 | 710 | 860 | 460 | 370 | 425 | 350 | 2,530 | 860 | 642 | 470 | 580 | 522 |
| 25 | 675 | 745 | 440 | 380 | 600 | 400 | 1,760 | 900 | 1,070 | 470 | 400 | 495 |
| 26 | 610 | 820 | 420 | 415 | 570 | 480 | 1,650 | 820 | 1,650 | 495 | 400 | 445 |
| 27 | 610 | 642 | 400 | 450 | 535 | 560 | 1,350 | 745 | 1,550 | 522 | 400 | 400 |
| 28 | 610 | 820 | 390 | 480 | 600 | 640 | 1,200 | 610 | 1,450 | 470 | 400 | 445 |
| 29 | 476 | 745 | 380 | 505 | ------- | 720 | 985 | 495 | 1,300 | 445 | 422 | 470 |
| 30 | 342 | 745 | 370 | 570 | ------- | 800 | 900 | 445 | 1,030 | 445 | 422 | 550 |
| 31 | 550 | ------- | 355 | 630 | ------- | 880 | ------- | 445 | ------- | 400 | 380 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 4 to Mar. 8. Gage not read Oct. 29, Aug. 13, and Sept. 16; discharge interpolated.

*Monthly discharge of Red Cedar River near Colfax, Wis., for the year ending September 30, 1923*

[Drainage area, 1,100 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 745 | 342 | 580 | 0.527 | 0.61 |
| November | 1,250 | 642 | 883 | .803 | .90 |
| December | 820 | 355 | 507 | .461 | .53 |
| January | 630 | 280 | 433 | .394 | .45 |
| February | 700 | 300 | 440 | .400 | .42 |
| March | 880 | 300 | 576 | .524 | .60 |
| April | 4,450 | 900 | 2,130 | 1.94 | 2.16 |
| May | 1,870 | 445 | 828 | .753 | .87 |
| June | 1,650 | 400 | 730 | .664 | .74 |
| July | 900 | 400 | 591 | .537 | .62 |
| August | 580 | 380 | 443 | .403 | .46 |
| September | 550 | 339 | 413 | .375 | .42 |
| The year | 4,450 | 280 | 712 | .647 | 8.78 |

### RED CEDAR RIVER AT CEDAR FALLS, WIS.

LOCATION.—In sec. 6, T. 28 N., R. 12 W. at highway bridge near Cedar Falls, Dunn County, immediately below power plant of Northern States Power Co. (formerly Wisconsin-Minnesota Light & Power Co.), 4½ miles above crossing of Chicago, St. Paul, Minneapolis & Omaha Railway.

DRAINAGE AREA.—1,680 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch =6 miles).

RECORDS AVAILABLE.—April 1, 1909, to September 30, 1923.

GAGE.—Staff, fastened to bridge pier; read by R. D. Wilsey and Chester Bolm.

DISCHARGE MEASUREMENTS.—No discharge measurements have been made at this station, which is maintained to determine fluctuation in stage.

CHANNEL AND CONTROL.—Channel rough and rocky, straight, and free from vegetation; banks high and are not overflowed.

EXTREMES OF STAGE.—Maximum stage recorded during year, 5.9 feet at 6 p. m. April 15; minimum stage recorded 0.2 foot, May 6.

1909–1923: Maximum stage recorded, 7.2 feet March 25 and 26, 1920; minimum stage recorded, 0.0 foot March 11, 1918. Minimum stages are caused by closing gates and wheels at power plant in dam above station.

REGULATION.—Operation of storage reservoirs in the headwaters of the river (see "Regulation" in station description for Red Cedar River at Colfax, Wis.) and storage at power plant above gaging station regulates flow.

ACCURACY.—Daily-discharge records are not computed or published for this station. To the best of knowledge stage-discharge relation is permanent. Gage is read twice daily to nearest tenth. There is considerable fluctuation, so that mean daily gage height as published probably does not present the average daily gage height.

COOPERATION.—Gage-height record furnished by Northern State Power Co.

*Daily gage height, in feet, of Red Cedar River at Cedar Falls, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.35 | 3.5 | 3.65 | 2.4 | 3.05 | 2.55 | .95 | 3.6 | 2.4 | 2.7 | 2.3 | 2.4 |
| 2 | 3.2 | 3.45 | 3.5 | 2.65 | 2.85 | 2.65 | 3.9 | 3.45 | 2.2 | 2.8 | 2.3 | 1.1 |
| 3 | 3.25 | 3.45 | 1.8 | 2.6 | 2.85 | 2.75 | 4.5 | 3.25 | 2.2 | 2.7 | 2.3 | 2.4 |
| 4 | 3.25 | 3.55 | 3.45 | 2.55 | .95 | .9 | 4.85 | 3.2 | 2.3 | 2.6 | 2.3 | 2.4 |
| 5 | 3.25 | 2.05 | 3.4 | 2.7 | 2.9 | 2.8 | 4.85 | 3.1 | 2.4 | 2.6 | 1.2 | 2.5 |
| 6 | 3.15 | 3.5 | 3.6 | 2.7 | 2.65 | 2.65 | 4.75 | .2 | 2.4 | 2.6 | 2.4 | 2.5 |
| 7 | 3.35 | 3.4 | 3.45 | 1.52 | 2.75 | 3.1 | 4.6 | 2.8 | 2.4 | 2.6 | 2.4 | 2.5 |
| 8 | 2.1 | 3.5 | 3.5 | 2.5 | 2.65 | 2.7 | 3.13 | 2.8 | 2.6 | 1.0 | 2.4 | 2.5 |
| 9 | 3.55 | 3.55 | 3.6 | 2.65 | 2.5 | 2.55 | 4.45 | 2.3 | 2.7 | 2.3 | 2.4 | 1.1 |
| 10 | 3.4 | 3.45 | 2.0 | 2.65 | 3.0 | 2.75 | 3.7 | 2.6 | 2.7 | 2.2 | 2.4 | 2.6 |
| 11 | 3.45 | 3.5 | 3.45 | 2.65 | 1.2 | 1.05 | 3.65 | 2.9 | 2.7 | 2.2 | 2.4 | 2.6 |
| 12 | 3.4 | ------- | 3.5 | 2.72 | 3.1 | 2.95 | 3.8 | 1.6 | 2.6 | 2.2 | 2.2 | 2.5 |
| 13 | 3.35 | ------- | 3.6 | 2.62 | 3.0 | 3.1 | 4.8 | 2.0 | 2.6 | 2.2 | 2.3 | 2.6 |
| 14 | 3.6 | ------- | 3.55 | 1.8 | 2.98 | 2.85 | 5.4 | 2.9 | 2.6 | 2.1 | 2.3 | 2.6 |
| 15 | 1.9 | ------- | 3.5 | 2.75 | 3.05 | 2.9 | 5.85 | 2.7 | 2.5 | 1.3 | 2.2 | 2.6 |
| 16 | 3.3 | ------- | 3.45 | 2.7 | 2.85 | 2.95 | 5.35 | 2.6 | 2.5 | 2.4 | 2.2 | 1.0 |
| 17 | 3.35 | ------- | 2.05 | 2.75 | 3.0 | 3.05 | 5.1 | 2.6 | 2.7 | 2.4 | 2.3 | 2.4 |
| 18 | 3.3 | ------- | 3.5 | 2.62 | 1.15 | 1.45 | 5.05 | 2.8 | 2.7 | 2.2 | 2.3 | 2.4 |
| 19 | 3.5 | 1.8 | 3.4 | 2.7 | 3.05 | 3.05 | 5.2 | 3.0 | 2.8 | 2.1 | 1.3 | 2.4 |
| 20 | 3.45 | 3.55 | 3.45 | 2.72 | 2.65 | 3.2 | 5.0 | 3.0 | 2.8 | 2.2 | 2.4 | 2.5 |
| 21 | 3.6 | 3.6 | 3.35 | 1.6 | 2.6 | 3.25 | 4.9 | 3.4 | 2.7 | 2.2 | 2.4 | 2.5 |
| 22 | 2.75 | 3.6 | 3.4 | 2.6 | 2.65 | 2.8 | 3.05 | 3.4 | 2.6 | 1.0 | 2.4 | 2.5 |
| 23 | 3.4 | 3.55 | 3.35 | 2.7 | 3.0 | 2.85 | 4.9 | 3.1 | 2.6 | 2.3 | 2.4 | 1.1 |
| 24 | 3.5 | 3.6 | 1.9 | 2.6 | 2.95 | 2.85 | 4.65 | 3.1 | 2.7 | 2.3 | 2.4 | 2.5 |
| 25 | 3.45 | 3.5 | 2.7 | 2.6 | 1.15 | 1.15 | 4.0 | 2.9 | 2.8 | 2.3 | 2.4 | 2.5 |
| 26 | 3.4 | 1.95 | 3.45 | 2.7 | 2.6 | 2.65 | 4.05 | 2.9 | 2.9 | 2.3 | 1.0 | 2.4 |
| 27 | 3.5 | 3.45 | 3.5 | 2.7 | 2.65 | 2.75 | 3.9 | 2.7 | 3.9 | 2.3 | 2.5 | 2.6 |
| 28 | 3.7 | 3.6 | 3.4 | 1.15 | 2.6 | 3.0 | 3.8 | 2.6 | 4.0 | 2.2 | 2.5 | 2.6 |
| 29 | 1.9 | 3.55 | 3.5 | 2.8 | ------- | 2.6 | 2.55 | 2.6 | 4.0 | 1.1 | 2.4 | 2.4 |
| 30 | 3.55 | 3.45 | 3.35 | 2.8 | ------- | 2.65 | 3.9 | 2.6 | 3.9 | 2.3 | 2.5 | 1.2 |
| 31 | 3.6 | ------- | 1.8 | 2.8 | ------- | 2.75 | ------- | 2.5 | ------- | 2.3 | 2.5 | ------- |

### RED CEDAR RIVER AT MENOMONIE, WIS.

LOCATION.—In sec. 26, T. 28 N., R. 13 W., 900 feet below power house of Wisconsin-Minnesota Light & Power Co., Menomonie, Dunn County, 13 miles above mouth of river. Wilson Creek discharges from right into service reservoir just above station.

DRAINAGE AREA.—1,810 square miles (measured on map issued by Wisconsin Geological & Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—June 16, 1907, to September 5, 1908; May 9, 1913, to September 30, 1923.

GAGE.—Barrett & Lawrence water-stage recorder installed May 9, 1913, on right bank of river 1 mile above site of old gage attached to a highway bridge 200 rods west of Chicago & Northwestern Railway station west of Menomonie, which was read from June 16, 1907, to September 5, 1908. No relation between data of the two gages. Gage inspected by Ed. Kausrud.

DISCHARGE MEASUREMENTS.—Made from highway bridge 1 mile below gage.

CHANNEL AND CONTROL.—Bed at gage composed of heavy gravel. Left bank high and not subject to overflow; right bank of medium height and will be overflowed at flood stages. Bed at measuring section sandy and subject to shift; banks high at measuring section and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.70 feet at 10 p. m. April 14 (discharge, 8,120 second-feet); minimum stage, 1.55 feet during August 6 (discharge, 320 second-feet).

1907–8; 1913–1923: Maximum discharge, 14,000 second-feet March 26, 1920; minimum discharge, 100 second-feet November 8, 1907. Minimum discharge is due to regulation and does not represent the natural flow.

ICE.—Stage-discharge relation not affected by ice.

REGULATION.—Considerable diurnal fluctuation in stage at gage is caused by operation of power plants of Wisconsin-Minnesota Light & Power Co. at Menomonie and Cedar Falls. (See also "Regulation" in station description for Red Cedar River at Colfax, Wis.)

ACCURACY.—Stage-discharge relation permanent during year. Rating curve only fairly well defined. Operation of water-stage recorder not very satisfactory; observer's record of settings of the pencil on recorder sheet somewhat confused and unreliable. Daily discharge ascertained by applying to rating table mean daily gage height determined from inspection of recorder graph. Records poor.

The following discharge measurement was made by S. B. Soulé:

June 11, 1923: Gage-height, 2.15 feet; discharge, 650 second-feet.

*Daily discharge, in second-feet, of Red Cedar River at Menomonie, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 806 | 638 | 1,080 | 725 | 1,080 | 1,220 | 890 | 1,580 | 1,150 | 2,030 | 360 | 540 |
| 2 | 1,000 | 675 | 890 | 725 | 1,020 | 1,150 | 1,080 | 1,580 | 890 | 1,880 | 360 | 480 |
| 3 | 1,010 | 890 | 698 | 775 | 832 | 1,020 | 2,350 | 1,730 | 890 | 1,430 | 360 | 540 |
| 4 | 746 | 832 | 1,150 | 775 | 600 | 1,080 | 2,030 | 1,730 | 1,150 | 1,020 | 360 | 675 |
| 5 | 890 | 675 | 1,150 | 832 | 775 | 1,150 | 2,030 | 1,430 | 1,150 | 1,730 | 340 | 660 |
| 6 | 990 | 955 | 1,080 | 775 | 890 | 1,290 | 2,700 | 770 | 1,430 | 1,730 | 320 | 600 |
| 7 | 1,040 | 1,150 | 1,020 | 890 | 890 | 1,020 | 2,700 | 1,430 | 1,730 | 1,430 | 360 | 638 |
| 8 | 806 | 1,290 | 1,220 | 910 | 1,220 | 955 | 2,700 | 1,150 | 1,430 | 1,020 | 360 | 600 |
| 9 | 1,030 | 1,430 | 890 | 832 | 832 | 1,020 | 2,700 | 1,100 | 1,430 | 1,150 | 360 | 725 |
| 10 | 1,130 | 1,150 | 775 | 832 | 1,020 | 955 | 2,520 | 1,100 | 890 | 890 | 430 | 890 |
| 11 | 1,120 | 1,360 | 775 | 1,220 | 955 | 955 | 2,190 | 1,100 | 1,430 | 890 | 430 | 775 |
| 12 | 1,120 | 1,220 | 890 | 890 | 1,080 | 890 | 3,460 | 1,100 | 1,150 | 1,020 | 405 | 890 |
| 13 | 1,120 | 1,360 | 890 | 890 | 955 | 1,080 | 6,110 | 1,100 | 890 | 890 | 510 | 570 |
| 14 | 1,150 | 775 | 775 | 1,150 | 832 | 1,220 | 7,740 | 1,100 | 1,020 | 725 | 540 | 540 |
| 15 | 725 | 1,150 | 770 | 955 | 775 | 1,290 | 7,740 | 890 | 1,020 | 675 | 540 | 570 |
| 16 | 798 | 1,220 | 890 | 890 | 738 | 1,080 | 6,110 | 1,150 | 1,020 | 775 | 570 | 540 |
| 17 | 1,010 | 1,290 | 832 | 775 | 600 | 1,020 | 4,290 | 1,150 | 890 | 638 | 570 | 570 |
| 18 | 890 | 1,290 | 775 | 775 | 675 | 832 | 4,290 | 1,150 | 1,020 | 638 | 540 | 455 |
| 19 | 1,080 | 1,290 | 890 | 955 | 1,020 | 1,220 | 4,070 | 1,150 | 1,150 | 675 | 540 | 455 |
| 20 | 890 | 1,360 | 890 | 675 | 1,360 | 1,150 | 3,460 | 1,150 | 1,150 | 675 | 675 | 405 |
| 21 | 1,020 | 1,290 | 832 | 775 | 1,430 | 955 | 4,290 | 1,430 | 1,580 | 540 | 600 | 405 |
| 22 | 675 | 1,020 | 775 | 832 | 1,150 | 955 | 3,460 | 2,030 | 1,580 | 480 | 638 | 360 |
| 23 | 866 | 832 | 890 | 955 | 1,080 | 1,050 | 3,260 | 1,580 | 1,730 | 480 | 638 | 360 |
| 24 | 1,050 | 890 | 775 | 832 | 1,290 | 955 | 3,260 | 1,430 | 1,730 | 405 | 405 | 510 |
| 25 | 830 | 832 | 725 | 1,220 | 1,080 | 955 | 3,070 | 1,430 | 1,730 | 540 | 480 | 570 |
| 26 | 866 | 955 | 890 | 1,220 | 1,080 | 1,080 | 2,700 | 1,150 | 1,730 | 540 | 480 | 725 |
| 27 | 1,020 | 775 | 500 | 890 | 955 | 1,150 | 2,350 | 1,020 | 1,730 | 510 | 725 | 675 |
| 28 | 832 | 1,020 | 832 | 890 | 832 | 1,020 | 2,030 | 1,430 | 2,030 | 455 | 638 | 675 |
| 29 | 725 | 1,150 | 675 | 1,290 | ------- | 1,020 | 1,580 | 1,730 | 2,190 | 360 | 600 | 638 |
| 30 | 955 | 890 | 832 | 1,020 | ------- | 890 | 2,030 | 1,150 | 2,030 | 380 | 600 | 540 |
| 31 | 638 | ------- | 675 | 1,080 | ------- | 955 | ------- | 1,290 | ------- | 360 | 600 | ------- |

*Monthly discharge of Red Cedar River at Menomonie, Wis., for the year ending September 30, 1923*

[Drainage area, 1,810 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 1,150 | 638 | 930 | 0.514 | 0.59 |
| November | 1,430 | 638 | 1,060 | .586 | .65 |
| December | 1,220 | 500 | 862 | .476 | .55 |
| January | 1,290 | 675 | 911 | .503 | .58 |
| February | 1,430 | 600 | 966 | .534 | .56 |
| March | 1,290 | 832 | 1,050 | .580 | .67 |
| April | 7,740 | 890 | 3,310 | 1.83 | 2.04 |
| May | 2,030 | 770 | 1,300 | .718 | .83 |
| June | 2,190 | 890 | 1,360 | .751 | .84 |
| July | 2,030 | 360 | 870 | .481 | .55 |
| August | 725 | 320 | 495 | .273 | .31 |
| September | 890 | 360 | 584 | .323 | .36 |
| The year | 7,740 | 320 | 1,140 | .630 | 8.53 |

76612—26—WSP 565——6

### BLACK RIVER AT NEILLSVILLE, WIS.

LOCATION.—In sec. 15, T. 24 N., R. 2 W., at lower highway bridge in Neillsville, Clark County. O'Neill Creek enters from left 1 mile above gage and Cunningham Creek, also from left, 1½ miles below.

DRAINAGE AREA.—774 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—April 6, 1905, to March 31, 1909; December 11, 1913, to September 30, 1923.

GAGE.—Chain gage fastened to downstream side of highway bridge; read by A. Bissell.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Control at head of rapids, a few hundred feet below gage. Banks high and rocky; water will not overflow banks at gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.1 feet at 5 p. m. April 22 (discharge, 6,830 second-feet); minimum discharge estimated, 15 second-feet February 4.

1905–1909; 1913–1923: Maximum stage recorded, 19.8 feet June 6, 1905 (discharge, about 29,400 second-feet). The maximum discharge, which occurred October 6, 1911, probably exceeded 29,000 second-feet, although data are not available regarding stage at gage during this flood. Minimum discharge estimated as 5 second-feet during month of February, 1918.

REGULATION.—Several dams on Black River and tributaries upstream from Neillsville are used to create a head for developing power. Operation of these plants causes a slight diurnal fluctuation at gage, especially during winter when flow is at a minimum.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 28 and 15,000 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except as explained in footnote to table of daily discharge. Open-water records good except at extremely low stages, for which they are fair; winter records poor.

*Discharge measurements of Black River at Neillsville, Wis., during the year ending September 30, 1923*

[Made by E. E. Foster]

| Date | Gage height | Discharge | Date | Gage height | Discharge |
|---|---|---|---|---|---|
| | *Feet* | *Sec.-ft.* | | *Feet* | *Sec.-ft.* |
| Dec 22 | [a] 2.32 | 23 | Feb. 22 | [a] 3.55 | 20 |
| Jan. 17 | [a] 2.75 | 27 | June 29 | 4.27 | 562 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Black River at Neillsville, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 49 | 46 | 165 | 30 | 40 | 30 | 55 | 580 | 114 | 280 | 47 | 49 |
| 2 | 41 | 62 | 108 | 35 | 40 | 30 | 145 | 500 | 105 | 220 | 43 | 53 |
| 3 | 46 | 60 | 147 | 35 | 30 | 125 | 295 | 440 | 86 | 151 | 44 | 47 |
| 4 | 35 | 62 | 165 | 30 | 15 | 125 | 460 | 420 | 90 | 190 | 44 | 46 |
| 5 | 33 | 63 | 200 | 30 | 20 | 160 | 710 | 580 | 380 | 870 | 43 | 51 |
| 6 | 33 | 105 | 220 | 30 | 20 | 160 | 950 | 630 | 235 | 2,960 | 41 | 51 |
| 7 | 36 | 78 | 105 | 30 | 25 | 75 | 1,290 | 540 | 2,460 | 1,800 | 36 | 43 |
| 8 | 42 | 75 | 110 | 30 | 25 | 65 | 1,570 | 480 | 3,260 | 940 | 42 | 41 |
| 9 | 41 | 78 | 70 | 35 | 25 | 95 | 1,980 | 520 | 2,260 | 520 | 39 | 38 |
| 10 | 49 | 92 | 45 | 30 | 25 | 80 | 2,460 | 580 | 1,500 | 345 | 35 | 43 |
| 11 | 36 | 82 | 35 | 30 | 25 | 85 | 3,260 | 680 | 1,150 | 280 | 36 | 36 |
| 12 | 38 | 81 | 25 | 30 | 25 | 65 | 3,680 | 655 | 838 | 265 | 35 | 43 |
| 13 | 41 | 90 | 30 | 30 | 30 | 75 | 5,320 | 560 | 740 | 190 | 35 | 42 |
| 14 | 42 | 105 | 25 | 30 | 25 | 65 | 3,910 | 420 | 940 | 151 | 33 | 41 |
| 15 | 44 | 112 | 25 | 35 | 20 | 55 | 3,260 | 362 | 605 | 119 | 32 | 41 |
| 16 | 47 | 104 | 25 | 25 | 20 | 55 | 2,960 | 345 | 400 | 98 | 31 | 38 |
| 17 | 52 | 93 | 25 | 30 | 20 | 50 | 3,060 | 320 | 265 | 81 | 31 | 43 |
| 18 | 51 | 190 | 25 | 30 | 20 | 55 | 3,160 | 280 | 220 | 72 | 31 | 72 |
| 19 | 55 | 345 | 20 | 30 | 20 | 45 | 4,160 | 440 | 149 | 60 | 32 | 67 |
| 20 | 55 | 460 | 20 | 30 | 25 | 40 | 4,850 | 870 | 460 | 51 | 33 | 93 |
| 21 | 62 | 520 | 20 | 30 | 25 | 35 | 5,480 | 1,010 | 870 | 49 | 30 | 98 |
| 22 | 63 | 460 | 25 | 30 | 25 | 205 | 6,650 | 940 | 630 | 47 | 33 | 87 |
| 23 | 56 | 345 | 25 | 30 | 25 | 160 | 5,320 | 710 | 420 | 51 | 33 | 76 |
| 24 | 44 | 250 | 25 | 30 | 25 | 160 | 3,680 | 520 | 265 | 49 | 31 | 72 |
| 25 | 44 | 160 | 25 | 30 | 25 | 150 | 2,360 | 362 | 220 | 43 | 36 | 65 |
| 26 | 51 | 165 | 30 | 35 | 25 | 125 | 1,720 | 295 | 520 | 75 | 49 | 60 |
| 27 | 46 | 165 | 30 | 35 | 30 | 115 | 1,360 | 250 | 1,150 | 98 | 60 | 58 |
| 28 | 46 | 142 | 35 | 40 | 30 | 80 | 1,150 | 190 | 870 | 78 | 75 | 105 |
| 29 | 50 | 134 | 35 | 40 | ------- | 80 | 870 | 165 | 605 | 65 | 60 | 56 |
| 30 | 51 | 134 | 35 | 40 | ------- | 80 | 655 | 130 | 420 | 60 | 51 | 52 |
| 31 | 51 | ------- | 30 | 40 | ------- | 60 | ------- | 112 | ------- | 49 | 47 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 4 to Apr. 10; daily discharge ascertained by means of gage heights, three discharge measurements, observer's notes, and weather records.

*Monthly discharge of Black River at Neillsville, Wis., for the year ending September 30, 1923*

[Drainage area, 774 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 63 | 33 | 46.1 | 0.060 | 0.07 |
| November | 520 | 46 | 162 | .209 | .23 |
| December | 220 | 20 | 61.5 | .079 | .09 |
| January | 40 | 25 | 32.1 | .041 | .05 |
| February | 40 | 15 | 25.2 | .033 | .03 |
| March | 205 | 30 | 89.8 | .116 | .13 |
| April | 6,650 | 55 | 2,560 | 3.31 | 3.69 |
| May | 1,010 | 112 | 480 | .620 | .71 |
| June | 3,260 | 86 | 741 | .957 | 1.07 |
| July | 2,960 | 43 | 332 | .429 | .49 |
| August | 75 | 30 | 40.3 | .052 | .06 |
| September | 105 | 36 | 56.9 | .074 | .08 |
| The year | 6,650 | 15 | 383 | .495 | 6.70 |

### LA CROSSE RIVER NEAR WEST SALEM, WIS.

LOCATION.—In sec. 32, T. 17 N., R. 6 W., at highway bridge 2 miles west of West Salem, La Crosse County, and 10 miles above mouth of river. Dutch Creek enters from right 6 miles above station.

DRAINAGE AREA.—412 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 22, 1913, to September 30, 1923.

GAGE.—Chain attached to concrete guardrail on upstream side of bridge; read by J. R. Carlson.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached and by wading.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Right bank high and not subject to overflow; left bank above the gage low, and subject to overflow at flood stages. Channel free from vegetation; control for low stages a rock riffle with a fall of 6 inches. Control is apparently drowned out at a stage of about 2.2 feet, as shown by a reversal in the rating curve. Control is filled in with silt which leaks through dam above, causing a shifting control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.80 feet at 7 a. m. and 6 p. m. April 4 (discharge, 2,240 second-feet); minimum discharge estimated 100 second-feet December 17 and February 11.

1913–1923: Maximum stage recorded, 8.45 feet at 6 p. m. March 16, 1919 (discharge, about 3,620 second-feet); minimum stage, 0.75 foot at 7 a. m. September 3, 1921 (discharge, 96 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Diurnal fluctuation at gage, amounting at low stages to from 0.10 to 0.40 foot, is caused by operation of power plants, especially the Neshonoc Dam a few miles above the station.

ACCURACY.—Stage-discharge relation changed considerably during summer of 1923. Rating curve, well defined between 175 and 2,300 second-feet. Gage read to quarter-tenths twice daily. Some diurnal fluctuation at low stages. Daily discharge determined by shifting-control method as indicated by discharge measurements. Records poor.

*Discharge measurements of La Crosse River near West Salem, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 7 | E. E. Foster | 1.47 | 203 | Apr. 5 | E. E. Foster | 4.86 | 1,290 |
| Jan. 19 | do | [a] 2.02 | 203 | June 5 | S. B. Soulé | 1.48 | 229 |
| Feb. 23 | do | [a] 2.59 | 185 | 5 | do | 1.50 | 246 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of La Crosse River near West Salem, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 170 | 206 | 206 | 170 | 180 | 835 | 595 | 209 | 212 | 212 | 184 | 190 |
| 2 | 187 | 248 | 209 | 160 | 170 | 890 | 749 | 200 | 209 | 288 | 187 | 166 |
| 3 | 193 | 244 | 177 | 170 | 140 | 1,230 | 1,800 | 206 | 170 | 288 | 187 | 230 |
| 4 | 177 | 216 | 216 | 170 | 110 | 1,120 | 2,240 | 187 | 184 | 206 | 193 | 244 |
| 5 | 181 | 196 | 268 | 150 | 150 | 945 | 1,350 | 206 | 248 | 212 | 149 | 196 |
| 6 | 170 | 241 | 268 | 180 | 170 | 660 | 1,000 | 173 | 288 | 219 | 193 | 193 |
| 7 | 193 | 288 | 219 | 135 | 130 | 460 | 862 | 187 | 461 | 212 | 193 | 179 |
| 8 | 164 | 248 | 156 | 180 | 130 | 350 | 715 | 200 | 350 | 173 | 179 | 187 |
| 9 | 181 | 234 | 288 | 195 | 140 | 350 | 638 | 200 | 328 | 234 | 190 | 147 |
| 10 | 164 | 219 | 212 | 195 | 135 | 370 | 573 | 196 | 268 | 230 | 177 | 190 |
| 11 | 162 | 219 | 180 | 170 | 100 | 370 | 678 | 203 | 308 | 193 | 177 | 196 |
| 12 | 151 | 187 | 135 | 180 | 160 | 680 | 749 | 190 | 288 | 187 | 144 | 190 |
| 13 | 156 | 216 | 160 | 180 | 140 | 615 | 616 | 170 | 219 | 184 | 181 | 179 |
| 14 | 162 | 219 | 160 | 180 | 170 | 350 | 438 | 200 | 308 | 184 | 179 | 179 |
| 15 | 162 | 241 | 150 | 210 | 140 | 290 | 288 | 196 | 288 | 149 | 175 | 170 |
| 16 | 173 | 226 | 140 | 180 | 135 | 180 | 288 | 200 | 234 | 200 | 168 | 131 |
| 17 | 181 | 187 | 100 | 170 | 140 | 180 | 248 | 226 | 181 | 200 | 166 | 175 |
| 18 | 181 | 216 | 135 | 170 | 110 | 230 | 248 | 216 | 234 | 200 | 168 | 177 |
| 19 | 184 | 187 | 150 | 195 | 170 | 150 | 230 | 248 | 226 | 181 | 131 | 170 |
| 20 | 206 | 200 | 160 | 160 | 160 | 140 | 244 | 328 | 244 | 179 | 164 | 237 |
| 21 | 209 | 209 | 130 | 135 | 180 | 370 | 288 | 506 | 308 | 187 | 209 | 308 |
| 22 | 156 | 193 | 115 | 170 | 160 | 640 | 308 | 328 | 308 | 139 | 200 | 308 |
| 23 | 184 | 200 | 160 | 170 | 170 | 680 | 528 | 268 | 288 | 181 | 193 | 216 |
| 24 | 184 | 209 | 120 | 195 | 170 | 660 | 461 | 248 | 190 | 193 | 187 | 248 |
| 25 | 187 | 193 | 140 | 195 | 140 | 460 | 308 | 237 | 715 | 181 | 187 | 216 |
| 26 | 181 | 164 | 170 | 180 | 310 | 370 | 268 | 237 | 638 | 173 | 156 | 216 |
| 27 | 177 | 196 | 195 | 150 | 310 | 395 | 248 | 184 | 595 | 187 | 193 | 223 |
| 28 | 193 | 216 | 170 | 135 | 395 | 330 | 234 | 212 | 416 | 203 | 193 | 203 |
| 29 | 158 | 216 | 170 | 170 | ------ | 575 | 193 | 226 | 328 | 371 | 193 | 209 |
| 30 | 179 | 184 | 180 | 195 | ------ | 595 | 223 | 190 | 328 | 187 | 196 | 146 |
| 31 | 212 | ------ | 150 | 195 | ------ | 678 | ------ | 193 | ------ | 203 | 193 | ------ |

NOTE.—Stage-discharge relation affected by ice Dec. 11 to Mar. 30.

*Monthly discharge of La Crosse River near West Salem, Wis., for the year ending September 30, 1923*

[Drainage area, 412 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 212 | 151 | 178 | 0.432 | 0.50 |
| November | 288 | 164 | 214 | .519 | .58 |
| December | 288 | 100 | 174 | .422 | .49 |
| January | 210 | 135 | 174 | .422 | .49 |
| February | 395 | 100 | 168 | .408 | .42 |
| March | 1,230 | 140 | 521 | 1.26 | 1.45 |
| April | 2,240 | 193 | 587 | 1.42 | 1.58 |
| May | 506 | 170 | 225 | .546 | .63 |
| June | 715 | 170 | 312 | .757 | .84 |
| July | 371 | 139 | 204 | .495 | .57 |
| August | 209 | 131 | 180 | .437 | .50 |
| September | 308 | 131 | 201 | .488 | .54 |
| The year | 2,240 | 100 | 262 | .636 | 8.59 |

### UPPER IOWA RIVER NEAR DECORAH, IOWA

LOCATION.—In sec. 13, T. 98 N., R. 8 W., 500 feet above highway bridge in Freeport, 3 miles below Decorah, Winneshiek County, and 4 miles above upper power plant of Interstate Power Co. Nearest tributary, Trout Run, enters from right 1 mile above station.

DRAINAGE AREA.—560 square miles (measured on United States Geological Survey map; scale, 1:500,000).

RECORDS AVAILABLE.—August 27, 1913 to November 21, 1914; May 12, 1919, to September 30, 1923.

GAGE.—Gurley seven-day graphic water-stage recorder on left bank 500 feet above highway bridge, attended by Mrs. W. D. Gross. Prior to August 28, 1920, chain gage attached to highway bridge used.

DISCHARGE MEASUREMENTS.—Made from bridge and by wading.

CHANNEL AND CONTROL.—A rock ledge probably forms a permanent control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.85 feet at noon, April 3 (discharge, 6,760 second-feet); minimum discharge, about 21 second-feet February 15.

1913–14; 1919–1923: Maximum discharge recorded, 14,700 second-feet February 22, 1922; minimum discharge, that of February 15, 1923.

ICE.—Stage-discharge relation affected by ice for short periods during extremely cold weather.

REGULATION.—Several mills in Decorah may cause slight diurnal fluctuation.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well defined between 100 and 12,000 second-feet. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspection of recorder-graph except as explained in footnote to table of daily discharge. Records good.

*Discharge measurements of Upper Iowa River near Decorah, Iowa, during the year ending September 30, 1923*

[Made by J. B. Spiegel]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Feb. 20 | [a] 1.85 | 41 |
| June 26 | 1.65 | 92 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Upper Iowa River near Decorah, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 93 | 118 | 86 | 84 | 74 | 535 | 1,060 | 242 | 84 | 95 | 62 | 172 |
| 2 | 86 | 128 | 76 | 74 | 64 | 890 | 2,610 | 227 | 82 | 93 | 68 | 99 |
| 3 | 86 | 128 | 86 | 74 | 57 | 770 | 6,650 | 232 | 91 | 90 | 66 | 80 |
| 4 | 82 | 125 | 97 | 72 | 52 | 330 | 5,310 | 204 | 88 | 88 | 62 | 106 |
| 5 | 78 | 118 | 104 | 70 | 50 | 217 | 2,310 | 187 | 82 | 85 | 61 | 122 |
| 6 | 88 | 123 | 95 | 76 | 54 | 234 | 1,230 | 184 | 80 | 82 | 59 | 88 |
| 7 | 113 | 128 | 111 | 68 | 59 | 220 | 920 | 178 | 84 | 80 | 64 | 88 |
| 8 | 125 | 120 | 118 | 74 | 64 | 187 | 596 | 175 | 86 | 80 | 62 | 86 |
| 9 | 108 | 113 | 95 | 76 | 64 | 231 | 475 | 175 | 86 | 82 | 54 | 88 |
| 10 | 104 | 111 | 86 | 78 | 64 | 392 | 486 | 172 | 86 | 276 | 57 | 82 |
| 11 | 91 | 104 | 82 | 74 | 61 | 557 | 480 | 169 | 86 | 118 | 64 | 76 |
| 12 | 88 | 106 | 82 | 78 | 54 | 440 | 374 | 172 | 85 | 125 | 57 | 72 |
| 13 | 86 | 116 | 82 | 76 | 39 | 252 | 356 | 135 | 85 | 95 | 56 | 68 |
| 14 | 86 | 120 | 80 | 70 | 26 | 197 | 296 | 106 | 85 | 84 | 54 | 66 |
| 15 | 91 | 108 | 79 | 78 | 21 | 125 | 321 | 111 | 85 | 84 | 52 | 66 |
| 16 | 80 | 108 | 78 | 78 | 27 | 118 | 300 | 108 | 84 | 82 | 54 | 66 |
| 17 | 84 | 108 | 77 | 78 | 37 | 163 | 276 | 108 | 84 | 82 | 64 | 68 |
| 18 | 84 | 108 | 75 | 70 | 40 | 100 | 296 | 106 | 84 | 82 | 57 | 66 |
| 19 | 88 | 106 | 70 | 86 | 40 | 120 | 292 | 108 | 84 | 84 | 54 | 130 |
| 20 | 88 | 102 | 73 | 78 | 41 | 163 | 300 | 111 | 84 | 80 | 61 | 152 |
| 21 | 93 | 104 | 75 | 84 | 52 | 256 | 317 | 106 | 163 | 80 | 68 | 125 |
| 22 | 88 | 95 | 76 | 88 | 84 | 590 | 383 | 102 | 144 | 80 | 61 | 108 |
| 23 | 91 | 88 | 77 | 86 | 130 | 557 | 347 | 97 | 144 | 78 | 61 | 104 |
| 24 | 93 | 84 | 78 | 84 | 204 | 552 | 330 | 99 | 144 | 80 | 56 | 102 |
| 25 | 88 | 84 | 79 | 84 | 455 | 496 | 330 | 95 | 128 | 78 | 54 | 97 |
| 26 | 86 | 93 | 80 | 80 | 1,150 | 486 | 330 | 97 | 106 | 76 | 50 | 95 |
| 27 | 86 | 99 | 82 | 84 | 632 | 602 | 313 | 93 | 97 | 76 | 61 | 93 |
| 28 | 97 | 82 | 82 | 84 | 491 | 590 | 288 | 93 | 106 | 80 | 54 | 91 |
| 29 | 97 | 82 | 84 | 99 | ------- | 860 | 280 | 88 | 111 | 72 | 57 | 296 |
| 30 | 86 | 91 | 84 | 82 | ------- | 1,090 | 268 | 84 | 97 | 64 | 61 | 200 |
| 31 | 102 | ------- | 80 | 80 | ------- | 890 | ------- | 84 | ------- | 62 | 88 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 15–28, Feb. 2–23, Mar. 18 and 19; daily discharge determined from gage heights corrected for effect of ice by means of one discharge measurement and weather records. Daily discharge interpolated June 10–15 and July 1–6.

*Monthly discharge of Upper Iowa River near Decorah, Iowa, for the year ending September 30, 1923*

[Drainage area, 560 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 125 | 78 | 91.5 | 0.163 | 0.19 |
| November | 128 | 82 | 107 | .191 | .21 |
| December | 118 | 70 | 84.2 | .150 | .17 |
| January | 99 | 68 | 78.9 | .141 | .16 |
| February | 1,150 | 21 | 150 | .268 | .28 |
| March | 1,090 | 100 | 426 | .761 | .88 |
| April | 6,650 | 268 | 937 | 1.67 | 1.86 |
| May | 242 | 84 | 137 | .245 | .28 |
| June | 163 | 80 | 97.8 | .175 | .20 |
| July | 276 | 62 | 90.1 | .161 | .19 |
| August | 88 | 50 | 60.0 | .107 | .12 |
| September | 296 | 66 | 105 | .188 | .21 |
| The year | 6,650 | 21 | 196 | .350 | 4.75 |

### WISCONSIN RIVER AT WHIRLPOOL RAPIDS, NEAR RHINELANDER, WIS.

LOCATION.—In sec. 4, T. 35 N., R. 8 E., at head of Whirlpool Rapids, 1 mile below mouth of outlet of Crescent Lake, entering from right and 3 miles downstream from power station of Rhinelander Power Co., 10 miles southwest of Rhinelander, Oneida County.

DRAINAGE AREA.—1,160 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch= 6 miles).

RECORDS AVAILABLE.—September 15, 1915, to September 30, 1923. December 1, 1905, to September 30, 1915, records were collected at a station 3 miles upstream.

GAGE.—Stevens continuous water-stage recorder on right bank.

DISCHARGE MEASUREMENTS.—Made from cable 150 feet above gage.

CHANNEL AND CONTROL.—Bed of stream composed of heavy gravel and rock. Banks medium high and not subject to overflow. Control is head of rapids, 100 feet downstream from gage; well defined and permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.24 feet at 11 a. m. April 23 (discharge, 4,590 second-feet); minimum stage recorded 1.18 feet at 8 p. m. August 5 (discharge, 345 second-feet).

1905–1923: Maximum stage recorded, 5.61 feet at 10 p. m. April 22, 1916 (discharge, 5,250 second-feet); minimum discharge, no flow, at old station during August and September, 1907, and June, 1908. The minimum flow is caused almost entirely by regulation and at the present location probably will never be zero. Minimum stage at present location, 0.65 foot at 8 p. m. July 7, 1918 (discharge, 165 second-feet).

REGULATION.—Above the station are 14 reservoirs [3] which are operated by the Wisconsin Valley Improvement Co. for the purpose of regulating the flow of Wisconsin River. The aggregate capacity of these reservoirs is 2.8 billion cubic feet during summer and 3.6 billion cubic feet during winter.

In addition to above reservoirs, there are on the Wisconsin River above this station three power plants. Owing to operation of these various storage reservoirs and service reservoirs in connection with the power plants, flow at station is not natural.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined throughout. Recording gage operating satisfactorily except during winter and about 15 per cent of open-water periods. For periods when recording gage records were available daily discharge was obtained by use of discharge integrator; during periods when stage-discharge relation was affected by ice or gage was not in operation, daily discharge was obtained from gage readings, weather records, and one discharge measurement at Hat Rapids. Open-water records when recording gage was in operation excellent; other records fair.

*Discharge measurements of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge |
|---|---|---|---|
| | | *Feet* | *Sec.-ft.* |
| Oct. 24 | S. B. Soulé | 2.19 | 886 |
| Jan. 14 | J. H. Olson | [4] 1.70 | [4] 272 |
| July 23 | E. E. Foster | 2.62 | 1,160 |

[3] Information concerning these reservoirs, based on maps and data furnished by W. E. Brooks, manager of the Wisconsin Valley Improvement Co., and data collected by the engineering department of the Railroad Commission of Wisconsin, is contained in United States Geological Survey Water-Supply Paper 405, p. 127.

[4] Gage height and discharge at Hat Rapids.

*Daily discharge, in second-feet, of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 640 | 1,090 | 805 | 585 | 800 | 1,010 | 800 | 2,340 | 1,100 | 1,640 | 985 | 972 |
| 2 | 554 | 856 | 852 | 755 | 800 | 985 | 545 | 2,350 | 990 | 1,510 | 918 | 942 |
| 3 | 762 | 948 | 680 | 840 | 840 | 935 | 890 | 2,390 | 1,100 | 1,410 | 840 | 1,100 |
| 4 | 827 | 946 | 548 | 775 | 840 | 910 | 755 | 2,520 | 600 | 1,440 | 746 | 892 |
| 5 | 1,070 | 636 | 627 | 735 | 610 | 585 | 715 | 2,810 | 1,140 | 1,260 | 466 | 1,080 |
| 6 | 731 | 726 | 985 | 800 | 755 | 890 | 715 | 1,660 | 1,100 | 1,310 | 741 | 967 |
| 7 | 822 | 1,020 | 882 | 755 | 890 | 935 | 715 | 1,700 | 1,480 | 1,390 | 930 | 980 |
| 8 | 718 | 1,000 | 865 | 585 | 800 | 890 | 1,010 | 1,050 | 1,830 | 1,040 | 976 | 1,210 |
| 9 | 570 | 854 | 840 | 800 | 800 | 935 | 585 | 1,760 | 1,680 | 1,110 | 949 | 748 |
| 10 | 900 | 876 | 800 | 800 | 840 | 910 | 840 | 1,800 | 2,120 | 1,320 | 1,010 | 935 |
| 11 | 786 | 890 | 595 | 755 | 865 | 1,120 | 840 | 1,750 | 1,560 | 1,280 | 1,010 | 1,090 |
| 12 | 744 | 840 | 755 | 840 | 610 | 585 | 735 | 1,710 | 2,120 | 1,270 | 637 | 1,080 |
| 13 | 725 | 505 | 820 | 820 | 890 | 935 | 735 | 1,350 | 2,060 | 1,330 | 736 | 965 |
| 14 | 646 | 915 | 840 | 820 | 840 | 820 | 715 | 1,510 | 2,220 | 1,380 | 1,020 | 1,270 |
| 15 | 538 | 865 | 840 | 570 | 800 | 840 | 800 | 1,600 | 2,400 | 1,410 | 926 | 910 |
| 16 | 696 | 840 | 865 | 910 | 935 | 800 | 530 | 1,580 | 3,450 | 1,440 | 720 | 865 |
| 17 | 851 | 868 | 775 | 800 | 935 | 775 | 890 | 1,570 | 1,860 | 1,420 | 728 | 725 |
| 18 | 795 | 854 | 585 | 985 | 1,060 | 775 | 960 | 1,400 | 1,890 | 1,350 | 766 | 1,000 |
| 19 | 835 | 668 | 1,040 | 890 | 585 | 530 | 980 | 1,370 | 1,650 | 1,510 | 618 | 1,000 |
| 20 | 834 | 682 | 960 | 840 | 935 | 890 | 1,300 | 988 | 1,750 | 1,540 | 802 | 965 |
| 21 | 926 | 870 | 890 | 775 | 890 | 755 | 2,330 | 1,100 | 2,120 | 1,400 | 1,050 | 890 |
| 22 | 584 | 740 | 800 | 585 | 985 | 715 | 4,000 | 1,420 | 1,820 | 1,180 | 900 | 873 |
| 23 | 720 | 780 | 800 | 840 | 755 | 755 | 3,780 | 1,360 | 2,310 | 1,120 | 688 | 1,060 |
| 24 | 770 | 880 | 1,040 | 820 | 935 | 735 | 3,500 | 1,320 | 2,790 | 1,270 | 838 | 632 |
| 25 | 939 | 924 | 595 | 775 | 1,090 | 820 | 4,080 | 1,270 | 2,120 | 1,140 | 1,050 | 850 |
| 26 | 973 | 698 | 715 | 800 | 570 | 530 | 4,020 | 1,200 | 1,800 | 1,120 | 563 | 847 |
| 27 | 1,020 | 634 | 935 | 840 | 1,150 | 840 | 4,100 | 728 | 1,850 | 1,040 | 647 | 855 |
| 28 | 966 | 845 | 820 | 865 | 1,040 | 715 | 4,200 | 880 | 1,850 | 884 | 849 | 800 |
| 29 | 522 | 836 | 800 | 585 | ------- | 755 | 3,120 | 1,140 | 1,710 | 694 | 936 | 832 |
| 30 | 728 | 740 | 865 | 840 | ------- | 715 | 2,700 | 1,040 | 1,580 | 773 | 942 | 770 |
| 31 | 982 | ------- | 985 | 890 | ------- | 715 | ------- | 1,240 | ------- | 1,040 | 984 | ------- |

NOTE.—Gage not operating on account of ice conditions Dec. 3, 6, and Dec. 8 to Apr. 21; stage-discharge relation affected by ice the greater part of this period. Gage not operating satisfactorily Nov. 11-16, May 29 to June 16, and Sept. 13-21. Daily discharge based on a study of gage heights at Hat Rapids power plant as compared with flow at station.

*Monthly discharge of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., for the year ending September 30, 1923*

[Drainage area, 1,160 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 1,070 | 522 | 780 | 0.672 | 0.77 |
| November | 1,090 | 505 | 828 | .714 | .80 |
| December | 1,040 | 548 | 813 | .701 | .81 |
| January | 985 | 570 | 783 | .675 | .78 |
| February | 1,150 | 570 | 852 | .734 | .76 |
| March | 1,120 | 530 | 810 | .698 | .80 |
| April | 4,200 | 530 | 1,730 | 1.49 | 1.66 |
| May | 2,810 | 728 | 1,550 | 1.34 | 1.54 |
| June | 3,450 | 600 | 1,800 | 1.55 | 1.73 |
| July | 1,640 | 694 | 1,260 | 1.09 | 1.26 |
| August | 1,050 | 466 | 838 | .722 | .83 |
| September | 1,270 | 632 | 937 | .808 | .90 |
| The year | 4,200 | 466 | 1,080 | .931 | 12.64 |

### WISCONSIN RIVER AT MERRILL, WIS.

LOCATION.—At highway bridge at east end of Merrill, Lincoln County, 1,000 feet below power house of Merrill plant of Wisconsin Valley Lighting Co., and half a mile below mouth of Prairie River, which enters from left.

DRAINAGE AREA.—2,630 square miles (measured on Wisconsin Geological and Natural History Survey map, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—November 16, 1902, to September 30, 1923.

GAGE.—Gurley water-stage recorder installed July 1, 1923, which replaced a Stevens water-stage recorder installed September 11, 1914; November 16, 1902, to June 17, 1903, staff gage; June 17, 1903, to September 10, 1914, chain gage attached to downstream side of highway bridge; datum same since June 17, 1903; records prior to this date questionable. Recorder inspected by O. F. Lueck.

DISCHARGE MEASUREMENTS.—Made from highway bridge a few feet upstream from gage.

CHANNEL AND CONTROL.—Bed of river composed of heavy gravel and rock; nearly permanent. Small island below gage and small rapids on either side probably constitute control. Banks fairly high and are seldom overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.87 feet at noon April 22 (discharge, 20,700 second-feet). Minimum discharge about 365 second-feet at 1 a. m. February 13; caused by regulation.

1902–1923: Maximum stage recorded, about 17.5 feet at 5 a. m. July 24, 1912 (discharge, 45,000 second-feet); minimum stage, 2.45 feet September 26, 1908 (discharge, about 90 second-feet). During the 24 hours preceding the maximum discharge, 11.25 inches of rain fell near Merrill. According to C. B. Stewart, consulting engineer, Madison, the run-off of the 700 square miles between Merrill and Tomahawk was at the rate of 65 second-feet per square mile. If the estimate is extended to the entire area above Merrill, the flow was 17 second-feet per square mile.

REGULATION.—Above the gaging station are 17 reservoirs,[4] which are operated by Wisconsin Valley Improvement Co. for the purpose of regulating the flow in Wisconsin River. The aggregate capacity of these reservoirs is 6¼ billion cubic feet. In addition to the above reservoirs, there are on the Wisconsin and Tomahawk Rivers above the station eight dams operated for power.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well developed between 1,000 and 19,400 second-feet. Operation of water-stage recorder excellent throughout year. Daily discharge determined by means of discharge integrator with correction for effect of ice during winter. Open-water records excellent; winter records good.

*Discharge measurements of Wisconsin River at Merrill, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 25 | E. E. Foster | 4.32 | 1,190 | Apr. 24 | S. B. Soulé | 9.44 | 12,800 |
| Jan. 11 | J. H. Olson | [a] 4.84 | 1,400 | June 27 | E. E. Foster | 6.29 | 4,420 |
| Feb. 21 | do | [a] 5.02 | 1,510 | | | | |

[4] Information concerning these reservoirs, based on maps and data furnished by the manager of Wisconsin Valley Improvement Co., and data collected by the engineering department of the Wisconsin Railroad Commission, is contained in U. S. Geol. Survey Water-Supply Paper 405, p 127.

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of the Wisconsin River at Merrill, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 930 | 1,540 | 1,970 | 1,180 | 1,430 | 1,510 | 1,090 | 6,410 | 1,880 | 2,040 | 1,530 | 1,720 |
| 2 | 1,100 | 1,860 | 1,640 | 1,140 | 1,120 | 1,620 | 862 | 5,640 | 1,740 | 1,950 | 2,010 | 1,930 |
| 3 | 1,500 | 1,880 | 2,080 | 1,390 | 1,310 | 1,300 | 1,250 | 5,640 | 2,140 | 2,000 | 1,640 | 1,860 |
| 4 | 1,350 | 1,680 | 1,580 | 1,320 | 1,670 | 1,190 | 1,350 | 5,230 | 2,530 | 1,780 | 1,600 | 2,040 |
| 5 | 1,430 | 1,780 | 1,320 | 1,280 | 1,460 | 1,250 | 1,580 | 5,830 | 2,440 | 2,570 | 1,740 | 1,940 |
| 6 | 1,610 | 1,410 | 1,580 | 1,370 | 995 | 1,210 | 1,810 | 5,530 | 3,000 | 2,500 | 1,590 | 2,100 |
| 7 | 1,710 | 1,620 | 1,750 | 1,290 | 1,270 | 1,360 | 1,550 | 4,000 | 7,230 | 2,530 | 1,500 | 2,240 |
| 8 | 1,680 | 1,780 | 1,880 | 1,290 | 1,260 | 1,320 | 1,620 | 4,150 | 10,300 | 2,860 | 1,660 | 2,000 |
| 9 | 1,220 | 1,840 | 1,820 | 1,140 | 1,200 | 1,420 | 1,620 | 4,230 | 10,800 | 3,250 | 1,380 | 2,000 |
| 10 | 1,330 | 1,820 | 1,880 | 1,450 | 907 | 1,320 | 1,860 | 4,180 | 8,980 | 2,400 | 2,020 | 1,670 |
| 11 | 1,470 | 2,000 | 1,180 | 1,270 | 924 | 1,430 | 2,090 | 4,140 | 6,730 | 3,300 | 1,740 | 1,980 |
| 12 | 1,510 | 1,840 | 1,200 | 1,400 | 772 | 1,260 | 2,370 | 4,030 | 6,500 | 2,900 | 1,670 | 1,540 |
| 13 | 1,480 | 1,430 | 1,210 | 1,460 | 750 | 1,180 | 2,190 | 3,660 | 5,520 | 2,830 | 1,600 | 1,630 |
| 14 | 1,710 | 1,580 | 1,480 | 1,380 | 1,420 | 1,500 | 2,060 | 2,970 | 4,530 | 2,280 | 1,180 | 1,910 |
| 15 | 1,500 | 2,020 | 1,360 | 1,220 | 1,340 | 1,470 | 2,430 | 3,440 | 4,440 | 2,720 | 1,370 | 1,800 |
| 16 | 1,000 | 1,880 | 1,450 | 1,140 | 1,260 | 1,250 | 2,210 | 3,220 | 4,440 | 3,310 | 1,580 | 1,100 |
| 17 | 1,410 | 1,960 | 1,460 | 1,380 | 1,220 | 1,130 | 2,940 | 3,180 | 4,140 | 2,320 | 1,540 | 1,640 |
| 18 | 1,400 | 2,070 | 1,400 | 1,420 | 1,040 | 1,210 | 5,410 | 2,890 | 3,240 | 2,120 | 1,540 | 1,600 |
| 19 | 1,580 | 2,980 | 1,090 | 1,320 | 1,310 | 920 | 8,300 | 2,780 | 3,180 | 2,020 | 1,660 | 2,020 |
| 20 | 1,540 | 2,360 | 1,370 | 1,540 | 1,120 | 980 | 14,200 | 4,620 | 3,290 | 2,090 | 1,370 | 1,800 |
| 21 | 1,680 | 2,640 | 1,530 | 1,300 | 1,170 | 1,210 | 18,500 | 4,430 | 3,580 | 2,240 | 1,600 | 1,950 |
| 22 | 1,820 | 2,920 | 1,410 | 1,110 | 1,170 | 1,180 | 20,300 | 3,800 | 3,980 | 2,030 | 1,590 | 1,700 |
| 23 | 1,460 | 2,320 | 1,350 | 1,120 | 1,170 | 1,200 | 17,200 | 3,410 | 3,330 | 2,360 | 1,490 | 1,730 |
| 24 | 1,450 | 1,990 | 1,380 | 1,290 | 1,120 | 1,310 | 13,600 | 3,440 | 3,660 | 1,930 | 1,860 | 1,590 |
| 25 | 1,510 | 1,740 | 1,370 | 1,180 | 1,310 | 1,240 | 11,600 | 3,260 | 4,870 | 2,010 | 1,540 | 1,740 |
| 26 | 1,630 | 1,940 | 1,080 | 1,180 | 1,080 | 1,140 | 10,700 | 2,350 | 5,090 | 1,940 | 1,800 | 1,460 |
| 27 | 1,750 | 1,640 | 1,630 | 1,240 | 885 | 1,340 | 9,880 | 2,250 | 4,250 | 2,230 | 1,670 | 1,510 |
| 28 | 1,880 | 1,760 | 1,600 | 1,300 | 1,410 | 1,370 | 9,540 | 2,680 | 3,700 | 1,840 | 1,540 | 1,700 |
| 29 | 1,640 | 1,880 | 1,280 | 1,260 | ------- | 1,220 | 8,840 | 2,110 | 3,200 | 1,940 | 1,600 | 1,540 |
| 30 | 1,430 | 2,030 | 1,320 | 1,180 | ------- | 1,230 | 7,320 | 1,990 | 2,750 | 1,620 | 1,430 | 1,900 |
| 31 | 1,450 | ------- | 1,230 | 1,550 | ------- | 1,130 | ------- | 1,920 | ------- | 1,500 | 1,740 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 11 to Apr. 5. Water-stage recorder not operating satisfactorily June 28–30 and Sept. 10 and 11; daily discharge estimated.

*Monthly discharge of the Wisconsin River at Merrill, Wis., for the year ending September 30, 1923*

[Drainage area, 2,630 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 1,880 | 930 | 1,490 | 0.567 | 0.65 |
| November | 2,980 | 1,410 | 1,940 | .738 | .82 |
| December | 2,080 | 1,080 | 1,480 | .563 | .65 |
| January | 1,550 | 1,110 | 1,290 | .490 | .56 |
| February | 1,670 | 750 | 1,180 | .449 | .47 |
| March | 1,620 | 920 | 1,270 | .483 | .56 |
| April | 20,300 | 862 | 6,210 | 2.36 | 2.63 |
| May | 6,410 | 1,920 | 3,790 | 1.44 | 1.66 |
| June | 10,800 | 1,740 | 4,520 | 1.72 | 1.92 |
| July | 3,310 | 1,500 | 2,300 | .875 | 1.01 |
| August | 2,020 | 1,180 | 1,610 | .612 | .71 |
| September | 2,240 | 1,100 | 1,780 | .677 | .76 |
| The year | 20,300 | 750 | 2,400 | .913 | 12.40 |

### WISCONSIN RIVER AT KNOWLTON, WIS.

LOCATION.—In N. ½ sec. 29, T. 26 N., R. 7 E., 50 feet below left end of combination railroad-highway bridge of Chicago, Milwaukee & St. Paul Railway and on State trunk highway No. 73 at Knowlton, Marathon County, 1½ miles below mouth of Big Eau Pleine River, which enters from right.

DRAINAGE AREA.—4,360 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 13, 1921, to September 30, 1923. Gage heights May 1, 1915, to July 12, 1921, published by United States Weather Bureau.

GAGE.—Gurley water-stage recorder installed August 6, 1921; inspected by W. T. Gunther. Gage previously used Friez automatic gage installed July 13, 1921. Both gages located 50 feet below left end of bridge. The United States Weather Bureau installed a chain gage on downstream handrail of bridge 150 feet from left end July 15, 1914, which is used as a reference for the recording gage.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge, from a boat, or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and light gravel. Control not well defined; there is, however, a decided contraction of the channel at an island 2,500 feet below gage. Right bank high and is seldom overflowed; left bank of medium height and is overflowed at extreme flood stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.55 feet at 5 a. m. April 22 (discharge, about 38,600 second-feet); minimum discharge about 1,080 second-feet March 3.

1921–1923: Maximum stage recorded, 19.5 feet at 10 p. m. April 10, 1922 (discharge, 49,800 second-feet); minimum stage, 1.0 foot at 2 a. m. August 15, 1921 (discharge, about 900 second-feet).

REGULATION.—No storage reservoirs discharge into Wisconsin River between Knowlton and Merrill. See "Regulation" in station description of Wisconsin River at Merrill (p. 76). Between Knowlton and Merrill are four dams operated for power.

ACCURACY.—Stage-discharge relation permanent. Rating curve fairly well defined between 1,600 and 30,000 second-feet. Operation of water-stage recorder satisfactory during 90 per cent of open-water period. Daily discharge obtained by use of discharge integrator except as shown in footnote to table of daily discharge. Open-water records fair; winter records poor.

*Discharge measurements of Wisconsin River at Knowlton, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Jan. 9 | J. H. Olson | [a] 4.19 | 1,950 | Apr. 21 | S. B. Soulé | 15.83 | 38,500 |
| Feb. 19 | do | [a] 3.94 | 1,360 | July 9 | E. E. Foster | 4.58 | 4,710 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Wisconsin River at Knowlton, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2,300 | 2,270 | 2,740 | 1,940 | | 1,540 | 1,660 | 11,500 | 2,800 | 3,190 | 2,520 | 2,820 |
| 2 | 2,320 | 1,930 | 3,050 | 1,940 | | 1,440 | 1,650 | 8,310 | 2,300 | 3,820 | 2,300 | 2,440 |
| 3 | 1,800 | 1,930 | 2,410 | 1,940 | | 1,360 | 1,960 | 7,550 | 1,660 | 3,690 | 2,180 | 2,950 |
| 4 | 2,020 | 2,370 | 2,560 | 1,940 | | 1,400 | 2,160 | 7,320 | 3,110 | 4,230 | 2,440 | 3,380 |
| 5 | 1,790 | 2,300 | 2,750 | 1,900 | | 1,440 | 2,300 | 6,800 | 3,080 | 4,010 | 1,900 | 2,690 |
| 6 | | 2,350 | 2,440 | 1,900 | | 1,680 | 1,930 | 7,460 | 3,210 | 4,770 | 1,860 | 3,060 |
| 7 | | 2,660 | 2,570 | 1,840 | | 1,680 | 2,120 | 6,400 | 5,020 | 5,200 | 2,600 | 3,270 |
| 8 | 1,820 | 2,340 | 2,540 | 1,780 | | 1,680 | 2,520 | 5,960 | 9,800 | 5,180 | 2,800 | 3,380 |
| 9 | | 2,130 | 2,520 | 2,080 | | 1,640 | 3,290 | 5,700 | 12,600 | 5,200 | 2,630 | 3,700 |
| 10 | | 2,700 | 2,200 | 2,000 | | 1,600 | 4,060 | 5,440 | 12,400 | 4,840 | 2,440 | 2,790 |
| 11 | | 2,940 | 1,720 | 1,940 | | 1,600 | 5,220 | 5,200 | 10,400 | 4,390 | 2,240 | 3,110 |
| 12 | | 2,220 | 1,760 | 1,650 | | 1,680 | 8,650 | 5,370 | 7,220 | 5,200 | 1,790 | 2,480 |
| 13 | 1,970 | 2,580 | 2,030 | 1,560 | | 1,760 | 14,500 | 4,940 | 6,600 | 5,190 | 2,240 | 2,420 |
| 14 | | 2,840 | 2,070 | 1,830 | | 1,800 | 19,000 | 5,110 | 5,730 | 4,400 | 2,460 | 2,880 |
| 15 | | 2,300 | 2,120 | 1,740 | 1,630 | 1,850 | 19,100 | 4,360 | 5,290 | 3,680 | 2,560 | 3,190 |
| 16 | 1,520 | 2,310 | 2,200 | 1,890 | | 1,850 | 19,300 | 4,450 | 4,750 | 3,920 | 2,530 | 2,580 |
| 17 | 2,380 | 2,900 | 2,060 | 1,640 | | 1,760 | 15,100 | 4,370 | 4,370 | 4,030 | 2,490 | 2,660 |
| 18 | 1,890 | 3,050 | 2,080 | 1,640 | | 1,850 | 12,800 | 4,270 | 4,680 | 3,820 | 2,530 | 2,700 |
| 19 | 1,920 | 3,160 | 2,120 | 1,600 | | 1,940 | 17,800 | 4,060 | 3,930 | 2,980 | 1,990 | 2,720 |
| 20 | 1,870 | 4,630 | 2,120 | 1,860 | | 2,020 | 25,800 | 4,420 | 4,030 | 2,760 | 2,520 | 3,050 |
| 21 | 2,050 | 4,520 | 2,120 | 1,740 | | 1,710 | 33,800 | 7,180 | 3,810 | 2,920 | | 3,240 |
| 22 | 1,780 | 4,430 | 2,120 | 1,710 | | 2,060 | 35,500 | 7,050 | | 2,690 | | 3,170 |
| 23 | 2,120 | 4,390 | 2,160 | 1,940 | | 2,110 | 31,500 | 5,570 | 4,280 | 3,170 | 2,340 | 3,130 |
| 24 | 2,300 | 3,570 | 1,970 | 1,630 | | 2,110 | 24,300 | 4,840 | | 3,650 | | 2,620 |
| 25 | 2,010 | 3,060 | 1,960 | 1,650 | | 1,650 | 19,100 | 4,660 | | 3,360 | | 3,220 |
| 26 | 2,020 | 2,830 | 1,980 | 1,800 | | 1,620 | 16,200 | 4,170 | 4,810 | 2,940 | 2,410 | 3,000 |
| 27 | 1,900 | 2,890 | 1,920 | 1,760 | | 1,940 | 13,800 | 2,830 | 4,600 | 2,840 | 2,450 | 2,920 |
| 28 | 2,030 | 3,010 | 1,730 | 1,680 | | 1,830 | 13,000 | 3,490 | 4,700 | 2,950 | 2,890 | 2,530 |
| 29 | 2,100 | 2,730 | 2,000 | 1,680 | | 2,030 | 12,700 | 3,520 | 4,520 | 2,520 | 3,140 | 2,530 |
| 30 | 2,180 | 2,370 | 1,980 | 1,720 | | 1,640 | 10,700 | 2,800 | 4,210 | 2,580 | 2,800 | 2,050 |
| 31 | 2,250 | | 1,850 | 1,760 | | 1,740 | | 3,110 | | 2,490 | 2,830 | |

NOTE.—Stage-discharge relation affected by ice Dec. 4 to Apr. 12. Recording gage not operating satisfactorily Oct. 6–15, 28–31, Dec. 7, 8, 11–22, Dec. 30 to Jan. 5, Jan. 22 to Mar. 1, Mar. 10–14, May 9–10, June 21–26, Aug. 21–25. Discharge determined by comparison with records of flow of Wisconsin River at Merril.

*Monthly discharge of Wisconsin River at Knowlton, Wis., for the year ending September 30, 1923*

[Drainage area, 4,360 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 2,380 | 1,520 | 1,980 | 0.454 | 0.52 |
| November | 4,630 | 1,930 | 2,860 | .656 | .73 |
| December | 3,050 | 1,720 | 2,190 | .502 | .58 |
| January | 2,080 | 1,560 | 1,800 | .413 | .48 |
| February | | | 1,630 | .374 | .39 |
| March | 2,110 | 1,360 | 1,740 | .399 | .46 |
| April | 35,500 | 1,650 | 13,100 | 3.00 | 3.35 |
| May | 11,500 | 2,800 | 5,430 | 1.25 | 1.44 |
| June | 12,600 | 1,660 | 5,220 | 1.20 | 1.34 |
| July | 5,200 | 2,490 | 3,760 | .862 | .99 |
| August | 3,140 | 1,790 | 2,430 | .557 | .64 |
| September | 3,700 | 2,050 | 2,890 | .663 | .74 |
| The year | 35,500 | 1,360 | 3,740 | .858 | 11.66 |

### WISCONSIN RIVER NEAR NEKOOSA, WIS.

LOCATION.—In sec. 15, T. 21 N., R. 5 E., 1½ miles below Nekoosa, Wood County. Tenmile Creek enters from left 4 miles below station, and Big Roche a Cri Creek, also from left, 38 miles below station.

DRAINAGE AREA.—5,500 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—May 21, 1914, to September 30, 1923.

GAGE.—Gurley water-stage recorder installed January 31, 1923, taking place of Stevens water-stage recorder installed July 18, 1916, on right bank; prior to latter date, Gurley water-stage recorder at same location. Gage attended by Henry Mans.

DISCHARGE MEASUREMENTS.—Made from cable just above gage.

CHANNEL AND CONTROL.—Bed composed of gravel; clean, permanent. Banks are high and rarely overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.04 feet at 6 a. m. April 23 (discharge, 44,800 second-feet); minimum stage recorded, 0.5 foot from 5 a. m. to noon October 1 (discharge, about 920 second-feet.)

1914–1923: Maximum stage recorded, 16.1 feet at 1 a. m. April 12, 1922 (discharge, 61,000 second-feet); minimum stage, 0.0 foot several times on August 25 and 26, 1922 (discharge, about 500 second-feet). Minimum flow is due to regulation.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—No storage reservoirs discharging into Wisconsin River between Nekoosa and Merrill. See "Regulation" in station description of Wisconsin River at Merrill (p. 76). Between Nekoosa and Merrill are 12 dams operated for power.

ACCURACY.—Stage-discharge relation permanent, except as affected by ice. Rating curve well defined throughout. Operation of water-stage recorder satisfactory throughout year. Daily discharge ascertained by use of discharge integrator with correction for effect of ice during winter. Open-water records excellent; winter records fair.

The following discharge measurement was made during year by J. H. Olson: January 8, 1923: Gage height, 2.25 feet; discharge, 1,920 second-feet (stage-discharge relation affected by ice).

*Daily discharge, in second-feet, of Wisconsin River near Nekoosa, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,530 | 2,120 | 2,300 | 2,140 | 2,430 | 2,690 | 1,710 | 11,500 | 3,380 | 4,440 | 2,320 | 2,700 |
| 2 | 1,680 | 2,510 | 3,120 | 1,850 | 2,100 | 2,600 | 2,260 | 10,500 | 3,460 | 3,930 | 2,330 | 3,260 |
| 3 | 1,980 | 1,980 | 2,570 | 2,050 | 2,980 | 2,310 | 2,300 | 8,620 | 2,860 | 3,740 | 2,250 | 2,280 |
| 4 | 1,800 | 2,100 | 2,900 | 2,190 | 2,380 | 2,150 | 2,300 | 8,300 | 2,240 | 4,080 | 2,440 | 2,400 |
| 5 | 1,720 | 2,570 | 3,010 | 1,750 | 2,820 | 2,820 | 2,160 | 8,550 | 4,120 | 5,050 | 2,050 | 3,070 |
| 6 | 1,910 | 2,480 | 2,700 | 2,870 | 2,950 | 2,020 | 2,550 | 7,730 | 3,770 | 5,410 | 2,240 | 2,300 |
| 7 | 1,860 | 2,910 | 2,630 | 2,000 | 2,690 | 2,340 | 2,960 | 8,480 | 4,600 | 6,290 | 2,010 | 3,160 |
| 8 | 1,680 | 2,900 | 2,610 | 2,200 | 2,280 | 2,140 | 2,220 | 6,950 | 8,400 | 5,940 | 2,220 | 2,890 |
| 9 | 1,770 | 2,240 | 2,450 | 1,920 | 2,410 | 2,290 | 2,620 | 6,670 | 13,900 | 6,300 | 2,460 | 2,840 |
| 10 | 1,530 | 2,390 | 1,960 | 2,150 | 1,880 | 1,890 | 2,850 | 6,690 | 16,600 | 5,930 | 2,340 | 3,480 |
| 11 | 2,510 | 3,270 | 2,120 | 2,580 | 1,880 | 1,600 | 4,920 | 6,260 | 14,200 | 5,500 | 2,490 | 2,520 |
| 12 | 2,240 | 2,780 | 3,100 | 2,290 | 1,750 | 2,460 | 7,040 | 5,980 | 12,000 | 4,590 | 2,080 | 2,580 |
| 13 | 1,690 | 1,990 | 2,920 | 2,920 | 2,040 | 2,020 | 11,300 | 6,390 | 8,800 | 5,840 | 1,780 | 2,230 |
| 14 | 1,950 | 2,750 | 3,060 | 1,700 | 3,500 | 2,340 | 14,500 | 5,810 | 7,760 | 5,660 | 1,960 | 2,220 |
| 15 | 1,760 | 3,130 | 3,360 | 2,100 | 3,080 | 2,060 | 16,900 | 6,150 | 6,900 | 4,440 | 2,030 | 2,680 |
| 16 | 1,980 | 2,170 | 2,500 | 2,040 | 3,450 | 2,240 | 17,200 | 4,980 | 6,420 | 3,590 | 2,240 | 2,580 |
| 17 | 1,920 | 2,430 | 2,170 | 2,480 | 3,140 | 2,170 | 16,300 | 4,780 | 5,630 | 4,070 | 2,280 | 2,160 |
| 18 | 2,380 | 3,570 | 2,390 | 1,870 | 2,720 | 2,310 | 15,700 | 5,160 | 5,240 | 4,440 | 2,280 | 2,500 |
| 19 | 1,810 | 3,280 | 2,520 | 2,230 | 2,800 | 2,820 | 22,200 | 5,200 | 5,400 | 3,550 | 2,070 | 2,260 |
| 20 | 1,890 | 4,450 | 2,630 | 2,090 | 2,700 | 2,540 | 26,600 | 5,370 | 4,960 | 2,680 | 2,020 | 2,820 |
| 21 | 1,820 | 5,870 | 2,320 | 2,240 | 2,900 | 2,900 | 36,600 | 7,170 | 4,820 | 2,530 | 2,380 | 2,920 |
| 22 | 1,880 | 5,260 | 2,080 | 2,930 | 2,730 | 2,260 | 43,100 | 10,100 | 4,410 | 2,600 | 2,440 | 2,940 |
| 23 | 2,080 | 5,020 | 2,450 | 2,560 | 2,880 | 2,300 | 44,500 | 8,880 | 5,250 | 2,740 | 2,150 | 2,740 |
| 24 | 2,320 | 4,760 | 2,030 | 2,510 | 2,730 | 2,410 | 39,400 | 7,020 | 4,930 | 3,380 | 2,360 | 2,630 |
| 25 | 2,110 | 3,370 | 2,480 | 2,360 | 2,240 | 2,280 | 30,100 | 6,190 | 4,640 | 3,460 | 2,350 | 2,560 |
| 26 | 2,000 | 3,410 | 2,400 | 2,320 | 2,600 | 2,540 | 23,200 | 5,940 | 6,840 | 3,120 | 2,350 | 3,080 |
| 27 | 1,940 | 2,920 | 2,260 | 2,550 | 2,390 | 1,680 | 19,600 | 4,810 | 7,020 | 2,880 | 2,500 | 2,420 |
| 28 | 2,070 | 3,280 | 2,180 | 2,040 | 2,600 | 2,340 | 16,600 | 3,700 | 6,280 | 2,820 | 2,280 | 2,690 |
| 29 | 1,620 | 3,610 | 1,800 | 2,060 | ------- | 2,440 | 15,400 | 4,580 | 5,260 | 2,330 | 2,350 | 2,350 |
| 30 | 2,140 | 2,960 | 2,360 | 1,900 | ------- | 2,240 | 14,800 | 3,960 | 5,180 | 2,570 | 2,800 | 1,970 |
| 31 | 1,980 | ------- | 2,400 | 2,190 | ------- | 1,890 | ------- | 3,650 | ------- | 2,180 | 2,440 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 7 to Apr. 11.

*Monthly discharge of Wisconsin River near Nekoosa, Wis., for the year ending September 30, 1923*

[Drainage area, 5,500 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 2,510 | 1,530 | 1,920 | 0.349 | 0.40 |
| November | 5,870 | 1,980 | 3,150 | .573 | .64 |
| December | 3,360 | 1,800 | 2,510 | .456 | .53 |
| January | 2,930 | 1,700 | 2,230 | .405 | .47 |
| February | 3,500 | 1,750 | 2,610 | .475 | .49 |
| March | 2,900 | 1,600 | 2,290 | .416 | .48 |
| April | 44,500 | 1,710 | 15,300 | 2.78 | 3.10 |
| May | 11,500 | 3,650 | 6,650 | 1.21 | 1.40 |
| June | 16,600 | 2,240 | 6,510 | 1.18 | 1.32 |
| July | 6,300 | 2,180 | 4,070 | .740 | .85 |
| August | 2,800 | 1,780 | 2,270 | .413 | .48 |
| September | 3,480 | 1,970 | 2,640 | .480 | .54 |
| The year | 44,500 | 1,530 | 4,330 | .787 | 10.70 |

WISCONSIN RIVER AT MUSCODA, WIS.

LOCATION.—In sec. 1, T. 8 N., R. 1 W., at highway bridge 1 mile north of Muscoda, Grant County. Eagle Mill Creek enters from right half a mile below station and Underwood Creek from left 4½ miles above.

DRAINAGE AREA.—10,300 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 21, 1902, to December 31, 1903; December 4, 1913, to September 30, 1923. Gage heights November 1, 1908, to December 31, 1912, published in United States Weather Bureau bulletin, "Daily river stages," parts 9, 10, and 11.

GAGE.—Chain gage fastened to handrail on upstream side of bridge; read by William Hessler and Bud Rice. Elevation of zero of present gage 12.62 feet above that of gage maintained December 21, 1902, to December 31, 1903; elevation of gage during period November 1, 1908, to December 31, 1912, as read and published by United States Weather Bureau, was about the same as that of present gage, sea-level elevation of which is approximately 666.2 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.65 feet at 5 p. m., April 27 (discharge, 52,500 second-feet); minimum discharge, 2,680 second-feet February 4.

1903; 1914–1923: Maximum stage recorded, 10.60 feet April 16, 1922 (discharge, 72,100 second-feet); minimum discharge, about 1,600 second-feet December 20, 1921. According to records of the United States Weather Bureau [5] (see note under gage), on June 11, 1881, the river reached a stage of 11.1 feet and during August, 1868, zero on gage; discharge not computed owing to changes in channel and datum of gage.

REGULATION.—Nearest power plant above station is at Prairie du Sac, 40 miles distant; since the latter part of 1915 considerable diurnal fluctuation has been observed at gage. Owing to regulation by storage in the headwaters, the flow at this station is not natural.

ACCURACY.—Stage-discharge relation not permanent, affected by ice and by shifting control. Standard rating curve fairly well defined between 4,000 and 45,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained from mean daily gage height corrected on basis of discharge measurements and also from study of observer's notes and weather records during winter. Records poor.

[5] Daily river stages, pt. 10, p. 98, U. S. Dept. Agr.

*Discharge measurements of Wisconsin River at Muscoda, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 5 | E. E. Foster | 1.08 | 4,920 | May 4 | Soulé and Foster | 1.57 | 6,430 |
| Dec. 29 | Soulé and Foster | a 1.64 | 3,810 | Aug. 24 | E. E. Foster | .66 | 4,260 |
| Jan. 26 | Foster and Olson | a 1.58 | 3,660 | | | | |

a Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Wisconsin River at Muscoda, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4,940 | 4,000 | 5,480 | 4,450 | 4,450 | 6,700 | 6,700 | 35,000 | 9,300 | 8,520 | 5,480 | 5,200 |
| 2 | 4,000 | 4,220 | 6,060 | 3,340 | 3,560 | 6,380 | 6,700 | 26,400 | 8,900 | 7,040 | 6,060 | 6,380 |
| 3 | 4,690 | 4,000 | 5,760 | 3,560 | 3,120 | 7,400 | 17,700 | 22,500 | 8,140 | 8,520 | 6,060 | 5,760 |
| 4 | 4,690 | 3,780 | 4,690 | 3,780 | 2,680 | 8,520 | 24,400 | 20,300 | 6,380 | 8,900 | 5,200 | 4,450 |
| 5 | 4,690 | 3,780 | 4,690 | 4,000 | 3,340 | 8,520 | 16,700 | 14,800 | 7,760 | 7,760 | 5,200 | 4,690 |
| 6 | 4,690 | 4,000 | 5,480 | 3,780 | 3,560 | 6,380 | 15,300 | 16,700 | 7,760 | 7,760 | 4,690 | 4,940 |
| 7 | 4,940 | 4,000 | 6,380 | 3,560 | 4,000 | 7,760 | 14,400 | 17,700 | 8,520 | 7,400 | 5,200 | 4,940 |
| 8 | 4,450 | 4,000 | 5,760 | 3,560 | 4,000 | 9,300 | 12,200 | 13,900 | 7,760 | 7,400 | 5,760 | 4,940 |
| 9 | 4,000 | 4,000 | 4,450 | 4,220 | 4,000 | 9,700 | 12,200 | 12,600 | 7,400 | 5,760 | 5,200 | 4,690 |
| 10 | 4,690 | 3,780 | 4,450 | 4,220 | 3,780 | 10,500 | 15,800 | 11,800 | 7,040 | 6,380 | 4,940 | 4,220 |
| 11 | 4,450 | 3,560 | 3,560 | 3,780 | 3,560 | 10,900 | 13,900 | 11,300 | 5,760 | 8,140 | 4,450 | 4,690 |
| 12 | 4,450 | 3,780 | 3,120 | 3,780 | 3,120 | 8,520 | 14,800 | 13,000 | 7,760 | 8,900 | 4,690 | 4,940 |
| 13 | 4,000 | 4,940 | 3,560 | 4,000 | 3,780 | 6,060 | 15,300 | 10,500 | 14,800 | 7,040 | 4,220 | 4,940 |
| 14 | 4,000 | 5,480 | 4,220 | 3,780 | 3,560 | 7,400 | 15,800 | 9,700 | 18,700 | 7,760 | 4,220 | 4,940 |
| 15 | 4,000 | 5,200 | 3,780 | 3,780 | 3,560 | 8,520 | 15,800 | 13,000 | 17,200 | 7,760 | 4,450 | 4,450 |
| 16 | 3,560 | 5,200 | 4,000 | 3,560 | 4,450 | 6,700 | 16,700 | 11,300 | 16,200 | 6,060 | 4,450 | 4,220 |
| 17 | 4,000 | 4,690 | 3,560 | 3,560 | 4,690 | 7,760 | 19,200 | 11,800 | 10,500 | 8,140 | 4,450 | 4,000 |
| 18 | 4,220 | 4,940 | 3,340 | 3,560 | 4,000 | 8,520 | 22,500 | 10,500 | 12,200 | 8,140 | 4,450 | 4,220 |
| 19 | 3,780 | 5,760 | 3,560 | 3,780 | 3,560 | 3,340 | 23,100 | 10,500 | 11,300 | 7,400 | 4,220 | 4,940 |
| 20 | 3,780 | 4,940 | 4,000 | 3,340 | 4,000 | 6,380 | 30,000 | 10,900 | 8,900 | 7,040 | 3,780 | 5,480 |
| 21 | 3,780 | 5,200 | 4,220 | 4,000 | 4,220 | 8,900 | 24,400 | 8,900 | 9,300 | 6,700 | 4,450 | 8,140 |
| 22 | 3,560 | 5,480 | 3,780 | 3,560 | 3,780 | 8,900 | 25,700 | 10,900 | 8,900 | 6,380 | 4,690 | 5,480 |
| 23 | 3,560 | 6,060 | 3,560 | 3,780 | 4,000 | 7,760 | 29,200 | 10,500 | 8,900 | 5,480 | 4,220 | 4,450 |
| 24 | 4,220 | 6,380 | 3,780 | 4,000 | 4,000 | 8,900 | 35,000 | 10,100 | 7,760 | 6,380 | 4,220 | 3,780 |
| 25 | 3,780 | 7,760 | 3,560 | 4,000 | 4,220 | 7,760 | 32,400 | 11,800 | 6,700 | 6,380 | 4,450 | 3,560 |
| 26 | 3,780 | 7,760 | 3,780 | 3,780 | 4,940 | 4,940 | 39,500 | 13,900 | 8,900 | 6,380 | 3,780 | 4,450 |
| 27 | 3,780 | 6,060 | 3,340 | 4,000 | 6,380 | 6,700 | 52,500 | 13,500 | 8,520 | 5,480 | 3,780 | 4,450 |
| 28 | 4,000 | 8,520 | 3,780 | 3,780 | 7,040 | 7,040 | 50,500 | 9,700 | 9,300 | 5,760 | 4,450 | 4,450 |
| 29 | 3,780 | 7,040 | 4,000 | 3,560 | ------ | 6,700 | 46,500 | 12,200 | 8,900 | 5,480 | 5,200 | 4,220 |
| 30 | 3,560 | 7,040 | 3,780 | 3,340 | ------ | 6,700 | 38,600 | 11,300 | 8,520 | 4,940 | 4,450 | 4,450 |
| 31 | 3,780 | ------ | 4,000 | 4,220 | ------ | 6,700 | ------ | 8,140 | ------ | 5,480 | 4,940 | ------ |

NOTE.—Stage-discharge relation affected by ice Dec. 12 to Apr. 1.

*Monthly discharge of Wisconsin River at Muscoda, Wis., for the year ending September 30, 1923*

[Drainage area, 10,300 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 4,940 | 3,560 | 4,120 | 0.400 | 0.46 |
| November | 8,520 | 3,560 | 5,180 | .503 | .56 |
| December | 6,380 | 3,120 | 4,240 | .412 | .48 |
| January | 4,450 | 3,340 | 3,790 | .368 | .42 |
| February | 7,040 | 2,680 | 4,050 | .393 | .41 |
| March | 10,900 | 3,340 | 7,620 | .740 | .85 |
| April | 52,500 | 6,700 | 23,400 | 2.27 | 2.53 |
| May | 35,000 | 8,140 | 13,700 | 1.33 | 1.53 |
| June | 18,700 | 5,760 | 9,600 | .932 | 1.04 |
| July | 8,900 | 4,940 | 6,990 | .679 | .78 |
| August | 6,060 | 3,780 | 4,700 | .456 | .53 |
| September | 8,140 | 3,560 | 4,820 | .468 | .52 |
| The year | 52,500 | 2,680 | 7,680 | .746 | 10.11 |

### TOMAHAWK RIVER NEAR BRADLEY, WIS.

LOCATION.—In sec. 16, T. 36 N., R. 6 E., 2 miles west of Cassion, 4 miles north of Bradley, Oneida County, 4 miles downstream from mouth of Bearskin Creek, which enters from right, and 8 miles above mouth of river.

DRAINAGE AREA.—422 square miles.

RECORDS AVAILABLE.—September 18, 1914, to September 30, 1923.

GAGE.—Slope gage fastened to concrete posts on right bank, installed September 24, 1919; prior to that date, chain gage fastened to cantilever arm on right bank; both gages same datum. Read by Frank Sutherland and H. F. Hemmings.

DISCHARGE MEASUREMENTS.—Made from cable half a mile below gage.

CHANNEL AND CONTROL.—Bed at gage and a short distance below, sandy and likely to shift. Control is formed by rapids 2,000 feet below gage. Bed at cable section heavy gravel. When a head of 15 feet is maintained in Rice Lake storage dam, in secs. 4 and 9, T. 35 N., R. 6 E., backwater will extend halfway up the rapids which may affect stage-discharge relation. The maximum head maintained during the year was considerably less than 15 feet.

EXTREMES OF DISCHARGE.—Maximum discharge during year, estimated 2,050 second-feet April 25; minimum discharge, estimated 220 second-feet April 2–6.

1914–1923: Maximum stage recorded, 6.9 feet April 24, 1916 (discharge, 2,200 second-feet); minimum stage recorded, 1.29 feet July 1 and August 9, 1921 (discharge, 132 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—The following reservoirs are maintained above station, for the purpose of regulating flow of Wisconsin River:

*Reservoirs used to regulate flow of Wisconsin River*

| Name | Location of reservoir | Location of dam | Area of reservoir | Drainage area | Capacity (millions of cubic feet) | |
|---|---|---|---|---|---|---|
| | | | | | Summer | Winter |
| | | | *Sq. mi.* | *Sq. mi.* | | |
| Squirrel | T. 39 N., R. 5 E. | Sec. 30, T. 39 N., R. 5 E. | 3.00 | 17.07 | 152 | 152 |
| Minocqua | Tps. 38-40 N. Rs. 6-7 E. | Sec. 10, T. 39 N., R. 6 E. | 11.31 | 81.60 | 291 | 651 |
| | | | 14.31 | 98.67 | 443 | 803 |

ACCURACY.—Stage-discharge relation permanent, except as affected by ice. Rating curve used is poorly defined below 370 second-feet; and fairly well defined above. Gage read to hundredths once daily except November 16 to April 30 when it was read once a week. Daily discharge obtained by applying mean daily gage height to rating curve, except for periods when daily gage heights are not available, for which periods it was obtained by study of the comparative run-off at this station and at Flambeau River near Butternut together with two winter discharge measurements. Medium and high stage open-water records, with the exception of those for April, fair; low-water records poor; winter records subject to considerable error.

*Discharge measurements of Tomahawk River near Bradley, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 24 | S. B. Soulé | 2.13 | 298 | Feb. 24 | J. H. Olson | [a] 2.94 | 254 |
| Jan. 13 | J. H. Olson | [a] 2.61 | 272 | June 25 | E. E. Foster | 3.27 | 545 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Tomahawk River near Bradley, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 304 | 285 | 355 | 300 | 280 | 280 | 230 | 1,080 | 289 | 447 | 261 | 261 |
| 2 | 304 | 297 | 355 | 300 | 280 | 280 | 220 | 886 | 280 | 421 | 263 | 266 |
| 3 | 300 | 298 | 350 | 300 | 280 | 280 | 220 | 798 | 460 | 396 | 250 | 268 |
| 4 | 295 | 297 | 350 | 300 | 280 | 285 | 220 | 780 | 530 | 345 | 243 | 260 |
| 5 | 285 | 304 | 345 | 300 | 280 | 285 | 220 | 763 | 574 | 324 | 234 | 250 |
| 6 | 282 | 324 | 345 | 295 | 280 | 285 | 220 | 746 | 559 | 318 | 232 | 242 |
| 7 | 289 | 336 | 345 | 295 | 280 | 290 | 225 | 730 | 780 | 396 | 232 | 265 |
| 8 | 304 | 345 | 340 | 290 | 280 | 290 | 230 | 713 | 850 | 460 | 230 | 269 |
| 9 | 300 | 372 | 335 | 290 | 280 | 290 | 235 | 713 | 886 | 447 | 230 | 263 |
| 10 | 298 | 408 | 330 | 285 | 280 | 290 | 245 | 697 | 886 | 447 | 232 | 257 |
| 11 | 293 | 447 | 320 | 285 | 275 | 290 | 255 | 681 | 850 | 447 | 240 | 252 |
| 12 | 282 | 488 | 315 | 280 | 270 | 285 | 265 | 681 | 780 | 421 | 237 | 252 |
| 13 | 276 | 502 | 310 | 280 | 265 | 285 | 280 | 634 | 666 | 396 | 233 | 248 |
| 14 | 289 | 502 | 305 | 280 | 260 | 285 | 280 | 589 | 574 | 367 | 233 | 248 |
| 15 | 285 | 516 | 300 | 285 | 255 | 280 | 280 | 559 | 544 | 360 | 229 | 249 |
| 16 | 285 | 515 | 300 | 285 | 250 | 280 | 305 | 530 | 516 | 324 | 227 | 248 |
| 17 | 300 | 515 | 300 | 285 | 250 | 280 | 360 | 516 | 460 | 308 | 226 | 249 |
| 18 | 304 | 515 | 300 | 290 | 255 | 275 | 470 | 488 | 408 | 289 | 233 | 280 |
| 19 | 300 | 515 | 300 | 290 | 255 | 275 | 570 | 460 | 372 | 280 | 240 | 291 |
| 20 | 298 | 515 | 300 | 290 | 260 | 270 | 680 | 502 | 384 | 271 | 240 | 293 |
| 21 | 297 | 515 | 300 | 285 | 260 | 270 | 950 | 530 | 447 | 265 | 252 | 289 |
| 22 | 298 | 515 | 300 | 285 | 265 | 270 | 1,200 | 530 | 474 | 258 | 265 | 285 |
| 23 | 304 | 475 | 300 | 280 | 265 | 265 | 1,520 | 502 | 502 | 261 | 266 | 282 |
| 24 | 312 | 440 | 300 | 275 | 270 | 265 | 1,800 | 460 | 502 | 271 | 263 | 280 |
| 25 | 308 | 400 | 300 | 270 | 270 | 265 | 2,050 | 434 | 574 | 271 | 260 | 276 |
| 26 | 300 | 365 | 300 | 270 | 270 | 260 | 1,650 | 396 | 604 | 266 | 257 | 268 |
| 27 | 297 | 365 | 300 | 270 | 270 | 260 | 1,450 | 372 | 604 | 263 | 261 | 263 |
| 28 | 289 | 360 | 300 | 270 | 275 | 260 | 1,270 | 367 | 574 | 258 | 263 | 263 |
| 29 | 289 | 360 | 300 | 275 | ------ | 255 | 1,200 | 349 | 530 | 252 | 263 | 261 |
| 30 | 287 | 360 | 300 | 275 | ------ | 255 | 1,150 | 324 | 488 | 249 | 268 | 260 |
| 31 | 285 | ------ | 300 | 275 | ------ | 240 | ------ | 302 | ------ | 248 | 263 | ------ |

NOTE.—Stage-discharge relation affected by ice from early in December to middle of April.

*Monthly discharge of Tomahawk River near Bradley, Wis., for the year ending September 30, 1923*

[Drainage area, 422 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 312 | 276 | 295 | 0.699 | 0.81 |
| November | 516 | 285 | 415 | .983 | 1.10 |
| December | 350 | 300 | 316 | .749 | .86 |
| January | 300 | 270 | 285 | .675 | .78 |
| February | 280 | 250 | 269 | .637 | .66 |
| March | 290 | 240 | 275 | .652 | .75 |
| April | 2,050 | 220 | 675 | 1.60 | 1.78 |
| May | 1,080 | 302 | 584 | 1.38 | 1.59 |
| June | 886 | 280 | 565 | 1.34 | 1.50 |
| July | 460 | 248 | 333 | .789 | .91 |
| August | 268 | 226 | 246 | .583 | .67 |
| September | 293 | 242 | 265 | .628 | .70 |
| The year | 2,050 | 220 | 377 | .893 | 12.11 |

### PRAIRIE RIVER NEAR MERRILL, WIS.

LOCATION.—On line between secs. 20 and 29, T. 32 N., R. 7 E., at highway bridge 4½ miles northeast of Merrill, Lincoln County, and 5½ miles above mouth of river. Haymeadow Creek enters from left 5 miles above station.

DRAINAGE AREA.—164 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 17, 1914, to September 30, 1923.

GAGE.—Chain gage attached to upstream side of bridge; read by Mrs. Meta Krause.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel; clean and free from vegetation. Right bank high, not subject to overflow; left bank may be overflowed at extreme flood stages; both banks wooded. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.1 feet at 9 a. m. April 22 (discharge, 2,290 second-feet); minimum discharge estimated 65 second-feet March 5 and 7–10.

1914–1923: Maximum stage recorded, 6.1 feet April 22, 1916, and April 22, 1923 (discharge, 2,290 second-feet); minimum discharge estimated 65 second-feet February 26 to March 1, 1922, and March 5 and 7–10, 1923.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 70 and 2,200 second-feet. Gage read to hundredths once daily. Daily discharge obtained by applying daily gage height to rating table, except for period in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for ice effect by means of two discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

*Discharge measurements of Prairie River near Merrill, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 25 | S. B. Soulé | 1.76 | 91 | Feb. 22 | J. H. Olson | [a] 1.83 | 69.3 |
| Jan. 12 | J. H. Olson | [a] 1.80 | 80 | Apr. 24 | S. B. Soulé | 4.67 | 1,210 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Prairie River near Merrill, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 88 | 91 | 113 | 90 | 80 | 70 | 88 | 384 | 108 | 133 | 88 | 84 |
| 2 | 86 | 102 | 115 | 80 | 75 | 70 | 91 | 348 | 102 | 129 | 88 | 88 |
| 3 | 88 | 105 | 118 | 80 | 75 | 70 | 88 | 313 | 112 | 118 | 87 | 133 |
| 4 | 88 | 105 | 118 | 80 | 70 | 70 | 81 | 278 | 137 | 115 | 86 | 148 |
| 5 | 86 | 105 | 110 | 80 | 75 | 70 | 88 | 261 | 172 | 118 | 86 | 137 |
| 6 | 112 | 108 | 110 | 80 | 75 | 65 | 115 | 244 | 212 | 137 | 84 | 137 |
| 7 | 112 | 112 | 100 | 80 | 75 | 70 | 102 | 212 | 496 | 313 | 84 | 244 |
| 8 | 86 | 112 | 100 | 80 | 75 | 65 | 94 | 212 | 1,060 | 458 | 84 | 290 |
| 9 | 86 | 112 | 95 | 80 | 75 | 65 | 96 | 228 | 1,160 | 440 | 81 | 278 |
| 10 | 86 | 115 | 95 | 80 | 75 | 65 | 102 | 278 | 870 | 348 | 84 | 212 |
| 11 | 86 | 118 | 95 | 80 | 75 | 70 | 118 | 313 | 614 | 535 | 81 | 159 |
| 12 | 85 | 129 | 90 | 80 | 70 | 70 | 137 | 313 | 458 | 348 | 81 | 137 |
| 13 | 86 | 126 | 80 | 80 | 70 | 70 | 159 | 244 | 348 | 261 | 81 | 122 |
| 14 | 87 | 122 | 80 | 80 | 70 | 70 | 184 | 212 | 290 | 198 | 81 | 112 |
| 15 | 88 | 118 | 80 | 80 | 70 | 70 | 228 | 184 | 244 | 148 | 81 | 105 |
| 16 | 88 | 115 | 80 | 80 | 70 | 70 | 244 | 184 | 212 | 159 | 79 | 102 |
| 17 | 91 | 118 | 80 | 75 | 70 | 70 | 458 | 184 | 184 | 148 | 79 | 99 |
| 18 | 101 | 122 | 80 | 75 | 70 | 70 | 825 | 172 | 159 | 137 | 81 | 122 |
| 19 | 91 | 212 | 80 | 75 | 70 | 75 | 1,160 | 159 | 159 | 122 | 91 | 198 |
| 20 | 91 | 228 | 80 | 75 | 70 | 75 | 2,020 | 278 | 137 | 112 | 91 | 212 |
| 21 | 88 | 184 | 75 | 80 | 70 | 80 | 1,940 | 458 | 159 | 102 | 108 | 244 |
| 22 | 91 | 159 | 80 | 80 | 70 | 90 | 2,290 | 440 | 184 | 99 | 99 | 212 |
| 23 | 99 | 137 | 80 | 80 | 70 | 80 | 1,860 | 348 | 184 | 99 | 102 | 184 |
| 24 | 99 | 122 | 90 | 80 | 70 | 70 | 1,280 | 278 | 184 | 105 | 94 | 159 |
| 25 | 96 | 120 | 90 | 80 | 70 | 70 | 1,060 | 212 | 184 | 108 | 91 | 137 |
| 26 | 99 | 115 | 95 | 80 | 70 | 70 | 781 | 184 | 278 | 102 | 88 | 126 |
| 27 | 96 | 115 | 90 | 80 | 70 | 70 | 696 | 159 | 330 | 99 | 88 | 118 |
| 28 | 96 | 112 | 90 | 80 | 70 | 70 | 574 | 137 | 261 | 96 | 91 | 112 |
| 29 | 94 | 112 | 90 | 80 | ------- | 70 | 496 | 137 | 184 | 94 | 88 | 108 |
| 30 | 94 | 112 | 90 | 80 | ------- | 70 | 440 | 122 | 148 | 94 | 88 | 104 |
| 31 | 91 | ------- | 90 | 80 | ------- | 70 | ------- | 115 | ------- | 88 | 86 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 5 to Mar. 31.

*Monthly discharge of Prairie River near Merrill, Wis., for the year ending September 30, 1923*

[Drainage area, 164 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 112 | 85 | 92.1 | 0.562 | 0.65 |
| November | 228 | 91 | 125 | .762 | .85 |
| December | 118 | 75 | 92.2 | .562 | .65 |
| January | 90 | 75 | 79.7 | .486 | .56 |
| February | 80 | 70 | 72.0 | .439 | .46 |
| March | 90 | 65 | 71.0 | .433 | .50 |
| April | 2,290 | 81 | 596 | 3.63 | 4.05 |
| May | 458 | 115 | 245 | 1.49 | 1.72 |
| June | 1,160 | 102 | 311 | 1.90 | 2.12 |
| July | 535 | 88 | 179 | 1.09 | 1.26 |
| August | 108 | 79 | 87.1 | .531 | .61 |
| September | 290 | 84 | 154 | .939 | 1.05 |
| The year | 2,290 | 65 | 175 | 1.07 | 14.48 |

### EAU CLAIRE RIVER AT KELLY, WIS.

LOCATION.—In sec. 13, T. 28 N., R. 8 E., at highway bridge three-fourths mile northeast of Kelly, Marathon County, 1 mile above mouth of Big Sandy Creek, which enters from right, and 4½ miles above mouth of river.

DRAINAGE AREA.—326 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 1, 1914, to September 30, 1923.

GAGE.—Chain gage fastened to downstream side of highway bridge; read by August Krueger.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Gage is in the rapids which form control. Banks of medium height and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.57 feet at 8.30 a. m. April 20 (discharge, 5,210 second-feet); minimum discharge estimated 40 second-feet February 17.

1914–1923: Maximum stage recorded, 7.40 feet at 3 p. m. April 9, 1922 (discharge, 6,320 second-feet); minimum discharge, estimated 30 second-feet December 6, 1917.

ACCURACY.—Stage-discharge relation changed slightly during winter. Rating curve well defined between 80 and 3,200 second-feet. Gage read to hundredths once daily. Daily discharge, October 1 to November 30, obtained by indirect method for shifting control on basis of two discharge measurements; from April 20 to September 30 by applying daily gage height to rating table; and for remainder of year it was obtained by applying to rating table daily gage height corrected for ice effect by means of two discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

*Discharge measurements of Eau Claire River at Kelly, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 25 | E. E. Foster | 0.96 | 104 | Feb. 20 | J. H. Olson | 2.03 | 61 |
| 25 | S. B. Soulé | .96 | 105 | Apr. 22 | S. B. Soulé | 4.95 | 3,190 |
| Jan. 10 | J. H. Olson | 1.84 | 83 | June 28 | E. E. Foster | 1.06 | 152 |

*Daily discharge, in second-feet, of Eau Claire River at Kelly, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 94 | 94 | 200 | 100 | 70 | 70 | 50 | 390 | 144 | 131 | 78 | 82 |
| 2 | 94 | 112 | 150 | 90 | 70 | 70 | 50 | 365 | 138 | 126 | 78 | 122 |
| 3 | 94 | 122 | 215 | 90 | 70 | 240 | 70 | 320 | 190 | 131 | 78 | 146 |
| 4 | 94 | 117 | 185 | 90 | 60 | 215 | 60 | 284 | 180 | 122 | 78 | 171 |
| 5 | 94 | 117 | 100 | 100 | 45 | 185 | 70 | 267 | 238 | 146 | 74 | 136 |
| 6 | 90 | 136 | 150 | 100 | 45 | 185 | 100 | 258 | 211 | 141 | 74 | 117 |
| 7 | 90 | 141 | 175 | 80 | 45 | 185 | 135 | 233 | 284 | 390 | 82 | 141 |
| 8 | 90 | 136 | 185 | 90 | 45 | 150 | 135 | 244 | 670 | 587 | 74 | 156 |
| 9 | 90 | 131 | 175 | 90 | 45 | 150 | 110 | 269 | 862 | 390 | 74 | 156 |
| 10 | 90 | 131 | 125 | 80 | 45 | 110 | 150 | 269 | 738 | 269 | 74 | 136 |
| 11 | 90 | 141 | 110 | 70 | 45 | 125 | 240 | 300 | 471 | 258 | 99 | 122 |
| 12 | 90 | 146 | 90 | 70 | 45 | 100 | 415 | 284 | 320 | 416 | 86 | 117 |
| 13 | 90 | 141 | 90 | 70 | 50 | 135 | 925 | 255 | 284 | 300 | 78 | 108 |
| 14 | 94 | 146 | 90 | 70 | 50 | 110 | 990 | 238 | 284 | 230 | 78 | 99 |
| 15 | 94 | 161 | 90 | 70 | 45 | 105 | 860 | 222 | 249 | 177 | 70 | 99 |
| 16 | 94 | 151 | 90 | 80 | 50 | 100 | 1,210 | 244 | 238 | 161 | 70 | 94 |
| 17 | 103 | 146 | 90 | 70 | 40 | 90 | 1,460 | 244 | 211 | 141 | 70 | 99 |
| 18 | 108 | 166 | 90 | 70 | 45 | 90 | 2,910 | 222 | 190 | 126 | 82 | 117 |
| 19 | 99 | 269 | 90 | 60 | 50 | 90 | 3,270 | 206 | 184 | 117 | 86 | 136 |
| 20 | 99 | 365 | 90 | 70 | 50 | 70 | 5,210 | 528 | 190 | 108 | 94 | 161 |
| 21 | 99 | 300 | 90 | 70 | 60 | 90 | 4,690 | 769 | 180 | 99 | 108 | 187 |
| 22 | 99 | 263 | 90 | 70 | 60 | 90 | 3,150 | 800 | 164 | 94 | 141 | 214 |
| 23 | 103 | 241 | 100 | 60 | 60 | 100 | 2,340 | 557 | 184 | 126 | 122 | 177 |
| 24 | 103 | 214 | 100 | 60 | 70 | 100 | 1,550 | 390 | 154 | 108 | 103 | 161 |
| 25 | 103 | 161 | 100 | 60 | 60 | 100 | 1,210 | 300 | 154 | 108 | 90 | 141 |
| 26 | 99 | 192 | 90 | 70 | 70 | 70 | 925 | 255 | 164 | 99 | 86 | 131 |
| 27 | 99 | 187 | 100 | 70 | 70 | 60 | 800 | 222 | 180 | 94 | 82 | 126 |
| 28 | 94 | 146 | 110 | 70 | 70 | 60 | 647 | 200 | 166 | 90 | 90 | 122 |
| 29 | 94 | 146 | 110 | 70 | ------- | 50 | 528 | 184 | 146 | 90 | 94 | 112 |
| 30 | 94 | 171 | 100 | 60 | ------- | 45 | 443 | 168 | 136 | 86 | 94 | 108 |
| 31 | 94 | ------- | 100 | 70 | ------- | 45 | ------- | 154 | ------- | 82 | 86 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 1 to Apr. 19.

*Monthly discharge of Eau Claire River at Kelly, Wis., for the year ending September 30, 1923*

[Drainage area, 326 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 108 | 90 | 95.5 | 0.293 | 0.34 |
| November | 365 | 94 | 170 | .521 | .58 |
| December | 215 | 90 | 118 | .362 | .42 |
| January | 100 | 60 | 75.5 | .232 | .27 |
| February | 70 | 40 | 54.6 | .167 | .17 |
| March | 240 | 45 | 109 | .334 | .39 |
| April | 5,210 | 50 | 1,160 | 3.56 | 3.97 |
| May | 800 | 154 | 311 | .954 | 1.10 |
| June | 862 | 136 | 263 | .807 | .90 |
| July | 587 | 82 | 179 | .549 | .63 |
| August | 141 | 70 | 86.2 | .264 | .30 |
| September | 214 | 82 | 133 | .408 | .46 |
| The year | 5,210 | 40 | 229 | .702 | 9.53 |

### BIG EAU PLEINE RIVER NEAR STRATFORD, WIS.

LOCATION.—In sec. 13, T. 27 N., R. 3 E. at highway bridge at a place locally known as Weber farm, 2 miles north of Stratford, Marathon County, and 1 mile above Chicago & Northwestern Railway bridge. Dill Creek enters from right 5 miles above station.

DRAINAGE AREA.—223 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 24, 1914, to September 30, 1923.

GAGE.—Sloping gage, reading from 1.0 to 15.6 feet, on right bank of river and vertical staff gage, reading from 15 to 18 feet, at upper end of sloping gage; read by Christian Weber.

DISCHARGE MEASUREMENTS.—Made by wading 1,000 feet below gage or from highway bridge half a mile below.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Control at head of rapids 400 feet below gage. Banks at gage are high and are overflowed only at stage of 15 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.25 feet at 6 p. m. April 18 (discharge, 2,360 second-feet); minimum stage, 1.23 feet at 6 p. m. August 17 and 7 a. m. August 18 (discharge, about 2.3 second-feet).

1914–1923: Maximum stage recorded, 10.9 feet at 4.30 p. m. November 10, 1919 (discharge, 8,630 second-feet); minimum stage recorded, that of August 17 and 18, 1923. The flood of June, 1914, reached a maximum height of 20.7 feet as determined by levels run to high-water marks.

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined above 50 second-feet; poorly defined below. Gage read to half-tenths twice daily. Daily discharge obtained by applying mean daily gage height to rating table, except during winter, when no records were obtained. Records for medium and high stages good; for low stages fair; and for extremely low water poor.

The following discharge measurement was made by E. E. Foster:
June 29, 1923: Gage height, 2.01 feet; discharge, 51 second-feet.

*Daily discharge, in second-feet, of Big Eau Pleine River near Stratford, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.0 | 7.0 | 63 | ------- | 102 | 21 | 27 | 6.6 | 5.6 |
| 2 | 7.0 | 12.0 | 36 | ------- | 73 | 19.4 | 24 | 6.2 | 9.5 |
| 3 | 7.0 | 12.0 | 31 | ------- | 75 | 13.8 | 21 | 5.8 | 9.5 |
| 4 | 7.0 | 12.0 | 29 | ------- | 71 | 18.0 | 18.0 | 5.4 | 7.0 |
| 5 | 7.0 | 15.0 | 25 | ------- | 63 | 22 | 705 | 5.0 | 6.2 |
| 6 | 6.6 | 27 | 16.8 | ------- | 58 | 19.4 | 630 | 4.6 | 6.2 |
| 7 | 6.0 | 25 | 12.0 | ------- | 57 | 182 | 206 | 5.6 | 6.2 |
| 8 | 6.0 | 22 | 11.0 | ------- | 58 | 530 | 102 | 6.2 | 6.2 |
| 9 | 6.0 | 22 | 8.0 | ------- | 57 | 302 | 63 | 6.2 | 5.8 |
| 10 | 6.0 | 22 | 7.0 | ------- | 91 | 159 | 40 | 6.2 | 5.6 |
| 11 | 6.0 | 22 | 6.6 | ------- | 102 | 102 | 33 | 5.8 | 4.6 |
| 12 | 6.0 | 18.0 | 6.0 | ------- | 83 | 79 | 31 | 5.0 | 4.6 |
| 13 | 6.0 | 22 | 5.0 | ------- | 58 | 58 | 27 | 4.2 | 4.6 |
| 14 | 7.0 | 19.4 | 4.6 | ------- | 52 | 46 | 24 | 3.8 | 4.6 |
| 15 | 7.0 | 18.0 | 4.0 | ------- | 46 | 33 | 19.4 | 2.9 | 3.8 |
| 16 | 7.0 | 18.0 | 4.0 | 1,050 | 55 | 27 | 16.2 | 2.9 | 3.8 |
| 17 | 12.0 | 18.0 | 4.0 | 1,320 | 55 | 24 | 13.8 | 2.7 | 5.8 |
| 18 | 12.0 | 47 | 4.0 | 1,950 | 46 | 19.4 | 11.0 | 2.7 | 16.2 |
| 19 | 12.0 | 244 | 3.4 | 1,950 | 46 | 18.0 | 9.5 | 2.9 | 18.0 |
| 20 | 12.0 | 218 | 3.0 | 1,470 | 319 | 27 | 8.5 | 2.9 | 19.4 |
| 21 | 12.0 | 122 | 3.0 | 1,320 | 302 | 96 | 7.0 | 8.5 | 18.0 |
| 22 | 11.0 | 75 | 3.0 | 1,180 | 182 | 58 | 6.6 | 7.0 | 16.2 |
| 23 | 9.0 | 57 | 3.0 | 815 | 124 | 40 | 8.5 | 6.6 | 13.8 |
| 24 | 9.0 | 49 | ------- | 483 | 91 | 32 | 10.5 | 6.2 | 11.5 |
| 25 | 9.0 | 41 | ------- | 336 | 47 | 40 | 12.0 | 5.8 | 8.5 |
| 26 | 9.0 | 30 | ------- | 244 | 53 | 71 | 9.5 | 5.6 | 7.0 |
| 27 | 9.0 | 29 | ------- | 206 | 40 | 98 | 9.5 | 5.6 | 6.6 |
| 28 | 7.0 | 29 | ------- | 182 | 33 | 67 | 9.5 | 5.6 | 6.2 |
| 29 | 7.0 | 25 | ------- | 148 | 31 | 46 | 9.5 | 5.6 | 24 |
| 30 | 7.0 | 27 | ------- | 119 | 27 | 33 | 9.5 | 5.6 | 19.4 |
| 31 | 7.0 | ------- | ------- | ------- | 24 | ------- | 7.0 | 5.6 | ------- |

*Monthly discharge of Big Eau Pleine River near Stratford, Wis., for the year ending September 30, 1923*

[Drainage area, 223 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 12.0 | 6.0 | 7.99 | 0.036 | 0.04 |
| November | 244 | 7.0 | 43.5 | .195 | .22 |
| December 1–23 | 63 | 3.0 | 12.7 | .057 | .03 |
| April 16–30 | 1,950 | 119.0 | 852. | 3.82 | 2.13 |
| May | 319 | 24.0 | 81.3 | .365 | .42 |
| June | 530 | 13.8 | 76.7 | .344 | .38 |
| July | 705 | 6.6 | 68.7 | .308 | .36 |
| August | 8.5 | 2.7 | 5.20 | .023 | .03 |
| September | 24.0 | 3.8 | 9.48 | .043 | .05 |

### KICKAPOO RIVER AT GAYS MILLS, WIS.

LOCATION.—In sec. 28, T. 10 N., R. 4 W., at highway bridge immediately below Norwood Mill, in Gays Mills, Crawford County, 2 miles below mouth of Tainter Creek, which enters from right, and 25 miles above mouth of river.

DRAINAGE AREA.—629 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911, scale, 1 inch = 6 miles).

RECORDS AVAILABLE.—December 25, 1913, to September 30, 1923.

GAGE.—Chain gage fastened to downstream side of bridge; read by George Atwood.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading a short distance below gage.

CHANNEL AND CONTROL.—Channel composed of rock covered by a deposit of sand and silt; banks at gage section fairly high and not subject to overflow. No definite control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.50 feet at 8 a. m. April 3 (discharge, about 4,300 second-feet); minimum stage, 1.4 feet August 17, 19, 25, and 26 (discharge, 198 second-feet).

1914–1923: Maximum stage recorded, 15.05 feet March 24, 1917 (discharge, about 6,300 second-feet); minimum discharge, about 100 second-feet during the latter part of January, 1915.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Mills at Gays Mills immediately above the station, at Soldiers Grove 7 miles upstream, and at several points above Soldiers Grove use comparatively little storage, so that recorded flow past station represents nearly natural flow. During low stages a small diurnal fluctuation is observed at gage.

ACCURACY.—Stage-discharge relation not permanent. One poorly defined rating curve and shifting-control method used during year. Gage read to half-tenths twice daily. Diurnal fluctuation at gage during low stages. Daily discharge ascertained by applying mean daily gage height, corrected for shifting control, to rating table, except for period when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for ice effect by means of one discharge measurement, observer's notes, and weather records. Records fair.

*Discharge measurements of Kickapoo River at Gays Mills, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 6 | E. E. Foster | 1.41 | 230 | Aug. 23 | E. E. Foster | 1.60 | 230 |
| Jan. 27 | do | [a]1.75 | 228 | 23 | do | 1.74 | 284 |
| June 4 | S. B. Soulé | 1.98 | 361 | | | | |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Kickapoo River at Gays Mills, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 285 | 325 | 365 | 275 | 235 | 1,150 | 743 | 365 | 265 | 365 | 246 | 265 |
| 2 | 265 | 365 | 365 | 236 | 235 | 1,780 | 1,420 | 365 | 256 | 386 | 246 | 285 |
| 3 | 265 | 365 | 305 | 220 | 255 | 2,260 | 4,240 | 325 | 285 | 626 | 246 | 345 |
| 4 | 246 | 305 | 285 | 225 | 245 | 2,100 | 4,180 | 325 | 305 | 345 | 227 | 256 |
| 5 | 246 | 305 | 256 | 220 | 245 | 1,700 | 3,950 | 325 | 365 | 345 | 227 | 236 |
| 6 | 236 | 492 | 246 | 220 | 235 | 791 | 2,900 | 325 | 672 | 492 | 236 | 227 |
| 7 | 285 | 407 | 265 | 220 | 235 | 536 | 2,340 | 325 | 603 | 325 | 227 | 236 |
| 8 | 305 | 325 | 305 | 235 | 265 | 449 | 1,450 | 325 | 449 | 305 | 246 | 213 |
| 9 | 285 | 325 | 265 | 235 | 255 | 603 | 940 | 365 | 386 | 305 | 236 | 246 |
| 10 | 285 | 305 | 265 | 220 | 275 | 940 | 840 | 345 | 345 | 285 | 246 | 236 |
| 11 | 285 | 305 | 285 | 225 | 235 | 1,210 | 1,270 | 325 | 345 | 285 | 246 | 218 |
| 12 | 265 | 325 | 220 | 235 | 255 | 1,270 | 1,450 | 325 | 470 | 285 | 236 | 227 |
| 13 | 246 | 325 | 245 | 235 | 275 | 767 | 1,060 | 305 | 492 | 285 | 227 | 218 |
| 14 | 246 | 345 | 245 | 225 | 255 | 492 | 865 | 305 | 514 | 285 | 236 | 218 |
| 15 | 285 | 345 | 225 | 235 | 255 | 470 | 695 | 325 | 386 | 285 | 218 | 218 |
| 16 | 265 | 325 | 245 | 220 | 265 | 345 | 626 | 365 | 325 | 265 | 208 | 218 |
| 17 | 265 | 305 | 245 | 220 | 255 | 407 | 580 | 345 | 325 | 256 | 198 | 236 |
| 18 | 265 | 325 | 245 | 225 | 275 | 345 | 536 | 325 | 305 | 256 | 208 | 256 |
| 19 | 285 | 365 | 245 | 225 | 265 | 305 | 492 | 325 | 325 | 256 | 198 | 285 |
| 20 | 265 | 365 | 245 | 225 | 265 | 492 | 514 | 492 | 365 | 265 | 218 | 449 |
| 21 | 265 | 325 | 255 | 220 | 265 | 536 | 514 | 428 | 470 | 256 | 256 | 492 |
| 22 | 265 | 305 | 255 | 220 | 265 | 649 | 558 | 345 | 365 | 256 | 246 | 386 |
| 23 | 265 | 305 | 255 | 220 | 265 | 672 | 767 | 305 | 305 | 256 | 256 | 285 |
| 24 | 265 | 305 | 245 | 220 | 285 | 695 | 536 | 285 | 325 | 256 | 208 | 265 |
| 25 | 265 | 285 | 265 | 210 | 449 | 580 | 492 | 285 | 325 | 256 | 198 | 256 |
| 26 | 265 | 265 | 265 | 220 | 649 | 449 | 449 | 285 | 1,330 | 256 | 198 | 256 |
| 27 | 246 | 305 | 265 | 235 | 1,150 | 536 | 428 | 265 | 719 | 256 | 218 | 256 |
| 28 | 265 | 305 | 245 | 225 | 1,150 | 536 | 407 | 265 | 865 | 265 | 236 | 246 |
| 29 | 246 | 285 | 255 | 245 | ------- | 558 | 386 | 285 | 492 | 256 | 256 | 285 |
| 30 | 265 | 305 | 285 | 245 | ------- | 915 | 386 | 285 | 407 | 265 | 227 | 265 |
| 31 | 265 | ------- | 235 | 255 | ------- | 719 | ------- | 256 | ------- | 265 | 218 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 11 to Mar. 1.

*Monthly discharge of Kickapoo River at Gays Mills, Wis., for the year ending September 30, 1923*

[Drainage area, 629 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 305 | 236 | 266 | 0.423 | 0.49 |
| November | 492 | 265 | 328 | .521 | .58 |
| December | 365 | 220 | 264 | .420 | .48 |
| January | 275 | 210 | 229 | .364 | .42 |
| February | 1,150 | 235 | 341 | .542 | .56 |
| March | 2,260 | 305 | 815 | 1.30 | 1.50 |
| April | 4,240 | 386 | 1,200 | 1.91 | 2.13 |
| May | 492 | 256 | 326 | .518 | .60 |
| June | 1,330 | 256 | 446 | .709 | .79 |
| July | 626 | 256 | 301 | .479 | .55 |
| August | 256 | 198 | 229 | .364 | .42 |
| September | 492 | 218 | 270 | .429 | .48 |
| The year | 4,240 | 198 | 417 | .663 | 9.00 |

### TURKEY RIVER AT GARBER, IOWA

LOCATION.—In sec. 36, T. 92 N., R. 4 W., at single-span highway bridge at Garber, Clayton County, 2,000 feet below mouth of Elk Creek.

DRAINAGE AREA.—1,530 square miles (measured on map issued by United States Geological Survey; scale 1:500,000).

RECORDS AVAILABLE.—August 29, 1913, to November 30, 1916; May 14, 1919, to September 30, 1923.

GAGE.—Chain gage attached to downstream handrail of bridge; read by E. J. Prolow.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and mud; channel shifting. Right bank high and not subject to overflow; left bank is overflowed at stages above 13 feet, road to left end of bridge is overflowed at gage height 22 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 24.1 feet at 6 p. m. April 3 (discharge, about 21,800 second-feet); minimum discharge, 130 second-feet October 13.

1913–1916; 1919–1923: Maximum stage recorded, 28.06 feet February 23, 1922; minimum discharge, 88 second-feet September 5, 6, and 7, 1922.

ICE.—Stage-discharge relation affected by ice. Gage readings discontinued.

REGULATION.—An electric light plant and grist mill at Elkader probably cause a slight diurnal fluctuation.

ACCURACY.—Stage-discharge relation changed April 8. Both rating curves fairly well defined between 200 and 11,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except as explained in footnote to table of daily discharge. Records fair.

*Discharge measurements of Turkey River at Garber, Iowa, during the year ending September 30, 1923*

[Made by J. B. Spiegel]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Feb. 21 | [a] 4.05 | 135 |
| June 27 | 3.56 | 205 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Turkey River at Garber, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 225 | 665 | 430 | | 1,140 | 3,420 | 785 | 252 | 205 | 178 | 310 |
| 2 | 225 | 630 | 528 | | 1,360 | 6,180 | 500 | 198 | 1,380 | 184 | 555 |
| 3 | 225 | 630 | 430 | | 1,360 | 19,300 | 450 | 202 | 490 | 180 | 286 |
| 4 | 245 | 665 | 462 | | 8,490 | 16,300 | 555 | 202 | 355 | 195 | 252 |
| 5 | 270 | 630 | 430 | | 4,320 | 13,700 | 500 | 202 | 373 | 205 | 246 |
| 6 | 225 | 595 | 430 | | 3,120 | 6,400 | 528 | 198 | 264 | 220 | 246 |
| 7 | 245 | 560 | | | 3,120 | 3,920 | 425 | 202 | 243 | 215 | 215 |
| 8 | 1,520 | 560 | | | 2,840 | 1,660 | 425 | 200 | 302 | 337 | 235 |
| 9 | 462 | 495 | | | 560 | 1,180 | 425 | 225 | 246 | 225 | 475 |
| 10 | 430 | 495 | | | 1,220 | 1,180 | 425 | 215 | 235 | 218 | 302 |
| 11 | 400 | 528 | | | 840 | 1,100 | 400 | 255 | 440 | 215 | 230 |
| 12 | 315 | 560 | | | 1,140 | 1,100 | 400 | 324 | 355 | 178 | 192 |
| 13 | 136 | 595 | | | 1,140 | 1,260 | 378 | 306 | 355 | 174 | 218 |
| 14 | 166 | 630 | | | 560 | 960 | 378 | 324 | 298 | 186 | 184 |
| 15 | 160 | 595 | | | 560 | 890 | 378 | 337 | 232 | 186 | 195 |
| 16 | 160 | 560 | | | 190 | 820 | 378 | 302 | 210 | 186 | 205 |
| 17 | 184 | 560 | | | 190 | 820 | 355 | 332 | 220 | 182 | 156 |
| 18 | 225 | 528 | | | 180 | 820 | 328 | 302 | 220 | 186 | 166 |
| 19 | 225 | 528 | | | 170 | 820 | 328 | 332 | 192 | 186 | 205 |
| 20 | 290 | 560 | | | 160 | 820 | 319 | 400 | 180 | 190 | 1,740 |
| 21 | 225 | 560 | | 135 | 190 | 1,030 | 328 | 450 | 220 | 240 | 1,100 |
| 22 | 225 | 560 | | | 2,000 | 1,180 | 319 | 475 | 205 | 235 | 450 |
| 23 | 225 | 560 | | | 2,160 | 1,180 | 319 | 475 | 190 | 246 | 310 |
| 24 | 245 | 528 | | | 2,160 | 1,180 | 298 | 475 | 172 | 235 | 290 |
| 25 | 225 | 560 | | 2,660 | 2,240 | 960 | 278 | 475 | 172 | 170 | 286 |
| 26 | 233 | 462 | | 3,020 | 2,410 | 890 | 302 | 400 | 195 | 182 | 286 |
| 27 | 275 | 430 | | 1,760 | 2,240 | 890 | 319 | 215 | 195 | 182 | 294 |
| 28 | 265 | 430 | | 1,060 | 2,320 | 785 | 302 | 195 | 205 | 235 | 278 |
| 29 | 249 | 400 | | | 2,580 | 750 | 278 | 210 | 186 | 215 | 648 |
| 30 | 270 | 430 | | | 2,580 | 750 | 264 | 186 | 174 | 205 | 555 |
| 31 | 325 | | | | 2,160 | | 252 | | 186 | 222 | |

NOTE.—Discharge estimated Mar. 18–23.

*Monthly discharge of Turkey River at Garber, Iowa, for the year ending September 30, 1923*

[Drainage area, 1,530 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 1,520 | 136 | 293 | 0.192 | 0.22 |
| November | 665 | 400 | 550 | .359 | .40 |
| March | 8,490 | 160 | 1,800 | 1.18 | 1.36 |
| April | 19,300 | 750 | 3,070 | 2.01 | 2.24 |
| May | 785 | 252 | 385 | .252 | .29 |
| June | 475 | 186 | 296 | .193 | .22 |
| July | 1,380 | 172 | 287 | .188 | .22 |
| August | 337 | 170 | 206 | .135 | .16 |
| September | 1,740 | 156 | 370 | .242 | .27 |

**MAQUOKETA RIVER BELOW NORTH FORK OF MAQUOKETA RIVER, NEAR MAQUOKETA, IOWA**

LOCATION.—In southwest corner NE. ¼ sec. 17, T. 84 N., R. 3 E., at Bridgeport Bridge, 1,200 feet above mouth of Mill Creek, 2 miles below mouth of North Fork of Maquoketa River, and 3 miles northeast of Maquoketa, Jackson County.

DRAINAGE AREA.—1,600 square miles (measured on map issued by United States Geological Survey; scale, 1 : 500,000).

RECORDS AVAILABLE.—September 1, 1913, to September 30, 1923.

GAGE.—Chain gage attached to downstream handrail of bridge, 100 feet from right abutment; read by John Strodthoff.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—No definite control; bed composed of sand and mud; shifts during high water. Above 12-foot stage, overflow occurs under a pile trestle approach on left side.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 20.6 feet at 11.45 a. m. April 4 (discharge, 18,500 second-feet); minimum stage recorded, 1.5 feet July 26 (discharge, 315 second-feet).

1913–1923: Maximum stage recorded, 22.0 feet March 27, 1916 (discharge, 21,300 second-feet); minimum stage, 1.59 feet December 25, 1918 (discharge, about 245 second-feet).

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation changed June 11–21 and again September 2. Rating curves fairly well defined between 300 and 16,000 second-feet. Gage read to hundredths once daily and frequently during periods of high water. Daily discharge ascertained by applying daily gage height to rating tables; shifting-control method used June 11–21. Records good.

*Discharge measurements of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, during the year ending September 30, 1923*

[Made by J. B. Spiegel]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Feb. 23 | [a] 2.92 | 373 |
| June 28 | 2.25 | 574 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 495 | 515 | 640 | ------ | 800 | 1,810 | 730 | 422 | 422 | 330 | 825 |
| 2 | 515 | 825 | 685 | ------ | 900 | 2,740 | 640 | 390 | 390 | 345 | 6,670 |
| 3 | 495 | 730 | 662 | ------ | 1,020 | 11,600 | 595 | 495 | 850 | 345 | 3,420 |
| 4 | 495 | 595 | 640 | ------ | 2,370 | 18,300 | 575 | 458 | 1,120 | 422 | 1,560 |
| 5 | 495 | 640 | 575 | ------ | 2,430 | 13,200 | 555 | 440 | 1,180 | 375 | 1,060 |
| 6 | 495 | 685 | 495 | ------ | 1,630 | 6,060 | 495 | 405 | 555 | 360 | 810 |
| 7 | 515 | 685 | 555 | ------ | 1,080 | 4,200 | 495 | 555 | 475 | 475 | 1,220 |
| 8 | 495 | 640 | 595 | ------ | 875 | 3,060 | 475 | 495 | 475 | 2,000 | 810 |
| 9 | 475 | 595 | 550 | ------ | 825 | 2,190 | 475 | 442 | 440 | 730 | 675 |
| 10 | 495 | 575 | 500 | ------ | 975 | 1,750 | 475 | 405 | 458 | 555 | 585 |
| 11 | 495 | 630 | 450 | ------ | 685 | 1,510 | 495 | 495 | 422 | 475 | 520 |
| 12 | 495 | 685 | 422 | ------ | 640 | 1,390 | 595 | 458 | 515 | 640 | 520 |
| 13 | 495 | 1,080 | ------ | ------ | 685 | 1,340 | 595 | 495 | 422 | 1,120 | 540 |
| 14 | 495 | 1,180 | ------ | ------ | 640 | 1,280 | 535 | 618 | 405 | 640 | 480 |
| 15 | 495 | 1,020 | ------ | ------ | 575 | 1,220 | 535 | 495 | 390 | 515 | 450 |
| 16 | 515 | 875 | ------ | ------ | 535 | 1,180 | 495 | 458 | 390 | 458 | 420 |
| 17 | 495 | 775 | ------ | ------ | 495 | 1,120 | 515 | 405 | 390 | 495 | 400 |
| 18 | 475 | 775 | ------ | ------ | 640 | 1,020 | 555 | 422 | 375 | 450 | 400 |
| 19 | 495 | 825 | ------ | ------ | 475 | 1,020 | 525 | 390 | 360 | 405 | 400 |
| 20 | 475 | 775 | ------ | ------ | 495 | 975 | 495 | 390 | 345 | 375 | 440 |
| 21 | 475 | 730 | ------ | ------ | 575 | 975 | 535 | 405 | 345 | 360 | 3,880 |
| 22 | 475 | 685 | ------ | ------ | 685 | 1,020 | 475 | 390 | 330 | 405 | 2,440 |
| 23 | 495 | 685 | ------ | 373 | 640 | 1,180 | 440 | 390 | 345 | 390 | 1,500 |
| 24 | 515 | 685 | ------ | ------ | 825 | 1,080 | 440 | 375 | 338 | 375 | 1,160 |
| 25 | 495 | 595 | ------ | ------ | 925 | 1,120 | 422 | 390 | 330 | 345 | 905 |
| 26 | 485 | 595 | ------ | ------ | 825 | 925 | 422 | 495 | 315 | 345 | 810 |
| 27 | 475 | 640 | ------ | ------ | 875 | 875 | 422 | 458 | 345 | 390 | 720 |
| 28 | 475 | 685 | ------ | ------ | 925 | 875 | 440 | 495 | 360 | 975 | 675 |
| 29 | 475 | 595 | ------ | ------ | 975 | 800 | 420 | 555 | 345 | 515 | 675 |
| 30 | 495 | 595 | ------ | ------ | 2,310 | 730 | 405 | 495 | 360 | 458 | 810 |
| 31 | 495 | ------ | ------ | ------ | 1,810 | ------ | 390 | ------ | 330 | 405 | ------ |

NOTE.—Stage-discharge relation affected by ice Dec. 9–11, Mar. 1 and 2; discharge estimated. Discharge interpolated Oct. 26, Nov. 5, 11, Dec. 3, Apr. 29, May 19, 29, 30, July 19, 24, Aug. 18, and Sept 15.

*Monthly discharge of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, for the year ending September 30, 1923*

[Drainage area, 1,600 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 515 | 475 | 492 | 0.308 | 0.36 |
| November | 1,180 | 515 | 720 | .450 | .50 |
| March | 2,430 | 475 | 972 | .608 | .70 |
| April | 18,300 | 730 | 2,880 | 1.80 | 2.1 |
| May | 730 | 390 | 505 | .316 | .36 |
| June | 618 | 375 | 453 | .283 | .32 |
| July | 1,180 | 315 | 456 | .285 | .33 |
| August | 2,000 | 330 | 531 | .332 | .38 |
| September | 6,670 | 400 | 1,190 | .744 | .83 |

**ROCK RIVER AT AFTON, WIS.**

LOCATION.—On line between secs. 22 and 27, T. 2 N., R. 12 E. at highway bridge in Afton, Rock County, 9 miles above Illinois State line. Bass Creek enters from right three-fourths mile below station.

DRAINAGE AREA.—3,190 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch = 6 miles).

RECORDS AVAILABLE.—February 5, 1914, to September 30, 1923.

GAGE.—Chain gage fastened to downstream side of bridge; read by George Robb.

DISCHARGE MEASUREMENTS.—Made from the downstream side of bridge and by wading.

CHANNEL AND CONTROL.—Banks medium high and will not be overflowed to any extent at flood stages; channel gravel and clean silt, practically permanent. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.55 feet at 6.45 a. m. April 12 (discharge, 10,400 second-feet); minimum stage, 0.08 foot at 6.40 a. m. December 9 (discharge, about 370 second-feet).

1914–1923: Maximum discharge recorded, 10.51 feet at noon March 26, 1918 (discharge, 12,700 second-feet); minimum stage recorded, that of December 9, 1922.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Operation of power plants at Janesville and above causes slight fluctuation at gage during low stages.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve fairly well defined between 600 and 1,000 second-feet; well defined between 1,000 and 7,000 second-feet. Gage read to hundredths twice daily. Some diurnal fluctuation at low stages. Daily discharge ascertained by applying mean daily gage height to rating curve, except for periods when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for ice effect by means of observer's notes and weather records. Open-water records for low stages fair; for medium and high stages good; winter records fair.

*Discharge measurements of Rock River at Afton, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Nov. 15 | S. B. Soulé | 2.01 | 1,050 | Apr. 5 | S. B. Soulé | 6.70 | 5,530 |
| Jan. 31 | J. H. Olson | 1.66 | 901 | July 4 | do | 1.62 | 776 |
| Mar. 24 | S. B. Soulé | 4.40 | 2,870 | 18 | do | 1.35 | 673 |

*Daily discharge, in second-feet, of Rock River at Afton, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,060 | 950 | 850 | 755 | 1,060 | 1,370 | 2,400 | 5,290 | 1,240 | 800 | 710 | 710 |
| 2 | 1,060 | 950 | 950 | 850 | 1,180 | 1,510 | 2,580 | 5,030 | 1,180 | 850 | 710 | 595 |
| 3 | 950 | 900 | 900 | 755 | 1,060 | 1,650 | 5,680 | 4,640 | 1,120 | 1,000 | 710 | 670 |
| 4 | 950 | 800 | 900 | 1,000 | 900 | 2,670 | 5,550 | 4,510 | 1,240 | 900 | 670 | 800 |
| 5 | 900 | 950 | 1,000 | 950 | 1,120 | 2,580 | 5,820 | 4,030 | 1,180 | 850 | 560 | 710 |
| 6 | 755 | 850 | 900 | 850 | 1,060 | 3,360 | 6,520 | 3,800 | 1,180 | 1,370 | 560 | 755 |
| 7 | 1,060 | 755 | 900 | 1,060 | 1,060 | 3,470 | 7,400 | 3,690 | 1,240 | 1,240 | 630 | 800 |
| 8 | 1,060 | 900 | 1,000 | 850 | 1,120 | 4,030 | 8,370 | 3,260 | 1,180 | 1,000 | 710 | 755 |
| 9 | 1,000 | 950 | 560 | 1,000 | 800 | 3,800 | 9,110 | 3,060 | 950 | 800 | 670 | 710 |
| 10 | 900 | 900 | 1,180 | 1,120 | 900 | 4,150 | 9,700 | 2,860 | 850 | 800 | 670 | 755 |
| 11 | 900 | 900 | 900 | 1,240 | 755 | 4,030 | 10,100 | 2,580 | 1,000 | 1,300 | 670 | 850 |
| 12 | 850 | 900 | 755 | 1,060 | 900 | 4,510 | 10,300 | 2,490 | 1,180 | 1,180 | 800 | 800 |
| 13 | 850 | 1,060 | 1,060 | 950 | 1,060 | 3,910 | 10,300 | 2,130 | 1,240 | 1,240 | 755 | 755 |
| 14 | 800 | 1,060 | 1,060 | 850 | 900 | 3,580 | 10,300 | 1,960 | 800 | 1,120 | 710 | 755 |
| 15 | 850 | 1,000 | 1,000 | 850 | 1,060 | 3,690 | 10,100 | 1,720 | 850 | 710 | 850 | 670 |
| 16 | 900 | 1,060 | 950 | 1,060 | 1,060 | 3,470 | 9,700 | 2,130 | 1,000 | 755 | 755 | 595 |
| 17 | 850 | 850 | 1,000 | 1,060 | 1,060 | 3,360 | 9,500 | 1,510 | 755 | 900 | 710 | 630 |
| 18 | 710 | 950 | 900 | 1,060 | 950 | 3,260 | 9,110 | 1,510 | 755 | 800 | 670 | 710 |
| 19 | 800 | 900 | 950 | 1,120 | 950 | 2,960 | 8,550 | 1,440 | 630 | 800 | 560 | 710 |
| 20 | 850 | 1,180 | 850 | 1,120 | 950 | 3,470 | 8,200 | 1,510 | 755 | 800 | 670 | 1,180 |
| 21 | 950 | 1,240 | 900 | 900 | 1,000 | 3,360 | 8,030 | 1,650 | 755 | 755 | 755 | 1,800 |
| 22 | 850 | 1,180 | 850 | 1,370 | 1,060 | 3,580 | 7,870 | 1,580 | 900 | 850 | 800 | 1,300 |
| 23 | 755 | 1,060 | 950 | 1,300 | 1,000 | 3,160 | 7,870 | 1,510 | 1,000 | 710 | 755 | 900 |
| 24 | 950 | 1,180 | 950 | 1,060 | 1,180 | 3,160 | 7,400 | 1,580 | 1,000 | 900 | 670 | 1,000 |
| 25 | 950 | 1,180 | 755 | 1,180 | 1,300 | 3,260 | 7,100 | 1,650 | 1,060 | 800 | 630 | 950 |
| 26 | 800 | 850 | 1,000 | 950 | 2,310 | 2,960 | 6,660 | 1,580 | 1,370 | 755 | 630 | 900 |
| 27 | 710 | 850 | 1,060 | 1,060 | 2,400 | 2,960 | 6,520 | 1,440 | 1,240 | 710 | 755 | 950 |
| 28 | 950 | 1,060 | 900 | 850 | 1,880 | 2,580 | 6,100 | 1,440 | 1,240 | 710 | 755 | 850 |
| 29 | 850 | 950 | 850 | 1,120 | ------- | 2,580 | 5,820 | 1,440 | 1,180 | 595 | 755 | 950 |
| 30 | 710 | 1,000 | 850 | 1,060 | ------- | 2,670 | 5,550 | 1,370 | 1,000 | 630 | 710 | 850 |
| 31 | 950 | ------- | 755 | 900 | ------- | 2,400 | ------- | 1,370 | ------- | 755 | 755 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 12–24, Jan. 10–13, 17, and Feb. 2–24.

*Monthly discharge of Rock River at Afton, Wis., for the year ending September 30, 1923*

[Drainage area, 3,190 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 1,060 | 710 | 886 | 0.278 | 0.32 |
| November | 1,240 | 755 | 977 | .306 | .34 |
| December | 1,180 | 560 | 916 | .287 | .33 |
| January | 1,370 | 755 | 1,010 | .317 | .37 |
| February | 2,400 | 755 | 1,140 | .357 | .37 |
| March | 4,510 | 1,370 | 3,150 | .987 | 1.14 |
| April | 10,300 | 2,400 | 7,610 | 2.39 | 2.67 |
| May | 5,290 | 1,370 | 2,440 | .765 | .88 |
| June | 1,370 | 630 | 1,040 | .326 | .86 |
| July | 1,370 | 595 | 883 | .277 | .32 |
| August | 850 | 560 | 701 | .220 | .25 |
| September | 1,800 | 595 | 846 | .265 | .30 |
| The year | 10,300 | 560 | 1,800 | .564 | 7.65 |

## ROCK RIVER AT LYNDON, ILL.

LOCATION.—In sec. 21, T. 20 N., R. 5 E., at highway bridge known as Lyndon Bridge, in Lyndon, Whiteside County; 10 miles above Rock Creek and 20 miles below dam at Sterling.

DRAINAGE AREA.—9,010 square miles.

RECORDS AVAILABLE.—November 24, 1914, to September 30, 1923.

GAGE.—Chain gage attached to bridge; read by George Cady.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders, practically permanent. Banks wooded.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.7 feet April 11 (discharge, 29,800 second-feet); minimum stage recorded, 4.53 feet at 7 a. m. September 5 (discharge, 1,220 second-feet).

1914–1923: Maximum stage recorded, 19.6 feet February 16, 1918 (discharge not determined because of backwater from ice). Maximum open-water stage recorded, 17.0 feet March 28, 1916 (discharge, 39,500 second-feet); minimum stage, 3.72 feet September 27, 1918 (discharge, 536 second-feet).

DIVERSIONS.—Water diverted at Sterling Dam to feed Illinois & Mississippi Canal probably averages about 100 second-feet.

REGULATION.—Flow past gage regulated by power plants in city of Sterling and above, mean of two daily readings of gage during low stages is probably somewhat less than true mean daily gage height due to such regulation.

ACCURACY.—Stage-discharge relation practically permanent; seriously affected by ice during winter. Rating curve well defined between 1,000 and 25,000 second-feet, fairly well defined beyond these limits. Gage read to hundredths twice daily. Diurnal fluctuation at gage rather large during low stages. Daily discharge ascertained by applying mean daily gage height to rating table except as shown in footnote to table of daily discharge. Records good for medium and high stages; poor for low stages and for periods of ice effect.

The following discharge measurement was made by H. E. Grosbach:
March **7, 1923**: Gage height, 8.58 feet; discharge, 9,820 second-feet.

*Daily discharge, in second-feet, of Rock River at Lyndon, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ------- | 1,910 | 2,370 | | | | 13,600 | 9,240 | 2,210 | 2,210 | 1,510 | 2,310 |
| 2 | ------- | 2,060 | 2,420 | | | | 16,000 | 8,720 | 2,210 | 2,210 | 1,330 | 2,210 |
| 3 | ------- | 1,910 | 2,470 | | | | 16,000 | 6,710 | 2,370 | 2,060 | 1,270 | 2,210 |
| 4 | ------- | 1,910 | 2,530 | | | 6,700 | 15,600 | 6,230 | 2,530 | 2,210 | 1,450 | 1,700 |
| 5 | ------- | 2,060 | 2,370 | | | | 16,000 | 6,280 | 2,700 | 2,210 | 1,510 | 1,450 |
| 6 | ------- | 1,910 | 2,370 | | | | 19,100 | 6,230 | 2,870 | 2,060 | 1,580 | 1,700 |
| 7 | ------- | 2,060 | 2,370 | | | 8,720 | 21,100 | 5,990 | 2,870 | 2,210 | 1,700 | 2,060 |
| 8 | ------- | 2,210 | 2,700 | | | 8,980 | 23,800 | 5,990 | 3,050 | 2,370 | 2,370 | 2,060 |
| 9 | ------- | 2,370 | 2,370 | | | 8,980 | 25,400 | 5,990 | 3,230 | 2,530 | 2,530 | 2,530 |
| 10 | ------- | 2,370 | 2,870 | | | 8,720 | 28,200 | 5,750 | 3,610 | 2,210 | 2,530 | ------- |
| 11 | ------- | 2,700 | 3,610 | | | 8,200 | 29,800 | 5,750 | 3,610 | 2,060 | 2,370 | ------- |
| 12 | ------- | 2,870 | | | | 8,460 | 28,600 | 5,520 | 3,230 | 2,060 | 2,210 | ------- |
| 13 | ------- | 2,870 | | | 3,420 | 8,200 | 25,800 | 5,520 | 3,420 | 2,210 | 2,370 | ------- |
| 14 | ------- | 2,870 | | | | 8,460 | 20,800 | 5,290 | 3,230 | 2,370 | 2,370 | ------- |
| 15 | ------- | 2,870 | | | | 8,460 | 19,700 | 4,620 | 3,420 | 2,370 | 1,910 | ------- |
| 16 | ------- | 2,700 | | 3,420 | | 8,460 | 16,900 | 4,000 | 3,610 | 2,530 | 1,910 | 2,370 |
| 17 | ------- | 2,530 | | | | 8,460 | 14,800 | 3,800 | 2,060 | 2,370 | 2,060 | ------- |
| 18 | 1,910 | 2,530 | | | | 8,720 | 14,200 | 3,610 | 1,910 | 1,700 | 2,210 | ------- |
| 19 | 1,910 | 2,530 | | | | 8,720 | 13,900 | 3,050 | 1,910 | 1,510 | 1,580 | ------- |
| 20 | 2,210 | 2,370 | | | | 8,720 | 13,600 | 2,700 | 1,910 | 1,640 | ------- | ------- |
| 21 | 2,210 | 2,700 | 3,420 | | | 8,720 | 13,300 | 2,530 | 1,910 | 1,640 | ------- | ------- |
| 22 | 1,910 | 2,870 | | | | 10,600 | 11,700 | 2,530 | 1,910 | 1,510 | ------- | ------- |
| 23 | 2,060 | 2,700 | | | | 11,100 | 11,400 | 2,530 | 1,770 | 1,640 | ------- | 2,870 |
| 24 | 2,060 | 2,530 | | | | 13,600 | 11,100 | 2,370 | 1,840 | 1,390 | ------- | 3,230 |
| 25 | 2,060 | 2,700 | | | | 18,100 | 11,100 | 2,370 | 1,910 | 1,510 | ------- | 3,050 |
| 26 | 2,060 | 2,530 | | | | 21,100 | 10,800 | 2,210 | 2,060 | 1,640 | 2,530 | 3,420 |
| 27 | 1,910 | 2,210 | | | 4,350 | 21,100 | 10,000 | 2,210 | 2,060 | 1,510 | 2,530 | 3,230 |
| 28 | 2,060 | 2,210 | | | | 21,100 | 9,770 | 2,210 | 2,060 | 1,390 | 1,580 | 3,050 |
| 29 | 1,910 | 2,370 | | | | 18,800 | 9,770 | 2,060 | 2,060 | 1,510 | 2,370 | 2,700 |
| 30 | 2,060 | 2,210 | | | | 17,500 | 9,500 | 2,060 | 2,210 | 1,700 | 2,530 | 2,870 |
| 31 | 1,910 | ------- | | | | 16,200 | ------- | 2,060 | ------- | 1,390 | 2,420 | ------- |

NOTE.—Gage not read Dec. 2, 3, June 24, Aug. 31, and Sept. 1; discharge interpolated. Stage-discharge relation affected by ice Dec. 12 to Mar. 6; discharge estimated from gage heights, observer's notes, and weather records.

*Monthly discharge of Rock River at Lyndon, Ill., for the year ending September 30, 1923*

[Drainage area, 9,010 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| November | 2,870 | 1,910 | 2,420 | 0.269 | 0.30 |
| December | ---------- | ---------- | 3,120 | .346 | .40 |
| January | ---------- | ---------- | 3,420 | .380 | .44 |
| February | ---------- | ---------- | 3,520 | .391 | .41 |
| March | 21,100 | ---------- | 10,900 | 1.21 | 1.40 |
| April | 29,800 | 9,500 | 16,700 | 1.85 | 2.06 |
| May | 9,240 | 2,060 | 4,390 | .487 | .56 |
| June | 3,610 | 1,770 | 2,520 | .280 | .31 |
| July | 2,530 | 1,390 | 1,930 | .214 | .25 |

### PECATONICA RIVER AT FREEPORT, ILL.

LOCATION.—In sec. 32, T. 27 N., R. 8 E., at highway bridge at Hancock Avenue, half a mile east of Illinois Central Railroad station at Freeport, Stephenson County, and 2 miles above mouth of Yellow Creek.

DRAINAGE AREA.—1,330 square miles.

RECORDS AVAILABLE.—September 11, 1914, to September 30, 1923.

GAGE.—Chain gage attached to upstream side of bridge; read by W. C. Krueger.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and silt; likely to shift. Left bank of only medium height and is overflowed during high water; at stages above 17 feet part of flow passes over left bank and through East Freeport.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 18.35 feet at 5 p. m. April 6 (discharge, 13,100 second-feet); minimum stage, 3.35 feet July 22 (discharge, 262 second-feet).

1914–1923: Maximum stage recorded, 19.4 feet March 28, 1916 (discharge, 17,000 second-feet); minimum discharge, 200 second-feet December 14, 1917.

REGULATION.—A dam and power plant three-fourths mile upstream regulates flow past gage. Only slight diurnal fluctuation is noticeable.

ACCURACY.—Stage-discharge relation changed slightly during year; affected by ice during winter. Rating curves well defined between 400 and 7,000 second-feet, and fairly well defined beyond these limits. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for medium and high stages, fair for low stages during open-water periods; poor for periods of ice effect.

*Discharge measurements of Pecatonica River at Freeport, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Mar. 8 | 7.49 | 1,150 |
| Apr. 9 | 16.71 | 8,190 |

*Daily discharge, in second-feet, of Pecatonica River at Freeport, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 447 | 465 | 501 | 1,020 | | 3,580 | 1,430 | 615 | 429 | 395 | 345 | 444 |
| 2 | 447 | 519 | 519 | 925 | | 3,580 | 1,580 | 595 | 429 | 395 | 345 | 410 |
| 3 | 465 | 575 | 575 | 835 | | 3,580 | 3,290 | 575 | 412 | 395 | 361 | 462 |
| 4 | 447 | 575 | 537 | 655 | | 2,800 | 5,210 | 575 | 395 | 395 | 345 | 856 |
| 5 | 447 | 575 | 501 | 537 | | 5,080 | 8,000 | 555 | 465 | 447 | 361 | 878 |
| 6 | 447 | 519 | 483 | 447 | | 4,710 | 12,600 | 537 | 412 | 2,600 | 393 | 768 |
| 7 | 501 | 615 | 447 | 429 | | 3,430 | 12,600 | 537 | 615 | 1,200 | 640 | 746 |
| 8 | 501 | 655 | 361 | 429 | | 1,820 | 10,600 | 537 | 735 | 1,050 | 950 | 856 |
| 9 | 501 | 555 | | 465 | | 1,300 | 7,510 | 537 | 715 | 795 | 500 | 790 |
| 10 | 501 | 465 | | 519 | | 1,460 | 6,110 | 519 | 715 | 501 | 377 | 600 |
| 11 | 483 | 465 | | 519 | | 1,380 | 4,000 | 537 | 695 | 465 | 345 | 462 |
| 12 | 483 | 465 | | 537 | | 1,250 | 2,230 | 519 | 675 | 447 | 330 | 427 |
| 13 | 483 | 501 | | 501 | 475 | 815 | 1,640 | 555 | 595 | 429 | 330 | 427 |
| 14 | 465 | 537 | | 465 | | 675 | 1,280 | 537 | 483 | 429 | 330 | 444 |
| 15 | 465 | 795 | | 483 | | 675 | 1,120 | 519 | 429 | 395 | 380 | 393 |
| 16 | 447 | 735 | | 483 | | 537 | 1,020 | 537 | 412 | 345 | 315 | 361 |
| 17 | 465 | 615 | | 537 | | 447 | 1,020 | 537 | 395 | 345 | 315 | 361 |
| 18 | 483 | 595 | | 501 | | 635 | 975 | 555 | 395 | 330 | 300 | 345 |
| 19 | 429 | 575 | 450 | 595 | | 615 | 925 | 575 | 395 | 315 | 300 | 361 |
| 20 | 465 | 575 | | 835 | | 655 | 835 | 575 | 395 | 300 | 315 | 361 |
| 21 | 483 | 575 | | 1,050 | | 695 | 815 | 555 | 378 | 300 | 361 | 856 |
| 22 | 412 | 537 | | 855 | | 735 | 795 | 537 | 328 | 270 | 410 | 1,420 |
| 23 | 447 | 519 | | 735 | | 1,080 | 795 | 537 | 296 | 270 | 410 | 1,280 |
| 24 | 501 | 519 | | 615 | | 1,910 | 795 | 555 | 296 | 270 | 410 | 856 |
| 25 | 483 | 501 | | 575 | 1,020 | 2,550 | 815 | 501 | 296 | 300 | 393 | 580 |
| 26 | 483 | 501 | | 501 | 1,430 | 2,310 | 755 | 483 | 395 | 393 | 361 | 377 |
| 27 | 465 | 465 | | 519 | 2,000 | 2,070 | 715 | 465 | 615 | 300 | 345 | 462 |
| 28 | 465 | 501 | | 501 | 3,030 | 1,820 | 715 | 447 | 795 | 345 | 480 | 480 |
| 29 | 412 | 501 | | 501 | ------- | 1,610 | 675 | 429 | 735 | 361 | 410 | 480 |
| 30 | 483 | 501 | | 501 | ------- | 1,700 | 635 | 429 | 695 | 345 | 427 | 500 |
| 31 | 465 | ------- | 695 | 483 | ------- | 1,430 | ------- | 429 | ------- | 345 | 462 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 9–30 and Feb. 1–24; discharge estimated from gage-height record, observer's notes, and weather records. Braced figures indicate mean discharge for periods included.

*Monthly discharge of Pecatonica River at Freeport, Ill., for the year ending September 30, 1923*

[Drainage area, 1,330 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 501 | 412 | 467 | 0.351 | 0.40 |
| November | 735 | 465 | 550 | .414 | .46 |
| December | 695 | 361 | 468 | .352 | .41 |
| January | 1,050 | 429 | 598 | .450 | .52 |
| February | 3,030 | ------- | 674 | .507 | .53 |
| March | 5,080 | 447 | 1,840 | 1.38 | 1.59 |
| April | 12,600 | 635 | 3,050 | 2.29 | 2.55 |
| May | 615 | 429 | 529 | .398 | .46 |
| June | 735 | 296 | 501 | .377 | .42 |
| July | 2,600 | 270 | 499 | .375 | .43 |
| August | 950 | 300 | 397 | .298 | .34 |
| September | 1,420 | 345 | 601 | .452 | .50 |
| The year | 12,600 | 270 | 845 | .635 | 8.61 |

76612—26—WSP 565——8

### SUGAR RIVER NEAR BRODHEAD, WIS.

LOCATION.—In sec. 26, T. 2 N., R. 9 E., at highway bridge 2 miles southwest of Brodhead, Green County, and 12 miles above Illinois State line. Jordan Creek enters from right 2 miles below station and Little Jordan Creek, also from right 4 miles above.

DRAINAGE AREA.—529 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—February 7, 1914, to September 30, 1923.

GAGE.—Chain gage attached to upstream side of bridge; read by Arthur Christenson.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; not permanent; control not well defined. Right bank of medium height; seldom overflowed; left bank at gage overflowed at stage of 6.8 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.65 feet at 5 p. m. April 4 (discharge, 7,580 second-feet); minimum stage, 0.78 foot at 5 p. m. August 26 (discharge, about 47 second-feet).

1914–1923: Maximum stage recorded, 11.4 feet September 13, 1915 (discharge, about 13,000 second-feet); minimum discharge, that of August 26, 1923.

REGULATION.—A power plant at Brodhead 2 miles above station causes slight fluctuation of stage during low water, but the pondage is small and it is believed that the monthly discharge represents the natural flow quite accurately. The difference between morning and evening gage readings is seldom more than 0.2 foot. There are two power plants farther upstream but they probably have no effect on the discharge at the gage.

ACCURACY.—Stage-discharge relation not permanent; affected by ice and by shifting control. Rating curve fairly well defined between 120 and 8,000 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying, directly or indirectly, mean daily gage height to rating table except as indicated in footnote to table of daily discharge. Open-water records fair; winter records poor.

*Discharge measurements of Sugar River near Brodhead, Wis., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Nov. 15 | S. B. Soulé | 2.02 | 390 | Apr. 30 | S. B. Soulé | 1.78 | 256 |
| Jan. 30 | J. H. Olson | 1.28 | 178 | May 16 | do | 1.70 | 239 |
| Mar. 23 | S. B. Soulé | 1.97 | 358 | July 18 | do | 1.33 | 173 |
| Apr. 4 | do | 8.62 | 7,460 | | | | |

*Daily discharge, in second-feet, of Sugar River near Brodhead, Wis., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 160 | 209 | 248 | 458 | 262 | 1,380 | 438 | 271 | 243 | 203 | 216 | 271 |
| 2 | 209 | 222 | 262 | 458 | 185 | 1,620 | 543 | 230 | 216 | 230 | 185 | 130 |
| 3 | 209 | 222 | 186 | 385 | 235 | 1,500 | 1,920 | 243 | 125 | 230 | 168 | 185 |
| 4 | 209 | 262 | 262 | 291 | 235 | 1,800 | 7,000 | 243 | 271 | 178 | 132 | 230 |
| 5 | 193 | 235 | 321 | 248 | 195 | 1,500 | 4,440 | 216 | 300 | 190 | 100 | 230 |
| 6 | 158 | 291 | 276 | 222 | 160 | 1,260 | 3,450 | 190 | 257 | 243 | 154 | 216 |
| 7 | 248 | 262 | 235 | 188 | 170 | 850 | 2,930 | 230 | 285 | 257 | 178 | 216 |
| 8 | 134 | 235 | 291 | 235 | 210 | 458 | 2,080 | 257 | 271 | 330 | 139 | 185 |
| 9 | 191 | 209 | 260 | 222 | 210 | 402 | 1,540 | 230 | 362 | 285 | 121 | 285 |
| 10 | 196 | 235 | 145 | 196 | 210 | 543 | 1,050 | 243 | 330 | 300 | 190 | 271 |
| 11 | 222 | 235 | 110 | 306 | 120 | 477 | 700 | 230 | 300 | 315 | 190 | 171 |
| 12 | 209 | 209 | 195 | 235 | 220 | 385 | 607 | 271 | 271 | 243 | 72 | 145 |
| 13 | 209 | 291 | 250 | 235 | 220 | 248 | 562 | 230 | 243 | 230 | 190 | 178 |
| 14 | 193 | 321 | 210 | 160 | 220 | 306 | 434 | 243 | 216 | 216 | 190 | 123 |
| 15 | 127 | 385 | 195 | 276 | 235 | 276 | 496 | 271 | 257 | 157 | 190 | 157 |
| 16 | 173 | 291 | 220 | 235 | 195 | 235 | 496 | 243 | 230 | 230 | 190 | 119 |
| 17 | 193 | 276 | 145 | 306 | 210 | 321 | 518 | 257 | 166 | 203 | 104 | 230 |
| 18 | 191 | 276 | 195 | 235 | 195 | 262 | 475 | 243 | 243 | 176 | 102 | 178 |
| 19 | 196 | 262 | 235 | 220 | 210 | 275 | 434 | 257 | 271 | 161 | 102 | 171 |
| 20 | 186 | 276 | 185 | 220 | 250 | 320 | 434 | 243 | 216 | 154 | 230 | 271 |
| 21 | 222 | 262 | 210 | 185 | 290 | 335 | 415 | 346 | 243 | 143 | 171 | 518 |
| 22 | 151 | 235 | 210 | 276 | 275 | 370 | 434 | 300 | 243 | 117 | 190 | 562 |
| 23 | 175 | 248 | 195 | 262 | 275 | 385 | 454 | 243 | 203 | 157 | 216 | 562 |
| 24 | 183 | 262 | 210 | 222 | 335 | 420 | 415 | 230 | 121 | 166 | 243 | 415 |
| 25 | 175 | 291 | 195 | 235 | 385 | 420 | 396 | 190 | 243 | 152 | 271 | 271 |
| 26 | 209 | 170 | 185 | 235 | 520 | 589 | 346 | 171 | 315 | 148 | 69 | 216 |
| 27 | 196 | 248 | 170 | 222 | 850 | 520 | 300 | 139 | 216 | 161 | 271 | 216 |
| 28 | 183 | 235 | 250 | 115 | 1,100 | 420 | 300 | 190 | 178 | 148 | 216 | 230 |
| 29 | 122 | 248 | 222 | 209 | ------- | 420 | 271 | 216 | 203 | 113 | 185 | 176 |
| 30 | 165 | 235 | 222 | 209 | ------- | 498 | 271 | 203 | 216 | 152 | 148 | 171 |
| 31 | 175 | ------- | 209 | 235 | ------- | 402 | ------- | 243 | ------- | 178 | 230 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 9–28, Jan. 19–21, Feb. 2 to Mar. 1, and Mar. 19–22; discharge determined from gage heights corrected for ice effect by means of observer's notes and weather records.

*Monthly discharge of Sugar River near Brodhead, Wis., for the year ending September 30, 1923*

[Drainage area, 529 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 248 | 122 | 186 | 0.352 | 0.41 |
| November | 385 | 170 | 255 | .482 | .54 |
| December | 321 | 110 | 216 | .408 | .47 |
| January | 458 | 115 | 250 | .473 | .55 |
| February | 1,100 | 120 | 292 | .552 | .57 |
| March | 1,800 | 235 | 619 | 1.17 | 1.35 |
| April | 7,000 | 271 | 1,140 | 2.16 | 2.41 |
| May | 346 | 139 | 236 | .446 | .51 |
| June | 362 | 121 | 242 | .457 | .51 |
| July | 330 | 113 | 199 | .376 | .43 |
| August | 271 | 69 | 173 | .327 | .38 |
| September | 562 | 119 | 243 | .459 | .51 |
| The year | 7,000 | 69 | 336 | .635 | 8.64 |

### IOWA RIVER AT MARSHALLTOWN, IOWA

LOCATION.—In sec. 23, T. 84 N., R. 18 W., at Third Avenue Bridge, 1 mile north of Marshalltown, Marshall County. Asher Creek, 1 mile above station, and Burnett Creek, 1 mile below, enter from left.

DRAINAGE AREA.—1,380 square miles (measured on map issued by United States Geological Survey; scale, 1:500,000).

RECORDS AVAILABLE.—May 21, 1915, to September 30, 1923. February 23, 1903, to August 8, 1903, at old dam site 1 mile above present station.

GAGE.—Chain gage attached to downstream handrail of bridge, 60 feet from right pier; read by B. S. Beehrle.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Gravel bar forms control at extremely low water. Bottom composed of mud and sand, subject to change. Banks subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.1 feet at 9.10 a. m. April 4 (discharge, 3,970 second-feet); minimum discharge occurred during winter.

1915–1923: Maximum stage recorded, 17.74 feet, June 4, 1918 (discharge 42,000 second-feet); minimum discharge, about 2 second-feet, November 24, 1917.

ICE.—Stage-discharge relation affected by ice for short periods during extremely cold weather.

REGULATION.—Operation of a power plant at Eldora causes slight diurnal fluctuation during low water.

ACCURACY.—Stage-discharge relation shifted April 1. Rating curves fairly well defined throughout. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except as explained in footnote to table of daily discharge. Open-water records good; winter records fair.

*Discharge measurements of Iowa River at Marshalltown, Iowa, during the year ending September 30, 1923*

[Made by J. B. Spiegel]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Jan. 29 | [a] 1.40 | 26.7 |
| May 23 | 2.20 | 188 |
| Sept. 29 | 3.50 | 613 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Iowa River at Marshalltown, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 72 | 140 | 120 | | | 152 | 1,580 | 325 | 198 | 185 | 48 | 120 |
| 2 | 65 | 255 | 130 | | | 202 | 1,480 | 310 | 160 | 198 | 55 | 120 |
| 3 | 65 | 240 | 130 | | | 215 | 3,360 | 310 | 150 | 185 | 55 | 110 |
| 4 | 72 | 215 | 130 | | | 1,540 | 3,480 | 265 | 198 | 150 | 48 | 92 |
| 5 | 65 | 190 | 130 | 45 | | 525 | 2,740 | 185 | 160 | 120 | 55 | 92 |
| 6 | 65 | 178 | 120 | | | 348 | 2,480 | 185 | 198 | 110 | 55 | 85 |
| 7 | 130 | 165 | 120 | | 27 | 330 | 2,480 | 210 | 172 | 100 | 62 | 85 |
| 8 | 130 | 120 | 120 | | | 300 | 1,800 | 210 | 172 | 100 | 55 | 92 |
| 9 | 120 | 120 | 120 | | | 240 | 990 | 210 | 150 | 92 | 55 | 100 |
| 10 | 100 | 120 | 120 | | | 190 | 1,040 | 198 | 185 | 85 | 62 | 85 |
| 11 | 100 | 110 | 110 | | | | 775 | 222 | 250 | 85 | 62 | 78 |
| 12 | 100 | 120 | 110 | | | | 735 | 295 | 250 | 85 | 70 | 70 |
| 13 | 90 | 140 | 100 | | | | 695 | 280 | 222 | 85 | 78 | 62 |
| 14 | 90 | 178 | 90 | | | | 695 | 280 | 210 | 78 | 85 | 55 |
| 15 | 80 | 165 | | 40 | | 160 | 735 | 295 | 325 | 70 | 110 | 55 |
| 16 | 80 | 165 | | | | | 695 | 295 | 310 | 62 | 120 | 62 |
| 17 | 80 | 165 | | | | | 695 | 295 | 310 | 62 | 130 | 85 |
| 18 | 72 | 190 | | | 20 | | 695 | 235 | 295 | 55 | 130 | 100 |
| 19 | 65 | 285 | | | | | 655 | 310 | 280 | 55 | 120 | 110 |
| 20 | 58 | 418 | 60 | | | | 655 | 222 | 265 | 62 | 120 | 395 |
| 21 | 50 | 418 | | | | 240 | 555 | 222 | 265 | 62 | 120 | 448 |
| 22 | 65 | 190 | | | 30 | 330 | 465 | 210 | 250 | 70 | 110 | 448 |
| 23 | 72 | 178 | | | | 545 | 535 | 210 | 235 | 62 | 100 | 412 |
| 24 | 72 | 140 | | | | 1,040 | 500 | 172 | 235 | 55 | 100 | 395 |
| 25 | 72 | 120 | | 30 | | 1,840 | 465 | 160 | 250 | 55 | 85 | 378 |
| 26 | 72 | 120 | | | | 1,980 | 500 | 140 | 265 | 48 | 85 | 360 |
| 27 | 72 | 130 | | | 55 | 2,340 | 518 | 130 | 280 | 55 | 110 | 310 |
| 28 | 72 | 120 | 55 | | | 3,480 | 430 | 130 | 235 | 55 | 160 | 250 |
| 29 | 72 | 120 | | 27 | | 2,820 | 412 | 140 | 222 | 55 | 140 | 412 |
| 30 | 72 | 120 | | 30 | | 2,690 | 360 | 198 | 140 | 48 | 140 | 615 |
| 31 | 90 | | | 30 | | 2,140 | | 198 | | 48 | 130 | |

NOTE.—Stage-discharge relation affected by ice Dec. 15 to Feb. 28 and Mar. 11–20; discharge determined from a study of gage height and weather records.

*Monthly discharge of Iowa River at Marshalltown, Iowa, for the year ending September 30, 1923*

[Drainage area, 1,380 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 130 | 50 | 80.0 | 0.058 | 0.07 |
| November | 418 | 110 | 178 | .129 | .14 |
| December | 130 | | 85.2 | .062 | .07 |
| January | | | 38.0 | .028 | .03 |
| February | | | 29.3 | .021 | .02 |
| March | 3,480 | | 809 | .586 | .68 |
| April | 3,480 | 360 | 1,110 | .804 | .90 |
| May | 325 | 130 | 228 | .165 | .19 |
| June | 325 | 140 | 228 | .165 | .18 |
| July | 198 | 48 | 85.1 | .062 | .07 |
| August | 160 | 48 | 92.1 | .067 | .08 |
| September | 615 | 55 | 203 | .147 | .16 |
| The year | 3,480 | | 264 | .191 | 2.59 |

### IOWA RIVER AT IOWA CITY, IOWA

LOCATION.—In sec. 15, T. 79 N., R. 6 W., 200 feet below highway bridge in Iowa City, Johnson County, and 100 feet below Iowa State University hydraulic laboratory.

DRAINAGE AREA.—3,140 square miles (measured on map issued by United States Geological Survey; scale, 1:500,000).

RECORDS AVAILABLE.—November 19, 1921, to September 30, 1923, at present site; from October 30, 1913, to November 18, 1921, at highway bridge 500 feet below Chicago, Rock Island & Pacific Railroad; June 1, 1903, to July 21, 1906, at highway bridge 200 feet upstream from present location.

GAGE.—Gurley seven-day water-stage recorder installed November 19, 1921. Prior to that date a chain gage was used. Gage datum lowered 1 foot October 1, 1922. Recorder inspected by Floyd A. Nagler.

DISCHARGE MEASUREMENTS.—Made from cable 75 feet below gage.

CHANNEL AND CONTROL.—Bed composed of sand with fairly definite control at Chicago, Rock Island & Pacific Railroad bridge. One channel at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.92 feet at 6 p. m. April 7 (discharge, 8,590 second-feet); minimum stage, −0.03 foot at 8 p. m. August 14 (discharge, 24 second-feet).

1903–1906; 1913–1923: Maximum stage recorded, 19.45 feet June 7, 1918 (discharge, 36,200 second-feet); minimum discharge, about 10 second-feet December 26, 1916. Stage refers to chain gage station.

REGULATION.—Considerable diurnal fluctuation occurs at low stages, owing to operation of power plant above station.

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined above 100 second-feet. Operation of water-stage recorder satisfactory. Daily discharge October 1 to November 3 ascertained by use of discharge integrator. Daily discharge for remainder of year ascertained by applying to rating table mean daily gage height obtained by inspection of gage-height graph or as explained in footnote to table of daily discharge. Open-water records excellent; winter records fair.

*Discharge measurements of Iowa River at Iowa City, Iowa, during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Nov. 14 | J. B. Spiegel | 2.88 | 1,240 | Apr. 5 | Wilsey and Ajwani [a] | 9.25 | 7,760 |
| Dec. 7 | Phillips [a] and Wilsey [a] | .94 | 294 | 7 | do | 9.86 | 8,350 |
| Mar. 24 | E. F. Wilsey | 2.28 | 860 | July 23 | J. B. Spiegel | .40 | 124 |
| 29 | Wilsey and Ajwani [a] | 6.26 | 4,190 | Aug. 14 | Wilsey and Shafer [a] | .52 | 135 |
| Apr. 3 | do | 9.75 | 8,360 | | | | |

[a] Graduate student of hydraulics at Iowa State University.

*Daily discharge, in second feet, of Iowa River at Iowa City, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 262 | 318 | 476 | | | 780 | 5,740 | 1,080 | 504 | 595 | 234 | 1,860 |
| 2 | 225 | 375 | 468 | | | 780 | 6,830 | 1,030 | 481 | 605 | 232 | 1,650 |
| 3 | 210 | 475 | 472 | 220 | 320 | 880 | 8,280 | 980 | 494 | 784 | 220 | 655 |
| 4 | 214 | 486 | 450 | | | 1,340 | 8,000 | 905 | 553 | 880 | 155 | 481 |
| 5 | 232 | 526 | 437 | | | 1,250 | 7,740 | 880 | 553 | 600 | 314 | 377 |
| 6 | 231 | 600 | 286 | | | 1,310 | 8,000 | 792 | 610 | 562 | 248 | 930 |
| 7 | 355 | 558 | 311 | | | 1,880 | 8,420 | 805 | 553 | 535 | 562 | 1,140 |
| 8 | 375 | 490 | 405 | 200 | 250 | 1,760 | 7,740 | 760 | 660 | 458 | 437 | 730 |
| 9 | 245 | 450 | 297 | | | 1,800 | 6,460 | 754 | 680 | 481 | 445 | 605 |
| 10 | 262 | 425 | 230 | | | 980 | 4,270 | 649 | 680 | 461 | 522 | 490 |
| 11 | 322 | 401 | | | | 905 | 3,360 | 730 | 830 | 353 | 353 | 605 |
| 12 | 331 | 535 | | | | 830 | 2,910 | 880 | 955 | 389 | 389 | 486 |
| 13 | 322 | 890 | 220 | | 210 | 830 | 2,550 | 830 | 1,310 | 508 | 314 | 445 |
| 14 | 340 | 1,200 | | | | 755 | 2,040 | 880 | 1,200 | 535 | 153 | 348 |
| 15 | 242 | 990 | | 180 | | 605 | 2,040 | 855 | 1,220 | 655 | 181 | 315 |
| 16 | 300 | 860 | | | | 468 | 1,960 | 805 | 1,000 | 544 | 236 | 409 |
| 17 | 260 | 780 | | | | 486 | 1,800 | 830 | 1,080 | 490 | 306 | 401 |
| 18 | 298 | 770 | 200 | | 230 | 590 | 1,720 | 805 | 930 | 445 | 232 | 296 |
| 19 | 265 | 745 | | | | 655 | 1,650 | 780 | 855 | 421 | 349 | 472 |
| 20 | 248 | 700 | | | | 170 | 1,540 | 755 | 955 | 330 | 202 | 522 |
| 21 | 268 | 680 | | | | 425 | 1,440 | 730 | 830 | 283 | 212 | 625 |
| 22 | 265 | 680 | | | | 680 | 1,370 | 730 | 730 | 405 | 230 | 755 |
| 23 | 270 | 576 | 180 | | 290 | 705 | 1,370 | 630 | 730 | 264 | 235 | 564 |
| 24 | 266 | 562 | | | | 930 | 1,370 | 680 | 535 | 238 | 239 | 602 |
| 25 | 256 | 540 | | | | 1,200 | 1,370 | 590 | 630 | 283 | 234 | 595 |
| 26 | 238 | 530 | | 200 | 445 | 1,310 | 1,370 | 576 | 540 | 283 | 333 | 544 |
| 27 | 225 | 522 | | | 580 | 2,200 | 1,310 | 558 | 535 | 283 | 247 | 730 |
| 28 | 265 | 512 | | | 680 | 3,360 | 1,230 | 571 | 553 | 273 | 218 | 1,110 |
| 29 | 208 | 490 | 200 | | ------- | 4,380 | 1,200 | 571 | 544 | 257 | 334 | 1,080 |
| 30 | 222 | 490 | | | ------- | 5,740 | 1,140 | 535 | 580 | 244 | 670 | 2,820 |
| 31 | 218 | ------- | | | ------- | 5,380 | ------- | 490 | ------- | 234 | 605 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 11 to Feb. 25 and Mar. 23–25; discharge determined from a study of gage-height and weather records. Discharge determined by averaging the bi-hourly discharge May 6–10, July 11, 19, 22, 29, Aug. 11, 14–18, 20–25, 27–29, Sept. 1, 14, 15, 18, 23–25

*Monthly discharge of Iowa River at Iowa City, Iowa, for the year ending September 30, 1923*

[Drainage area, 3,140 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 375 | 208 | 266 | 0.085 | 0.10 |
| November | 1,200 | 318 | 605 | .193 | .22 |
| December | 476 | ------- | 259 | .082 | .09 |
| January | ------- | ------- | 197 | .063 | .07 |
| February | 680 | ------- | 293 | .093 | .10 |
| March | 5,740 | 170 | 1,460 | .465 | .54 |
| April | 8,420 | 1,140 | 3,540 | 1.13 | 1.26 |
| May | 1,080 | 490 | 756 | .241 | .28 |
| June | 1,310 | 481 | 744 | .237 | .26 |
| July | 880 | 234 | 441 | .140 | .16 |
| August | 670 | 153 | 311 | .099 | .11 |
| September | 2,820 | 296 | 755 | .240 | .27 |
| The year | 8,420 | ------- | 800 | .219 | 3.46 |

### IOWA RIVER AT WAPELLO, IOWA

LOCATION.—In sec. 27, T. 74 N., R. 3 W., at highway bridge half a mile from railroad station at Wapello, Louisa County, and 20 miles from mouth of river. No important tributaries enter near station.

DRAINAGE AREA.—At gaging station, 12,480 square miles; at mouth, 12,600 square miles (measured on map issued by United States Geological Survey; scale, 1: 500,000).

RECORDS AVAILABLE.—February 26, 1915, to September 30, 1923.

GAGE.—Chain gage attached near center of first span from right abutment; read by C. W. Warren.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; subject to shift. Right bank high and will not be overflowed; levee along left bank, which broke during flood of June, 1918.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.5 feet at 7 a. m. April 7 (discharge, 31,200 second-feet); minimum discharge, 570 second-feet July 28 and 29.

1915–1923: Maximum stage recorded, 14.94 feet, June 8, 1918 (discharge, 63,100 second-feet); minimum discharge, about 400 second-feet December 15–17, 1916. The flood of June, 1892, was probably much higher than the flood of 1918.

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation subject to gradual shift during 1923. Rating curve fairly well defined. Gage read to hundredths at least once daily. Daily discharge computed by shifting-channel method except during winter when discharge was estimated from observer's notes and climatological records. Open-water records good; winter records fair.

*Discharge measurements of Iowa River at Wapello, Iowa, during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 6 | P. L. Mercer | 0.03 | 1,260 | Feb. 21 | P. L. Mercer | [a] 0.95 | 1,000 |
| 7 | do | .05 | 1,180 | Apr. 13 | Mercer and Venning | 4.50 | 9,980 |
| Dec. 30 | Herlofson and Mercer | [a] .68 | 1,190 | July 21 | J. B. Spiegel | .28 | 1,670 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Iowa River at Wapello, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,110 | 1,230 | 1,770 | | 4,000 | 2,200 | 19,200 | 4,740 | 2,230 | 2,560 | 990 | 2,390 |
| 2 | 1,170 | 1,290 | 1,700 | | 3,500 | 2,700 | 19,200 | 4,520 | 2,070 | 2,390 | 1,050 | 3,470 |
| 3 | 1,110 | 1,490 | 1,630 | | 2,400 | 2,910 | 20,900 | 4,090 | 3,880 | 2,390 | 990 | 4,970 |
| 4 | 1,050 | 1,770 | 1,630 | | 2,200 | 3,090 | 24,200 | 4,090 | 3,090 | 3,090 | 1,110 | 3,880 |
| 5 | 1,110 | 1,770 | 1,770 | 1,100 | 2,200 | 4,090 | 28,300 | 3,670 | 2,390 | 3,090 | 620 | 3,470 |
| 6 | 1,170 | 1,700 | 1,770 | | 1,900 | 4,300 | 30,700 | 3,470 | 2,560 | 2,390 | 1,360 | 5,200 |
| 7 | 1,110 | 1,700 | 1,630 | | 1,900 | 4,090 | 30,700 | 3,280 | 2,730 | 2,230 | 1,290 | 5,940 |
| 8 | 1,170 | 1,920 | 1,630 | | 1,900 | 4,740 | 27,800 | 3,280 | 2,730 | 2,390 | 1,170 | 4,520 |
| 9 | 1,630 | 1,770 | 1,360 | | 1,900 | 4,300 | 26,900 | 3,280 | 2,390 | 2,070 | 1,560 | 3,280 |
| 10 | 1,360 | 1,770 | 990 | | 1,900 | 4,090 | 25,100 | 3,090 | 2,730 | 2,070 | 1,700 | 2,730 |
| 11 | 1,290 | 1,630 | 880 | | 1,400 | 4,090 | 17,300 | 3,670 | 3,880 | 1,770 | 1,770 | 2,560 |
| 12 | 1,290 | 1,770 | 600 | | 1,000 | 3,280 | 12,800 | 4,740 | 4,300 | 1,700 | 1,770 | 2,560 |
| 13 | 1,290 | 1,990 | 600 | | 1,000 | 3,090 | 10,400 | 4,520 | 4,300 | 1,700 | 1,490 | 2,390 |
| 14 | 1,420 | 2,910 | 1,000 | | 1,000 | 3,090 | 9,730 | 4,300 | 4,300 | 1,700 | 1,920 | 2,230 |
| 15 | 1,420 | 4,090 | 1,100 | | 1,200 | 3,090 | 9,100 | 4,090 | 5,200 | 1,770 | 1,920 | 2,070 |
| 16 | 1,290 | 3,470 | 1,100 | | 1,200 | 2,800 | 8,480 | 3,670 | 5,200 | 1,920 | 1,840 | 1,770 |
| 17 | 1,230 | 3,090 | 1,050 | | 1,200 | 2,700 | 7,880 | 3,470 | 3,880 | 1,770 | 1,770 | 1,630 |
| 18 | 1,230 | 2,560 | 1,050 | | 1,200 | 1,800 | 7,020 | 3,470 | 3,670 | 1,630 | 1,770 | 1,630 |
| 19 | 1,230 | 2,390 | 1,000 | | 1,200 | 1,400 | 6,740 | 3,280 | 3,280 | 1,490 | 1,630 | 1,490 |
| 20 | 1,230 | 2,390 | 1,000 | 1,000 | 1,200 | 1,600 | 6,470 | 3,090 | 3,090 | 1,560 | 1,560 | 1,700 |
| 21 | 1,230 | 2,390 | 950 | | 1,000 | 2,500 | 5,940 | 2,910 | 2,730 | 1,360 | 1,290 | 1,990 |
| 22 | 1,230 | 2,390 | 950 | | 1,100 | 2,910 | 5,690 | 2,910 | 2,560 | 1,290 | 1,230 | 2,560 |
| 23 | 1,230 | 2,230 | 1,000 | | 1,200 | 3,470 | 5,690 | 2,560 | 2,560 | 1,290 | 1,230 | 3,470 |
| 24 | 1,230 | 2,230 | 950 | | 1,400 | 4,300 | 5,690 | 2,560 | 2,390 | 1,230 | 1,170 | 3,280 |
| 25 | 1,230 | 1,990 | 950 | | 1,600 | 6,740 | 5,440 | 2,560 | 2,230 | 990 | 1,110 | 3,670 |
| 26 | 1,170 | 1,920 | 950 | | 1,800 | 7,880 | 5,690 | 2,230 | 2,070 | 1,110 | 1,110 | 3,470 |
| 27 | 1,110 | 1,920 | 950 | | 2,000 | 8,180 | 5,200 | 2,390 | 2,230 | 880 | 1,290 | 4,300 |
| 28 | 1,110 | 1,840 | 950 | | 2,000 | 10,400 | 5,200 | 2,390 | 2,730 | 570 | 1,230 | 7,300 |
| 29 | 1,050 | 1,840 | 1,100 | | ------- | 13,200 | 4,970 | 2,390 | 2,390 | 570 | 1,170 | 6,740 |
| 30 | 1,050 | 1,770 | 1,100 | | ------- | 15,400 | 4,520 | 2,230 | 2,390 | 1,770 | 1,290 | 6,470 |
| 31 | 1,050 | ------- | 1,100 | 1,500 | ------- | 19,200 | -------- | 2,070 | ------- | 935 | 1,700 | ------- |

NOTE.—Stage-discharge relation affected by iee Dec. 12 to Mar. 2 and Mar. 16–21.

*Monthly discharge of Iowa River at Wapello, Iowa, for the year ending September 30, 1923*

[Discharge area, 12,480 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 1,630 | 1,050 | 1,210 | 0.097 | 0.11 |
| November | 4,090 | 1,230 | 2,110 | .169 | .19 |
| December | 1,770 | 600 | 1,170 | .094 | .11 |
| January | | | 1,050 | .084 | .10 |
| February | 4,000 | 1,000 | 1,700 | .136 | .14 |
| March | 19,200 | 1,400 | 5,080 | .407 | .47 |
| April | 30,700 | 4,520 | 13,400 | 1.07 | 1.19 |
| May | 4,740 | 2,070 | 3,320 | .266 | .31 |
| June | 5,200 | 2,070 | 3,070 | .246 | .27 |
| July | 3,090 | 570 | 1,730 | .139 | .16 |
| August | 1,920 | 620 | 1,390 | .111 | .13 |
| September | 7,300 | 1,490 | 3,440 | .276 | .31 |
| The year | 30,700 | 570 | 3,210 | .257 | 3.49 |

### CEDAR RIVER AT JANESVILLE, IOWA

LOCATION.—In sec. 35, T. 91 N., R. 14 W., at highway bridge in Janesville, Bremer County, and 3 miles above junction with Shellrock River.

DRAINAGE AREA.—1,660 square miles (measured on map issued by United States Geological Survey, scale 1:500,000).

RECORDS AVAILABLE.—April 26, 1905, to September 30, 1906; May 28, 1915, to September 30, 1923.

GAGE.—Chain gage attached to downstream handrail of middle span of highway bridge; read by Mrs. Emma Cameron.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; the remains of an old grist-mill dam forms a permanent control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.05 feet at 6 a. m. April 4 (discharge, 5,320 second-feet); minimum stage, 1.20 feet at 5.30 p. m. October 21 (discharge, 28 second-feet).

1905–6; 1915–1923: Maximum discharge, about 27,000 second-feet May 29, 1921; minimum discharge recorded, that of October 21, 1922.

ICE.—Stage-discharge relation seriously affected by ice. Observation discontinued during winter.

REGULATION.—There is slight diurnal fluctuation of stage during low-water periods, owing to operation of power plant at Waverly, 9 miles above station.

ACCURACY.—Stage-discharge relation probably permanent. Rating curve well defined between 100 and 5,000 second-feet. Gage read to hundredths twice daily. Gage-height record for April and May may be somewhat in error. Daily discharge ascertained by applying mean daily gage height to rating table. Records good, except during April and May, for which they are fair.

The following discharge measurement was made by J. B. Spiegel:

June 26, 1923: Gage height, 1.63 feet; discharge, 163 second-feet.

*Daily discharge, in second-feet, of Cedar River at Janesville, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 240 | 236 | ------- | 2,040 | 420 | 235 | 181 | 154 | 230 |
| 2 | 181 | 300 | ------- | 1,370 | 434 | 258 | 124 | 163 | 434 |
| 3 | 162 | 200 | ------- | 2,160 | 402 | 294 | 168 | 145 | 360 |
| 4 | 190 | 200 | ------- | 4,880 | 420 | 215 | 348 | 145 | 408 |
| 5 | 177 | 215 | ------- | 4,720 | 360 | 252 | 240 | 190 | 402 |
| 6 | 230 | 168 | ------- | 3,340 | 476 | 215 | 294 | 145 | 294 |
| 7 | 483 | 168 | ------- | 2,790 | 300 | 225 | 230 | 360 | 402 |
| 8 | 324 | 324 | ------- | 1,480 | 240 | 210 | 390 | 137 | 324 |
| 9 | 215 | 168 | ------- | 1,060 | 476 | 141 | 270 | 145 | 252 |
| 10 | 181 | 210 | ------- | 970 | 414 | 258 | 300 | 154 | 168 |
| 11 | 225 | 300 | ------- | 880 | 420 | 163 | 390 | 176 | 270 |
| 12 | 145 | 354 | ------- | 710 | 312 | 246 | 300 | 240 | 282 |
| 13 | 200 | 225 | ------- | 710 | 300 | 240 | 282 | 154 | 270 |
| 14 | 200 | 200 | ------- | 630 | 288 | 342 | 312 | 124 | 240 |
| 15 | 162 | 270 | ------- | 710 | 312 | 168 | 294 | 154 | 181 |
| 16 | 434 | 225 | ------- | 490 | 300 | 235 | 168 | 154 | 168 |
| 17 | 200 | 190 | ------- | 490 | 270 | 220 | 154 | 137 | 215 |
| 18 | 210 | 168 | ------- | 525 | 312 | 372 | 145 | 215 | 154 |
| 19 | 145 | 240 | ------- | 525 | 270 | 240 | 163 | 137 | 186 |
| 20 | 52 | 225 | ------- | 560 | 312 | 195 | 145 | 120 | 560 |
| 21 | 28 | 181 | ------- | 595 | 312 | 168 | 124 | 120 | 455 |
| 22 | 176 | 103 | ------- | 595 | 300 | 246 | 186 | 137 | 330 |
| 23 | 154 | 145 | ------- | 476 | 270 | 176 | 154 | 124 | 324 |
| 24 | 215 | 163 | ------- | 434 | 312 | 205 | 132 | 103 | 288 |
| 25 | 225 | 294 | ------- | 469 | 252 | 190 | 111 | 145 | 288 |
| 26 | 312 | 200 | 3,930 | 448 | 264 | 210 | 120 | 154 | 376 |
| 27 | 270 | 141 | 2,920 | 455 | 300 | 312 | 252 | 145 | 360 |
| 28 | 154 | 120 | 2,530 | 434 | 215 | 200 | 190 | 145 | 300 |
| 29 | 360 | 163 | 2,280 | 384 | 176 | 181 | 163 | 190 | 434 |
| 30 | 154 | 145 | 2,160 | 630 | 230 | 190 | 137 | 163 | 420 |
| 31 | 154 | ------- | 2,660 | ------- | 288 | ------- | 137 | 200 | ------- |

*Monthly discharge of Cedar River at Janesville, Iowa, for the year ending September 30, 1923*

[Drainage area, 1,660 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 483 | 28 | 212 | 0.127 | 0.15 |
| November | 354 | 103 | 208 | .125 | .14 |
| April | 4,880 | 384 | 1,200 | .723 | .81 |
| May | 476 | 176 | 321 | .193 | .22 |
| June | 372 | 141 | 227 | .137 | .15 |
| July | 390 | 111 | 213 | .128 | .15 |
| August | 360 | 103 | 160 | .096 | .11 |
| September | 560 | 154 | 312 | .188 | .21 |

### CEDAR RIVER AT CEDAR RAPIDS, IOWA

LOCATION.—In sec. 28, T. 83 N., R. 7 W., in central part of Cedar Rapids, Linn County, 1,000 feet above Eighth Avenue Bridge and half a mile below dam.

DRAINAGE AREA.—At station, 6,640 square miles; at junction with Iowa River, 7,930 square miles (measured on map issued by United States Geological Survey, scale, 1 : 500,000).

RECORDS AVAILABLE.—February 14, 1903, to September 30, 1923.

GAGE.—Gurley water-stage recorder installed on right bank in rear of plant of Iowa Windmill & Pump Co., August 20, 1920; inspected by R. S. Toogood. Previous to that date an inclined staff at same site was used. Elevation of zero of both gages from Northwestern Railroad levels, 723.03 feet above sea level.

DISCHARGE MEASUREMENTS.—Made from upstream side of Eighth Avenue Bridge.

CHANNEL AND CONTROL.—Bed composed of rock and gravel, free from vegetation and practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.80 feet at 11 p. m. April 4 (discharge, 16,000 second-feet); minimum stage, 2.12 feet at 2 p. m. July 21 (discharge, 302 second-feet).

1903–1923: Maximum stage recorded, 17.2 feet April 1, 1912, and March 26, 1917 (discharge, 54,100 second-feet); minimum discharge 190 second-feet September 9, 1921.

Greatest known flood probably occurred in June, 1851, when the maximum stage was about 20 feet (discharge, about 65,000 second-feet).

ICE.—Stage-discharge relation affected by ice during extremely cold weather. The swift current and proximity to power plant keeps the river open at other times.

REGULATION.—Power plant half a mile above gage causes marked diurnal fluctuation during all periods of low water.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined above 800 second-feet. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspection of recorder graph, except as explained in footnote to table of daily discharge. Records excellent except for periods when stage-discharge relation was affected by ice or when gage heights were missing, for which they are fair.

*Discharge measurements of Cedar River at Cedar Rapids, Iowa, during the year ending September 30, 1923*

[Made by J. B. Spiegel]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Nov. 11 | 3.22 | 1,450 |
| 15 | 3.22 | 1,430 |
| June 29 | 3.20 | 1,420 |

*Daily discharge, in second-feet, of Cedar River at Cedar Rapids, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 855 | 960 | 1,090 | 837 | 1,250 | 1,060 | 10,100 | 1,910 | 1,150 | 1,060 | 588 | 1,610 |
| 2 | 960 | 1,050 | 1,040 | 837 | 859 | 1,200 | 11,100 | 1,790 | 918 | 990 | 740 | 1,950 |
| 3 | 925 | 1,100 | 1,090 | 815 | 870 | 1,350 | 14,900 | 1,680 | 1,150 | 965 | 570 | 2,470 |
| 4 | 845 | 1,120 | 1,090 | 804 | 1,020 | 2,490 | 15,700 | 1,660 | 1,080 | 990 | 710 | 2,130 |
| 5 | 870 | 1,150 | 930 | 990 | 700 | 3,150 | 14,900 | 1,570 | 1,110 | 1,040 | 554 | 1,910 |
| 6 | 890 | 1,180 | 760 | 1,000 | 606 | 3,460 | 14,100 | 1,620 | 1,110 | 930 | 710 | 1,930 |
| 7 | 870 | 1,140 | 597 | 894 | 815 | 3,010 | 14,900 | 1,590 | 1,150 | 966 | 793 | 1,890 |
| 8 | 870 | 1,150 | 710 | 893 | 690 | 2,660 | 11,500 | 1,550 | 990 | 978 | 771 | 1,680 |
| 9 | 1,010 | 1,090 | 660 | 771 | 750 | 2,610 | 7,720 | 1,540 | 1,260 | 930 | 1,080 | 1,620 |
| 10 | 1,060 | 1,040 | 660 | 826 | 771 | 1,850 | 5,960 | 1,430 | 1,260 | 918 | 1,000 | 1,610 |
| 11 | 1,040 | 1,110 | 710 | 1,090 | 760 | 1,850 | 4,740 | 1,380 | 1,120 | 870 | 990 | 1,570 |
| 12 | 1,020 | 1,420 | 930 | 1,090 | 651 | 1,680 | 4,140 | 1,540 | 1,340 | 918 | 1,540 | 1,540 |
| 13 | 940 | 1,350 | 815 | 1,020 | 660 | 1,950 | 3,710 | 1,570 | 1,470 | 906 | 1,290 | 1,410 |
| 14 | 1,030 | 1,460 | 804 | 730 | 660 | 1,890 | 3,430 | 1,510 | 1,430 | 894 | 1,490 | 1,090 |
| 15 | 975 | 1,370 | | 815 | | 1,710 | 3,430 | 1,510 | 1,360 | 894 | 1,020 | 1,150 |
| 16 | 1,040 | 1,360 | | 840 | 640 | 1,090 | 3,150 | 1,540 | 1,430 | 930 | 1,040 | 930 |
| 17 | 940 | 1,300 | | 1,040 | | 870 | 2,870 | 1,520 | 1,440 | 870 | 990 | 942 |
| 18 | 925 | 1,320 | | 815 | | 930 | 2,710 | 1,440 | 1,340 | 815 | 978 | 1,000 |
| 19 | 1,040 | 1,230 | 790 | 942 | 660 | 640 | 2,790 | 1,380 | 1,070 | 826 | 990 | 1,020 |
| 20 | 925 | 1,230 | | 826 | 615 | 570 | 2,440 | 1,290 | 1,060 | 815 | 966 | 2,280 |
| 21 | 955 | 1,220 | | 826 | 627 | 615 | 2,300 | 1,410 | 1,130 | 760 | 942 | 2,370 |
| 22 | 1,020 | 1,200 | | 848 | 639 | 954 | 2,370 | 1,360 | 1,160 | 606 | 894 | 2,490 |
| 23 | 995 | 1,170 | 782 | 740 | 651 | 1,150 | 2,330 | 1,260 | 1,090 | 606 | 859 | 2,510 |
| 24 | 940 | 1,170 | 750 | 690 | 588 | 1,340 | 2,490 | 1,190 | 1,090 | 642 | 793 | 2,490 |
| 25 | 920 | 1,090 | 760 | 750 | 660 | 1,750 | 2,370 | 1,230 | 990 | 642 | 760 | 2,300 |
| 26 | 890 | 1,090 | 771 | 690 | 870 | 2,870 | 2,190 | 1,200 | 1,020 | 660 | 760 | 2,030 |
| 27 | 850 | 1,150 | 782 | 700 | 906 | 5,040 | 2,150 | 1,360 | 966 | 848 | 870 | 1,950 |
| 28 | 870 | 1,110 | 894 | 760 | 894 | 6,760 | 2,150 | 1,190 | 990 | 588 | 882 | 1,710 |
| 29 | 870 | 1,130 | 882 | 782 | ------- | 7,720 | 2,110 | 1,200 | 1,020 | 570 | 1,230 | 2,110 |
| 30 | 870 | 1,120 | 826 | 782 | ------- | 8,710 | 1,990 | 1,160 | 1,110 | 690 | 1,180 | 3,090 |
| 31 | 870 | ------- | 870 | 1,250 | ------- | 9,380 | ------- | 1,160 | ------- | 660 | 1,380 | ------- |

NOTE.—Daily discharge, Oct. 1–6, 8–13, 15–27, Nov. 5–10, 11–17, 19–24, obtained by use of discharge integrator; daily discharge Oct. 29 to Nov. 3 based on a comparison with records of flow of Iowa River at Iowa City; discharge interpolated Feb. 21, 22, and Mar. 19. Braced figures show estimated mean discharge for period indicated.

*Monthly discharge of Cedar River at Cedar Rapids, Iowa, for the year ending September 30, 1923*

[Drainage area, 6,640 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 1,060 | 845 | 938 | 0.141 | 0.16 |
| November | 1,460 | 960 | 1,190 | .179 | .20 |
| December | 1,090 | 597 | 823 | .124 | .14 |
| January | 1,250 | 690 | 861 | .130 | .15 |
| February | 1,250 | 588 | 740 | .111 | .12 |
| March | 9,380 | 570 | 2,660 | .401 | .46 |
| April | 15,700 | 1,990 | 5,890 | .887 | .99 |
| May | 1,910 | 1,160 | 1,440 | .217 | .25 |
| June | 1,470 | 918 | 1,160 | .175 | .20 |
| July | 1,060 | 570 | 832 | .125 | .14 |
| August | 1,540 | 554 | 947 | .143 | .16 |
| September | 3,090 | 930 | 1,830 | .276 | .31 |
| The year | 15,700 | 554 | 1,610 | .242 | 3.28 |

### SHELLROCK RIVER NEAR CLARKSVILLE, IOWA

LOCATION.—In T. 92 N., R. 16 W., at highway bridge 1¼ miles northwest of Clarksville, Butler County, and 25 miles above junction with Cedar River. No large tributary enters for several miles above or below station.

DRAINAGE AREA.—1,660 square miles at station; 2,680 square miles at junction with Cedar River (measured on map issued by United States Geological Survey; scale, 1: 500,000).

RECORDS AVAILABLE.—May 28, 1915, to September 30, 1923.

GAGE.—Chain gage attached to handrail on upstream side of bridge, 75 feet from right abutment; read by Mrs. H. H. Sherburne.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of rock and sand; fairly permanent. Right bank high; left bank would probably be overflowed at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.1 feet at 4 p. m. April 4 (discharge, 3,870 second-feet); minimum stage, 0.48 foot at 7.30 a. m. August 29 and September 17 (discharge, 50 second-feet).

1915–1923: Maximum discharge, 12,200 second-feet June 2, 1916. Minimum stage, that of August 29 and September 17, 1923. In April, 1907, a stage of about 16.5 feet was reached (discharge, about 19,000 second-feet).

ICE.—Stage-discharge relation affected by ice. Observation discontinued during winter.

REGULATION.—Slight diurnal fluctuation may occur during low stages; owing to operation of power plant at Greene, 10 miles upstream.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 75 and 10,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

The following discharge measurement was made by J. B. Spiegel:
June 25, 1923: Gage height, 0.78 foot; discharge, 84 second-feet.

*Daily discharge, in second-feet, of Shellrock River near Clarksville, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|
| 1 | 168 | 140 | ------- | 255 | 168 | 81 | 67 | 126 |
| 2 | 88 | 128 | ------- | 236 | 128 | 74 | 58 | 62 |
| 3 | 154 | 116 | ------- | 236 | 116 | 80 | 60 | 58 |
| 4 | 116 | 101 | 3,870 | 236 | 95 | 70 | 64 | 58 |
| 5 | 68 | 95 | 2,760 | 274 | 121 | 78 | 64 | 55 |
| 6 | 106 | 92 | 1,120 | 294 | 116 | 71 | 62 | 81 |
| 7 | 184 | 168 | 805 | 255 | 83 | 116 | 64 | 78 |
| 8 | 218 | 184 | 590 | 218 | 106 | 116 | 58 | 71 |
| 9 | 110 | 218 | 492 | 200 | 76 | 86 | 58 | 60 |
| 10 | 168 | 200 | 446 | 200 | 116 | 110 | 60 | 60 |
| 11 | 138 | 128 | 446 | 200 | 108 | 116 | 58 | 71 |
| 12 | 128 | 122 | 424 | 200 | 133 | 116 | 64 | 135 |
| 13 | 92 | 116 | 401 | 184 | 135 | 86 | 62 | 91 |
| 14 | 108 | 111 | 379 | 168 | 154 | 78 | 58 | 78 |
| 15 | 118 | 106 | 336 | 140 | 128 | 81 | 58 | 58 |
| 16 | 106 | 101 | 336 | 112 | 116 | 78 | 64 | 52 |
| 17 | 78 | 95 | 336 | 134 | 116 | 71 | 64 | 50 |
| 18 | 106 | 86 | 315 | 154 | 95 | 64 | 62 | 53 |
| 19 | 81 | 128 | 315 | 200 | 126 | 78 | 64 | 58 |
| 20 | 68 | 168 | 294 | 236 | 95 | 71 | 72 | 64 |
| 21 | 75 | 168 | 294 | 154 | 140 | 62 | 60 | 60 |
| 22 | 92 | 154 | 315 | 184 | 133 | 62 | 58 | 60 |
| 23 | 67 | 140 | 336 | 140 | 138 | 59 | 58 | 154 |
| 24 | 83 | 128 | 357 | 140 | 99 | 59 | 64 | 168 |
| 25 | 95 | 116 | 357 | 126 | 95 | 64 | 62 | 140 |
| 26 | 78 | 168 | 357 | 128 | 78 | 64 | 58 | 133 |
| 27 | 86 | 184 | 336 | 184 | 128 | 60 | 58 | 123 |
| 28 | 71 | 168 | 294 | 95 | 74 | 62 | 58 | 116 |
| 29 | 103 | 140 | 294 | 121 | 77 | 64 | 50 | 154 |
| 30 | 85 | 140 | 274 | 128 | 106 | 70 | 60 | 168 |
| 31 | 116 | ------- | ------- | 106 | ------- | 70 | 60 | ------- |

NOTE.—Gage not read Nov. 12–15, 28–30, and May 17, daily discharge estimated by comparison with record of flow of Cedar River at Janesville.

*Monthly discharge of Shellrock River near Clarksville, Iowa, for the year ending September 30, 1923*

[Drainage area, 1,660 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 218 | 67 | 108 | 0.065 | 0.07 |
| November | 218 | 86 | 137 | .083 | .09 |
| April 4-30 | 3,870 | 274 | 625 | .377 | .38 |
| May | 294 | 95 | 182 | .110 | .13 |
| June | 168 | 74 | 113 | .068 | .06 |
| July | 116 | 59 | 78.0 | .047 | .05 |
| August | 72 | 50 | 60.9 | .037 | .43 |
| September | 168 | 50 | 89.8 | .054 | .06 |

### SKUNK RIVER NEAR AMES, IOWA

LOCATION.—In sec. 23, T. 84 N., R. 24 W., at site of old county bridge, 2½ miles north of Ames, Story County, 3½ miles below Keigley Branch and 5 miles above mouth of Squaw Creek.

DRAINAGE AREA.—320 square miles (measured on topographic map and on United States post route map).

RECORDS AVAILABLE.—July 28, 1920, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder installed August 25, 1921; inspected by W. P. Coon. Staff gage at same location used previously.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—A rock ledge forms control. Both banks are high, but right bank is overflowed during extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.22 feet at 2 a. m. March 28 (discharge, 1,670 second-feet); minimum discharge, 2 second-feet July 24–31.

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation changed March 1. Rating curves well defined between 5 and 1,500 second-feet. Operation of water-stage recorder satisfactory. Mean daily gage height obtained by inspection of recorder graph. Daily discharge ascertained by applying mean daily gage height to rating table except as explained in footnote to table of daily discharge. Open-water records excellent; winter records fair.

*Discharge measurements of Skunk River near Ames, Iowa, during the year ending September 30, 1923*

[Made by J. B. Spiegel]

| Date | Gage height | Discharge | Date | Gage height | Discharge |
|---|---|---|---|---|---|
| | *Feet* | *Sec.-ft.* | | *Feet* | *Sec.-ft.* |
| Oct. 28 | 2.00 | 6.4 | Mar. 8 | 2.57 | 58.6 |
| Nov. 1 | 2.78 | 77.1 | Apr. 25 | 3.22 | 177 |
| Dec. 8 | 2.50 | 40.5 | May 28 | 2.40 | 39 |
| Jan 22 | [a] 2.16 | 12.5 | Sept. 28 | 5.46 | 1,190 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Skunk River near Ames, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 65 | 52 | 25 | 17 | 54 | 268 | 80 | 27 | 26 | 13 | 125 |
| 2 | 11 | 65 | 53 | 25 | 16 | 69 | 348 | 73 | 25 | 24 | 11 | 150 |
| 3 | 12 | 55 | 51 | 25 | 15 | 150 | 595 | 67 | 27 | 28 | 9 | 103 |
| 4 | 12 | 46 | 53 | 25 | 14 | 155 | 762 | 62 | 24 | 24 | 8 | 70 |
| 5 | 10 | 45 | 35 | 24 | 12 | 125 | 391 | 59 | 24 | 20 | 6 | 48 |
| 6 | 12 | 45 | 40 | 23 | 12 | 110 | 280 | 59 | 47 | 17 | 4 | 66 |
| 7 | 19 | 46 | 48 | 23 | 11 | 83 | 243 | 55 | 70 | 14 | 10 | 77 |
| 8 | 18 | 42 | 39 | 22 | 10 | 63 | 187 | 54 | 71 | 12 | 10 | 68 |
| 9 | 16 | 39 | 33 | 22 | 9 | 66 | 179 | 49 | 54 | 10 | 7 | 58 |
| 10 | 14 | 36 | 33 | 22 | 8 | 89 | 162 | 45 | 77 | 10 | 6 | 48 |
| 11 | 13 | 33 | 31 | 20 | 7 | 150 | 162 | 51 | 192 | 11 | 5 | 41 |
| 12 | 11 | 47 | 23 | 20 | 6 | 120 | 177 | 84 | 197 | 10 | 7 | 31 |
| 13 | 11 | 79 | 21 | 20 | 6 | 92 | 174 | 97 | 148 | 9 | 9 | 23 |
| 14 | 11 | 128 | 22 | 20 | 5 | 74 | 169 | 90 | 116 | 7 | 7 | 21 |
| 15 | 11 | 124 | 23 | 20 | 5 | 82 | 187 | 97 | 97 | 11 | 5 | 19 |
| 16 | 11 | 103 | 24 | 19 | 4 | 99 | 179 | 116 | 83 | 10 | 14 | 19 |
| 17 | 10 | 87 | 21 | 18 | 4 | 112 | 150 | 110 | 77 | 7 | 14 | 82 |
| 18 | 9 | 82 | 21 | 17 | 4 | 74 | 135 | 94 | 63 | 6 | 10 | 97 |
| 19 | 9 | 76 | 20 | 16 | 4 | 77 | 121 | 88 | 60 | 5 | 8 | 101 |
| 20 | 8 | 68 | 19 | 15 | 6 | 89 | 110 | 80 | 55 | 4 | 6 | 148 |
| 21 | 8 | 64 | 19 | 14 | 8 | 114 | 121 | 71 | 48 | 4 | 5 | 234 |
| 22 | 7 | 62 | 19 | 13 | 15 | 304 | 137 | 66 | 41 | 3 | 5 | 179 |
| 23 | 8 | 58 | 20 | 13 | 28 | 574 | 137 | 58 | 36 | 3 | 4 | 135 |
| 24 | 8 | 54 | 21 | 13 | 37 | 735 | 177 | 50 | 32 | 2 | 3 | 105 |
| 25 | 8 | 50 | 24 | 13 | 53 | 970 | 179 | 48 | 27 | 2 | 3 | 92 |
| 26 | 7 | 53 | 25 | 13 | 44 | 850 | 157 | 45 | 24 | 2 | 4 | 82 |
| 27 | 7 | 54 | 26 | 13 | 44 | 1,150 | 137 | 40 | 33 | 2 | 39 | 110 |
| 28 | 7 | 52 | 26 | 13 | 43 | 1,460 | 118 | 39 | 48 | 2 | 56 | 358 |
| 29 | 7 | 48 | 25 | 13 | ------- | 762 | 103 | 35 | 36 | 2 | 40 | 970 |
| 30 | 8 | 50 | 26 | 14 | ------- | 662 | 89 | 33 | 29 | 2 | 20 | 820 |
| 31 | 29 | ------- | 28 | 17 | ------- | 414 | ------- | 29 | ------- | 2 | 20 | ------- |

NOTE.—Stage-discharge relation affected by ice Jan. 8 to Feb. 22; discharge determined from gage heights corrected for effect of ice by means of one discharge measurement and weather records. Discharge interpolated Aug. 2–4; estimated by comparison with records of flow of Squaw Creek Aug. 29 to Sept. 1.

*Monthly discharge of Skunk River near Ames, Iowa, for the year ending September 30, 1923*

[Drainage area, 320 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 29 | 7 | 11.0 | 0.034 | 0.04 |
| November | 128 | 33 | 61.9 | .193 | .22 |
| December | 53 | 19 | 29.7 | .093 | .11 |
| January | 25 | 13 | 18.4 | .058 | .07 |
| February | 53 | 4 | 16.0 | .050 | .05 |
| March | 1,460 | 54 | 32.0 | 1.00 | 1.15 |
| April | 762 | 89 | 211 | .659 | .74 |
| May | 116 | 29 | 65.3 | .204 | .24 |
| June | 197 | 24 | 62.9 | .197 | .22 |
| July | 28 | 2 | 9.4 | .029 | .03 |
| August | 56 | 3 | 11.9 | .037 | .04 |
| September | 970 | 19 | 149 | .466 | .52 |
| The year | 1,460 | 2 | 80.7 | .252 | 3.43 |

### SKUNK RIVER AT COPPOCK, IOWA

LOCATION.—In sec. 1, T. 73 N., R. 8 W., at highway bridge one-eighth mile above Chicago, Burlington & Quincy Railroad bridge at Coppock, Henry County, and one-fourth mile above junction with Crooked Creek.

DRAINAGE AREA.—2,890 square miles (measured on map issued by United States Geological Survey, scale 1: 500,000).

RECORDS AVAILABLE.—October 21, 1913, to September 30, 1923.

GAGE.—Chain gage attached to downstream side of bridge; read by J. W. Ricks.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached and by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; channel shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.24 feet at 10 a. m. April 2 (discharge, 5,300 second-feet); minimum discharge, 150 second-feet February 17–21.

1913–1923: Maximum stage recorded, 19.7 feet June 9, 1918 (discharge, 19,600 second-feet); minimum stage, 2.10 feet August 15, 18, and 25–27, 1914 (discharge, 33 second-feet).

A stage of about 22 feet occurred on or about May 31, 1903 (discharge, 25,000 second-feet).

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation subject to gradual shift during year. Rating curve fairly well defined. Gage read to hundredths at least once daily. Daily discharge ascertained by applying daily gage height, directly or indirectly, to rating table except as explained in footnote to table of daily discharge. Open-water records good; winter records fair.

*Discharge measurements of Skunk River at Coppock, Iowa, during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 6 | P. L. Mercer | 2.89 | 202 | Apr. 14 | Mercer and Venning | 5.98 | 1,660 |
| Dec. 29 | Herlofson and Mercer | a 3.48 | 249 | July 20 | J. B. Spiegel | 3.34 | 408 |
| Feb. 20 | P. L. Mercer | a 3.45 | 149 | | | | |

a Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Skunk River at Coppock, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 215 | 228 | 503 | 260 | 800 | 700 | 5,260 | 1,090 | 924 | 1,450 | 215 | 652 |
| 2 | 215 | 330 | 465 | 260 | 400 | 800 | 5,260 | 1,090 | 768 | 1,390 | 203 | 584 |
| 3 | 215 | 299 | 465 | 270 | 400 | 900 | 4,840 | 979 | 1,510 | 1,150 | 203 | 543 |
| 4 | 215 | 429 | 465 | 280 | 400 | 924 | 3,880 | 924 | 1,040 | 979 | 203 | 395 |
| 5 | 203 | 672 | 447 | 260 | 400 | 768 | 3,530 | 870 | 870 | 924 | 395 | 330 |
| 6 | 203 | 584 | 429 | 200 | 500 | 768 | 3,780 | 818 | 719 | 818 | 447 | 1,090 |
| 7 | 215 | 503 | 429 | 200 | 500 | 1,210 | 3,360 | 768 | 1,210 | 719 | 346 | 818 |
| 8 | 241 | 447 | 429 | 180 | 500 | 1,090 | 3,040 | 719 | 1,150 | 672 | 465 | 543 |
| 9 | 503 | 412 | 240 | 170 | 450 | 979 | 2,560 | 672 | 818 | 627 | 362 | 484 |
| 10 | 447 | 412 | 200 | 160 | 400 | 870 | 2,340 | 672 | 818 | 584 | 979 | 447 |
| 11 | 362 | 378 | 220 | 170 | 300 | 768 | 2,050 | 672 | 2,190 | 523 | 672 | 429 |
| 12 | 330 | 429 | 160 | 180 | 320 | 818 | 1,840 | 3,200 | 2,340 | 719 | 503 | 378 |
| 13 | 299 | 584 | 170 | 200 | 300 | 719 | 1,700 | 3,620 | 1,770 | 979 | 346 | 314 |
| 14 | 269 | 1,040 | 200 | 200 | 200 | 768 | 1,700 | 2,720 | 1,700 | 1,390 | 299 | 284 |
| 15 | 241 | 1,090 | 180 | 180 | 180 | 768 | 1,640 | 1,980 | 1,580 | 818 | 269 | 269 |
| 16 | 228 | 979 | 180 | 180 | 160 | 700 | 1,580 | 1,700 | 1,450 | 719 | 225 | 269 |
| 17 | 215 | 870 | 170 | 180 | 150 | 700 | 1,580 | 1,580 | 1,640 | 627 | 228 | 269 |
| 18 | 228 | 870 | 170 | 200 | 150 | 400 | 1,510 | 1,510 | 1,980 | 523 | 215 | 269 |
| 19 | 215 | 818 | 170 | 220 | 150 | 300 | 1,450 | 1,390 | 1,450 | 447 | 203 | 255 |
| 20 | 215 | 818 | 160 | 200 | 150 | 600 | 1,390 | 1,330 | 1,150 | 412 | 191 | 269 |
| 21 | 215 | 719 | 160 | 200 | 150 | 1,000 | 1,270 | 1,210 | 1,040 | 395 | 191 | 269 |
| 22 | 203 | 672 | 160 | 200 | 240 | 1,700 | 1,210 | 1,090 | 924 | 362 | 191 | 284 |
| 23 | 203 | 627 | 200 | 180 | 300 | 2,120 | 1,270 | 979 | 672 | 362 | 180 | 719 |
| 24 | 203 | 584 | 220 | 170 | 400 | 2,800 | 1,330 | 870 | 672 | 330 | 180 | 768 |
| 25 | 203 | 584 | 220 | 180 | 700 | 4,840 | 1,330 | 818 | 672 | 314 | 168 | 719 |
| 26 | 191 | 543 | 240 | 170 | 800 | 4,640 | 1,450 | 768 | 627 | 269 | 157 | 627 |
| 27 | 191 | 543 | 240 | 200 | 700 | 4,240 | 1,450 | 719 | 584 | 269 | 191 | 979 |
| 28 | 191 | 503 | 250 | 250 | 600 | 4,440 | 1,330 | 719 | 924 | 255 | 330 | 1,840 |
| 29 | 191 | 503 | 250 | 300 | ------- | 4,640 | 1,270 | 672 | 1,270 | 241 | 314 | 4,640 |
| 30 | 191 | 503 | 260 | 350 | ------- | 4,840 | 1,210 | 627 | 1,450 | 241 | 465 | 5,040 |
| 31 | 191 | ------- | 260 | 1,300 | ------- | 5,040 | ------- | 776 | ------- | 241 | 719 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 9 to Mar. 3, and Mar. 16–21; discharge ascertained from gage heights corrected for ice effect by means of two discharge measurements, observer's notes, weather records, and comparison with records of flow at Augusta.

*Monthly discharge of Skunk River at Coppock, Iowa, for the year ending September 30, 1923*

[Drainage area, 2,890 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 503 | 191 | 240 | 0.083 | 0.10 |
| November | 1,090 | 228 | 599 | .207 | .23 |
| December | 503 | 160 | 268 | .093 | .11 |
| January | 1,300 | 160 | 247 | .085 | .10 |
| February | 800 | 150 | 382 | .132 | .14 |
| March | 5,040 | 300 | 1,800 | .623 | .72 |
| April | 5,260 | 1,210 | 2,250 | .779 | .87 |
| May | 3,620 | 627 | 1,210 | .419 | .48 |
| June | 2,340 | 584 | 1,200 | .415 | .46 |
| July | 1,450 | 241 | 637 | .220 | .25 |
| August | 979 | 157 | 324 | .112 | .13 |
| September | 5,040 | 255 | 826 | .286 | .32 |
| The year | 5,260 | 150 | 831 | .288 | 3.91 |

SKUNK RIVER AT AUGUSTA, IOWA

LOCATION.—In sec. 26, T. 69 N., R. 4 W., at highway bridge one-third mile from Augusta post office, Des Moines County, and 12.2 miles above point where river empties into the Mississippi. Mouth of river is 32.2 miles above dam of Mississippi River Power Co., at Keokuk.

DRAINAGE AREA.—At gaging station, 4,290 square miles; at mouth, 4,350 square miles (measured on map issued by United States Geological Survey; scale, 1 : 500,000).

RECORDS AVAILABLE.—September 30 to November 15, 1913; May 27, 1915, to September 30, 1923.

GAGE.—Chain gage attached to downstream handrail of bridge 95 feet from left abutment; read by J. A. Schroder. Zero of chain gage is elevation 528.55 feet, Memphis datum.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed of stream sandy and subject to change. Right bank high and will not be overflowed; left bank will be overflowed only at extremely high stages. Remains of old mill dam 600 feet below gage form control. The riffle at the dam causes a drop of about 3 feet at medium low stages. Backwater from the Mississippi probably will not occur oftener than once in 50 years.

REGULATION.—Natural discharge at extremely low stages occasionally affected by storage of water at Oakland Mills, 26 miles upstream.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.30 feet at 10 a. m. March 26 (discharge, 8,320 second-feet); minimum discharge, estimated, 80 second-feet February 19.

1913; 1915–1923: Maximum stage recorded, 18.0 feet March 28, 1916 (discharge, 30,800 second-feet); minimum stage, 1.29 feet September 8, 1919 (discharge, 26 second-feet by current-meter measurement).

A stage of about 21 feet (discharge ,45,000 second-feet) was reached on or about June 1, 1903.

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined. Gage read to half-tenths once daily. Daily discharge determined by applying daily gage height to rating table, except when stage-discharge relation was slightly affected by ice for which it was obtained from daily gage heights, two discharge measurements, observer's notes, and climatological records. Records good except for periods of low water or ice effect for which they are fair.

*Discharge measurements of Skunk River at Augusta, Iowa, during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge |
|---|---|---|---|
| | | *Feet* | *Sec.-ft.* |
| Dec. 27 | Herlofson and Mercer | 2.05 | 288 |
| Feb. 10 | P. L. Mercer | 2.21 | 360 |
| July 20 | J. B. Spiegel | 2.43 | 520 |

*Daily discharge, in second-feet, of Skunk River at Augusta, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 220 | 145 | 370 | 300 | 1,400 | 700 | 5,660 | 1,300 | 855 | 1,790 | 130 | 708 |
| 2 | 242 | 145 | 660 | 500 | 1,400 | 805 | 5,800 | 1,300 | 1,070 | 1,790 | 139 | 755 |
| 3 | 242 | 465 | 618 | 170 | 400 | 960 | 5,800 | 1,300 | 1,660 | 1,660 | 388 | 1,070 |
| 4 | 242 | 538 | 575 | 170 | 350 | 1,070 | 5,100 | 1,130 | 1,920 | 1,300 | 145 | 805 |
| 5 | 200 | 538 | 660 | 170 | 360 | 1,180 | 4,260 | 1,070 | 1,480 | 1,070 | 162 | 755 |
| 6 | 265 | 755 | 660 | 160 | 800 | 1,020 | 3,980 | 1,020 | 1,070 | 1,070 | 418 | 500 |
| 7 | 265 | 805 | 618 | 170 | 800 | 908 | 3,980 | 960 | 960 | 960 | 538 | 1,480 |
| 8 | 200 | 708 | 538 | 170 | 700 | 1,360 | 3,560 | 855 | 1,480 | 855 | 575 | 1,300 |
| 9 | 162 | 660 | 350 | 170 | 400 | 1,300 | 3,280 | 755 | 1,360 | 755 | 538 | 418 |
| 10 | 290 | 618 | 300 | 200 | 340 | 1,130 | 2,860 | 708 | 1,180 | 708 | 575 | 430 |
| 11 | 618 | 618 | 250 | 170 | 340 | 1,070 | 2,580 | 755 | 1,240 | 618 | 755 | 575 |
| 12 | 575 | 660 | 90 | 170 | 340 | 1,540 | 2,310 | 1,540 | 2,720 | 618 | 708 | 575 |
| 13 | 290 | 618 | 200 | 170 | 250 | 1,420 | 2,040 | 3,980 | 2,720 | 660 | 618 | 500 |
| 14 | 538 | 960 | 300 | 190 | 220 | 1,360 | 1,920 | 4,120 | 2,310 | 1,130 | 538 | 500 |
| 15 | 342 | 1,420 | 180 | 250 | 140 | 1,480 | 1,920 | 3,140 | 2,040 | 1,070 | 465 | 468 |
| 16 | 200 | 1,540 | 200 | 250 | 140 | 1,300 | 1,790 | 2,310 | 1,790 | 960 | 465 | 388 |
| 17 | 465 | 1,300 | 180 | 100 | 140 | 1,200 | 1,790 | 2,040 | 1,660 | 805 | 139 | 234 |
| 18 | 130 | 1,180 | 180 | 200 | 100 | 1,200 | 1,790 | 1,790 | 1,790 | 708 | 430 | 465 |
| 19 | 130 | 1,020 | 150 | 140 | 80 | 800 | 1,660 | 1,790 | 2,180 | 575 | 305 | 400 |
| 20 | 115 | 1,020 | 130 | 160 | 170 | 1,500 | 1,540 | 1,540 | 1,660 | 500 | 180 | 465 |
| 21 | 145 | 960 | 140 | 170 | 140 | 2,440 | 1,540 | 1,540 | 1,300 | 500 | 430 | 315 |
| 22 | 265 | 908 | 150 | 170 | 140 | 3,560 | 1,420 | 1,420 | 1,130 | 500 | 102 | 305 |
| 23 | 370 | 855 | 160 | 250 | 240 | 5,940 | 1,360 | 1,300 | 1,020 | 305 | 180 | 342 |
| 24 | 290 | 805 | 180 | 170 | 140 | 6,080 | 1,480 | 1,180 | 960 | 500 | 115 | 234 |
| 25 | 130 | 708 | 180 | 140 | 600 | 7,340 | 1,130 | 1,070 | 855 | 465 | 124 | 855 |
| 26 | 115 | 708 | 240 | 170 | 900 | 8,320 | 1,660 | 1,020 | 755 | 265 | 115 | 908 |
| 27 | 115 | 660 | 280 | 200 | 1,100 | 6,780 | 1,660 | 960 | 755 | 430 | 156 | 1,540 |
| 28 | 115 | 708 | 140 | 400 | 1,000 | 5,800 | 1,660 | 908 | 805 | 315 | 400 | 1,480 |
| 29 | 115 | 660 | 140 | 400 | ------- | 5,660 | 1,540 | 855 | 1,240 | 200 | 430 | 2,860 |
| 30 | 115 | 708 | 150 | 400 | ------- | 5,800 | 1,480 | 855 | 1,540 | 130 | 400 | 5,660 |
| 31 | 500 | ------- | 200 | 500 | ------- | 5,520 | ------- | 805 | ------- | 430 | 500 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 9 to Mar. 1 and Mar. 16–20; discharge ascertained from gage heights corrected for ice effect by means of observer's notes, weather records, and comparison with records of flow at Coppock.

*Monthly discharge of Skunk River at Augusta, Iowa, for the year ending September 30, 1923*

[Drainage area, 4,290 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 618 | 115 | 258 | 0.060 | 0.07 |
| November | 1,540 | 145 | 780 | .182 | .20 |
| December | 660 | 90 | 296 | .069 | .08 |
| January | 500 | 100 | 224 | .052 | .06 |
| February | 1,400 | 80 | 469 | .109 | .11 |
| March | 8,320 | 700 | 2,790 | .650 | .75 |
| April | 5,800 | 1,130 | 2,620 | .611 | .68 |
| May | 4,120 | 708 | 1,460 | .340 | .39 |
| June | 2,720 | 755 | 1,450 | .338 | .38 |
| July | 1,790 | 130 | 763 | .178 | .21 |
| August | 755 | 102 | 360 | .084 | .10 |
| September | 5,660 | 234 | 910 | .212 | .24 |
| The year | 8,320 | 80 | 1,030 | .240 | 3.27 |

### SQUAW CREEK AT AMES, IOWA

LOCATION.—In sec. 3, T. 83 N., R. 24 W., at footbridge 1,700 feet above Chicago & North Western Railway bridge, in Ames, Story County, 2 miles above junction with Skunk River.

DRAINAGE AREA.—210 square miles (measured on topographic map and United States post route map).

RECORDS AVAILABLE.—May 24, 1919, to September 30, 1923.

GAGE.—Vertical staff gage attached to middle pile of left bent of bridge; read by George Foster and D. M. Fish.

DISCHARGE MEASUREMENTS.—Made from footbridge, by wading, and from Chicago & North Western Railway bridge.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Sand shifts during high water. Left bank high; right bank subject to overflow at a stage above 7 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.1 feet September 28 (discharge, 1,340 second-feet); minimum discharge, 1 second-foot August 24–26.

1919–1923: Maximum stage recorded, 10.40 feet July 17, 1922 (discharge, 3,920 second-feet); minimum discharge, no flow, August 26 to September 17, 1919.

Maximum stage in recent years, about 14.5 feet June 4, 1918 (discharge, about 6,900 second-feet).

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation changed September 1. Rating curves well defined above 5 second-feet. Gage read to hundredths twice daily and more often during periods of high water. Daily discharge ascertained by applying mean daily gage height to rating table, except as explained in footnote to table of daily discharge. Open-water records good; winter records fair.

*Discharge measurements of Squaw Creek at Ames, Iowa, during the year ending September 30, 1923*

[Made by J. B. Spiegel]

| Date | Gage height | Discharge | Date | Gage height | Discharge |
|---|---|---|---|---|---|
| | *Feet* | *Sec.-ft.* | | *Feet* | *Sec.-ft* |
| Dec. 8 | [a] 1.12 | 22.1 | May 28 | 1.10 | 29.4 |
| Jan. 22 | [a] 1.38 | 13.3 | July 31 | .50 | [b] 1 |
| Mar. 8 | [a] 2.10 | 77 | Sept. 7 | 1.36 | 78 |
| Mar. 24 | 4.50 | 861 | Sept. 28 | 5.60 | 1,110 |
| Apr. 25 | 1.98 | 153 | | | |

[a] Stage-discharge relation affected by ice. [b] Discharge estimated.

*Daily discharge, in second-feet, of Squaw Creek at Ames, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 39 | 40 | | | | 240 | 60 | 30 | 48 | 3 | 133 |
| 2 | 13 | 37 | 40 | | | | 240 | 55 | 30 | 38 | 2 | 141 |
| 3 | 14 | 35 | 38 | | | 78 | 240 | 48 | 30 | 25 | 6 | 68 |
| 4 | 14 | 34 | 36 | | | | 240 | 45 | 30 | 21 | 6 | 21 |
| 5 | 11 | 31 | 35 | | | | 221 | 42 | 40 | 20 | 6 | 16 |
| 6 | 16 | 36 | 29 | | | | 203 | 35 | 104 | 17 | 10 | 24 |
| 7 | 22 | 34 | 26 | | | | 167 | 32 | 116 | 16 | 14 | 62 |
| 8 | 19 | 30 | 22 | 16 | | 80 | 142 | 31 | 65 | 13 | 14 | 55 |
| 9 | 17 | 30 | | | | | 150 | 30 | 60 | 4 | 8 | 31 |
| 10 | 16 | 30 | | | 10 | | 150 | 32 | 82 | 2 | 6 | 28 |
| 11 | 16 | 30 | 21 | | | | 150 | 39 | 167 | 2 | 6 | 23 |
| 12 | 15 | 30 | | | | | 142 | 52 | 150 | 2 | 8 | 24 |
| 13 | 16 | 104 | | | | | 150 | 52 | 112 | 2 | 10 | 21 |
| 14 | 16 | 104 | | | | | 134 | 49 | 96 | 3 | 4 | 23 |
| 15 | 16 | 86 | | | | | 126 | 55 | 78 | 15 | 2 | 18 |
| | | | | | | 45 | | | | | | |
| 16 | 16 | 72 | | | | | 119 | 57 | 60 | 16 | 7 | 19 |
| 17 | 15 | 60 | | | | | 104 | 52 | 50 | 10 | 12 | 28 |
| 18 | 14 | 56 | | | | | 104 | 62 | 39 | 6 | 8 | 38 |
| 19 | 14 | 55 | | | | | 89 | 56 | 39 | 6 | 6 | 32 |
| 20 | 14 | 51 | | | | | 96 | 60 | 32 | 6 | 3 | 128 |
| 21 | 14 | 48 | | | | 119 | 96 | 56 | 28 | 4 | 2 | 127 |
| 22 | 14 | 46 | | | | 545 | 89 | 56 | 26 | 4 | 12 | 82 |
| 23 | 14 | 40 | 16 | 13 | | 1,060 | 96 | 46 | 26 | 2 | 2 | 65 |
| 24 | 14 | 35 | | | | 862 | 104 | 32 | 24 | 2 | 1 | 62 |
| 25 | 14 | 30 | | | 25 | 501 | 134 | 30 | 22 | 3 | 1 | 65 |
| 26 | 14 | 35 | | | | 337 | 119 | 30 | 17 | 2 | 1 | 78 |
| 27 | 14 | 36 | | | | 240 | 104 | 30 | 16 | 2 | 68 | 1,110 |
| 28 | 14 | 36 | | | | 240 | 75 | 30 | 119 | 2 | 21 | 1,070 |
| 29 | 14 | 37 | | | ------ | 240 | 75 | 30 | 72 | 6 | 14 | 790 |
| 30 | 14 | 39 | | | ------ | 240 | 68 | 30 | 62 | 4 | 8 | 490 |
| 31 | 29 | ------ | | | ------ | 240 | ------ | 31 | ------ | 2 | 11 | ------ |

NOTE.—Stage-discharge relation affected by ice Nov. 25–28 and Dec. 6 to Mar. 20; discharge ascertained from gage heights corrected for effect of ice by means of three discharge measurements and weather records. Shifting-control method used Mar. 22–25. Discharge estimated Aug. 5, 6, and Sept. 29.

*Monthly discharge of Squaw Creek at Ames, Iowa, for the year ending September 30, 1923*

[Drainage area, 210 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 29 | 11 | 15.4 | 0.073 | 0.08 |
| November | 104 | 30 | 45.5 | .217 | .24 |
| December | 40 | | 21.6 | .103 | .12 |
| January | | | 14.5 | .069 | .08 |
| February | | | 14.3 | .068 | .07 |
| March | 1,060 | | 189 | .900 | 1.04 |
| April | 240 | 68 | 139 | .662 | .74 |
| May | 62 | 30 | 43.4 | .207 | .24 |
| June | 167 | 16 | 60.7 | .289 | .32 |
| July | 48 | 2 | 9.8 | .047 | .05 |
| August | 68 | 1 | 9.1 | .043 | .05 |
| September | 1,110 | 16 | 162 | .771 | .86 |
| The year | 1,110 | 1 | 60.3 | .287 | 3.89 |

**DES MOINES RIVER AT KALO, IOWA**

LOCATION.—In sec. 17, T. 88 N., R. 28 W., at Kalo, Webster County, 1½ miles east of Otho, a station on Minneapolis & St. Louis Railroad, and 1½ miles above mouth of Holiday Creek, which enters from left.

DRAINAGE AREA.—4,170 square miles (measured on map issued by United States Geological Survey; scale, 1: 500,000).

RECORDS AVAILABLE.—October 18, 1913, to September 30, 1923.

GAGE.—Gurley seven-day water-stage recorder on right bank 300 feet below highway bridge to which chain gage formerly used is attached; inspected by S. C. Fuller.

DISCHARGE MEASUREMENTS.—Measurements made from bridge and by wading.

CHANNEL AND CONTROL.—No well-defined control. Channel consists of gravel and is fairly permanent.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year, about 4,160 second-feet March 25; minimum stage recorded, −0.15 foot several times October 9–15 (discharge, 14 second-feet).

1913–1923: Maximum stage recorded, 14.0 feet May 30, 1915 (discharge, 18,500 second-feet); minimum stage recorded, that of October 9–15, 1922.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Operation of the city power plant, at Fort Dodge, 7 miles upstream causes diurnal fluctuation during periods of low water.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well defined below 1,000 second-feet. Operation of water-stage recorder satisfactory. Mean daily gage height ascertained by inspection of recorder graph. Daily discharge obtained by applying mean daily gage height to rating table except as explained in footnote to table of daily discharge. Records fair.

*Discharge measurements of Des Moines River at Kalo, Iowa, during the year ending September 30, 1923*

[Made by J. B. Spiegel]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Oct. 25 | 0.02 | 46.6 |
| Jan. 26 | *.70 | 28.6 |
| May 24 | .84 | 292 |

* Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Des Moines River at Kalo, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 97 | 127 | | | | 1,300 | 797 | 380 | 458 | 74 | 422 |
| 2 | | 120 | 118 | | | | 1,460 | 650 | 500 | 410 | 154 | 488 |
| 3 | 65 | 142 | 148 | 60 | 125 | 250 | 1,870 | 458 | 464 | 410 | 112 | 410 |
| 4 | | 195 | 90 | | | | 1,640 | 395 | 255 | 361 | 100 | 315 |
| 5 | | 174 | 124 | | | | 1,380 | 351 | 342 | 338 | 44 | 275 |
| 6 | | 211 | 64 | | | | 1,220 | 476 | 453 | 303 | 61 | 255 |
| 7 | 75 | 243 | 90 | | | | 1,220 | 440 | 263 | 410 | 39 | 271 |
| 8 | | 265 | 103 | 80 | 80 | 170 | 1,000 | 595 | 315 | 307 | 100 | 259 |
| 9 | 84 | 280 | 118 | | | | 900 | 416 | 458 | 275 | 95 | 133 |
| 10 | 51 | 290 | 133 | | | | 830 | 360 | 671 | 243 | 97 | 142 |
| 11 | 69 | 250 | 100 | | | | 780 | 351 | 964 | 287 | 160 | 124 |
| 12 | 79 | 270 | 69 | | | | 770 | 422 | 1,460 | 307 | 227 | 124 |
| 13 | 69 | 192 | 115 | 40 | 105 | 320 | 770 | 434 | 1,300 | 188 | 267 | 112 |
| 14 | 69 | 167 | 79 | | | | 692 | 600 | 1,060 | 207 | 109 | 106 |
| 15 | 48 | 199 | 115 | | | | 566 | 550 | 832 | 174 | 84 | 100 |
| 16 | 100 | 230 | 118 | | | | 506 | 500 | 644 | 172 | 133 | 106 |
| 17 | 95 | 240 | | | | | 506 | 550 | 632 | 195 | 160 | 207 |
| 18 | 92 | 203 | | 35 | 135 | 330 | 536 | 600 | 620 | 172 | 127 | 151 |
| 19 | 87 | 219 | | | | | 506 | 524 | 572 | 142 | 127 | 100 |
| 20 | 61 | 250 | | | | | 446 | 494 | 769 | 133 | 167 | 674 |
| 21 | 74 | 250 | | | | 560 | 333 | 390 | 790 | 121 | 90 | 584 |
| 22 | 30 | 127 | | | | 1,870 | 494 | 307 | 650 | 145 | 84 | 776 |
| 23 | 95 | 207 | | 50 | | 2,600 | 572 | 342 | 536 | 154 | 77 | 755 |
| 24 | 92 | 215 | 90 | | | 3,540 | 790 | 342 | 470 | 100 | 84 | 650 |
| 25 | 84 | 148 | | | 260 | 4,160 | 868 | 333 | 400 | 69 | 56 | 566 |
| 26 | 79 | 39 | | | | 4,030 | 988 | 195 | 400 | 30 | 71 | 530 |
| 27 | 118 | 124 | | | | 3,200 | 924 | 330 | 410 | 69 | 136 | 590 |
| 28 | 77 | 127 | | 100 | | 2,410 | 988 | 300 | 530 | 74 | 79 | 602 |
| 29 | 71 | 148 | | | ------- | 2,180 | 818 | 300 | 410 | 74 | 95 | 650 |
| 30 | 142 | 154 | | | ------- | 1,870 | 748 | 300 | 458 | 103 | 87 | 1,060 |
| 31 | 106 | ------- | 65 | | ------- | 1,380 | ------- | 330 | ------- | 74 | 79 | ------- |

NOTE.—Water-stage recorder not operating satisfactorily Oct. 1–8, 23, 24, Nov. 2, 8–12, 16, 17, 20, 21, Apr. 8–13, May 14–18, and May 27 to June 1; discharge estimated by comparison with records of flow of Des Moines River near Boone. Stage-discharge relation affected by ice Dec. 17 to Mar. 27; discharge determined from incomplete gage-height record corrected for ice effect by means of one discharge measurement, weather records, and comparison with records of flow of Des Moines River near Boone. Discharge June 6, 7, and Sept. 20 determined by averaging bi-hourly discharge.

*Monthly discharge of Des Moines River at Kalo, Iowa, for the year ending September 30, 1923*

[Drainage area, 4,170 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 142 | ------- | 78.1 | 0.019 | 0.02 |
| November | 290 | 39 | 193 | .046 | .05 |
| December | 148 | ------- | 97.9 | .023 | .03 |
| January | ------- | ------- | 62.1 | .015 | .02 |
| February | ------- | ------- | 154 | .037 | .04 |
| March | 4,160 | ------- | 1,070 | .257 | .30 |
| April | 1,870 | 333 | 881 | .211 | .24 |
| May | 797 | 195 | 433 | .104 | .12 |
| June | 1,460 | 255 | 600 | .144 | .16 |
| July | 458 | 30 | 210 | .050 | .06 |
| August | 267 | 39 | 109 | .026 | .03 |
| September | 1,060 | 100 | 385 | .092 | .10 |
| The year | 4,160 | ------- | 356 | .085 | 1.17 |

### DES MOINES RIVER NEAR BOONE, IOWA

LOCATION.—In sec. 12, T. 84 N., R. 27 W., at highway bridge in Centerville, 1 mile above Boone waterworks, 2½ miles northwest of Boone, Boone County, and 3 miles above Bluff Creek.

DRAINAGE AREA.—5,480 square miles (measured on map issued by United States Geological Survey; scale, 1:500,000.)

RECORDS AVAILABLE.—April 1, 1920, to September 30, 1923. At site of old gage 3½ miles downstream at the Chicago & Northwestern Railway crossing, scattered records of stage have been obtained by the United States Weather Bureau from 1905 to 1917.

GAGE.—Chain gage attached to downstream side of bridge 20 feet from left end of right span; read by S. A. Elliott.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Well-defined control is formed by remains of an old dam, 300 feet below bridge. Channel consists of gravel and sand and is fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.6 feet at 9 a. m. March 28 (discharge, 6,520 second-feet); minimum stage, 1.18 feet at 7 a. m. July 28 (discharge, 62 second-feet).

1920–1923: Maximum stage recorded, 13.39 feet July 11, 1920 (discharge, 16,900 second-feet); minimum stage, that of July 28, 1923.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—The city power plant at Fort Dodge causes some diurnal fluctuation during periods of extremely low water.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined between 100 and 18,000 second-feet. Gage read to hundredths once daily and frequently during days of rapidly changing stage. Daily discharge ascertained by applying mean daily gage height to rating table except as explained in footnote to table of daily discharge. Records good.

*Discharge measurements of Des Moines River near Boone, Iowa, during the year ending September 30, 1923*

[Made by J. B. Spiegel]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Oct. 21 | 1.38 | 115 |
| May 25 | 2.08 | 409 |

*Daily discharge, in second-feet, of Des Moines River near Boone, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 85 | 155 | 326 | ------- | 99 | 241 | 2,310 | 1,000 | 465 | 665 | 102 | 288 |
| 2 | 108 | 204 | 348 | ------- | 141 | 301 | 2,310 | 900 | 479 | 622 | 134 | 378 |
| 3 | 169 | 249 | 316 | ------- | ------- | 321 | 2,740 | 950 | 1,060 | 665 | 120 | 472 |
| 4 | 96 | 233 | 283 | ------- | ------- | 430 | 3,470 | 710 | 850 | 540 | 204 | 580 |
| 5 | 65 | 204 | 190 | ------- | ------- | 850 | 3,040 | 665 | 802 | 540 | 120 | 500 |
| 6 | 70 | 237 | 150 | ------- | ------- | 391 | 2,740 | 665 | 850 | 540 | 114 | 465 |
| 7 | 96 | 270 | 110 | ------- | ------- | 301 | 2,460 | 665 | 665 | 540 | 108 | 417 |
| 8 | 190 | 288 | 70 | ------- | ------- | 333 | 1,730 | 580 | 665 | 540 | 96 | 332 |
| 9 | 148 | 296 | ------- | ------- | ------- | 365 | 1,310 | 580 | 622 | 500 | 102 | 354 |
| 10 | 96 | 310 | ------- | ------- | ------- | 354 | 1,180 | 500 | 802 | 479 | 117 | 326 |
| 11 | 75 | 274 | ------- | ------- | ------- | 622 | 1,120 | 540 | 1,240 | 417 | 148 | 241 |
| 12 | 80 | 310 | ------- | ------- | ------- | 665 | 1,000 | 622 | 1,870 | 472 | 176 | 208 |
| 13 | 105 | 332 | ------- | ------- | ------- | 622 | 1,000 | 622 | 2,160 | 365 | 321 | 190 |
| 14 | 120 | 321 | ------- | ------- | ------- | 665 | 1,000 | 665 | 2,020 | 365 | 288 | 176 |
| 15 | 127 | 310 | ------- | ------- | ------- | 622 | 950 | 622 | 1,660 | 365 | 257 | 155 |
| 16 | 114 | 310 | ------- | ------- | ------- | 500 | 900 | 540 | 1,180 | 310 | 245 | 169 |
| 17 | 105 | 326 | ------- | ------- | ------- | 500 | 802 | 755 | 1,000 | 278 | 237 | 218 |
| 18 | 96 | 354 | ------- | ------- | ------- | 500 | 802 | 622 | 1,060 | 245 | 233 | 265 |
| 19 | 114 | 365 | ------- | ------- | ------- | 400 | 850 | 665 | 900 | 241 | 241 | 292 |
| 20 | 108 | 365 | ------- | ------- | ------- | 500 | 665 | 580 | 850 | 249 | 208 | 306 |
| 21 | 90 | 354 | ------- | ------- | ------- | 800 | 710 | 580 | 950 | 237 | 204 | 665 |
| 22 | 90 | 338 | ------- | ------- | ------- | 2,300 | 665 | 540 | 1,120 | 190 | 162 | 1,120 |
| 23 | 127 | 321 | ------- | ------- | ------- | 2,600 | 710 | 458 | 900 | 183 | 141 | 1,240 |
| 24 | 127 | 321 | ------- | ------- | ------- | 3,180 | 950 | 417 | 755 | 197 | 96 | 1,180 |
| 25 | 120 | 310 | ------- | ------- | ------- | 5,790 | 1,180 | 437 | 665 | 169 | 102 | 1,180 |
| 26 | 99 | 310 | ------- | ------- | 108 | 5,360 | 1,240 | 486 | 622 | 120 | 102 | 1,120 |
| 27 | 93 | 310 | ------- | ------- | 108 | 6,080 | 1,450 | 410 | 540 | 88 | 114 | 1,120 |
| 28 | 93 | 316 | ------- | ------- | 233 | 6,520 | 1,450 | 444 | 665 | 62 | 111 | 1,310 |
| 29 | 93 | 321 | ------- | 75 | ------- | 4,340 | 1,240 | 430 | 850 | 75 | 105 | 1,450 |
| 30 | 75 | 332 | ------- | 70 | ------- | 4,200 | 1,120 | 365 | 622 | 77 | 162 | 1,590 |
| 31 | 96 | ------- | ------- | 68 | ------- | 3,040 | ------- | 398 | ------- | 77 | 214 | ------- |

NOTE.—Gage not read Dec. 6 and 7; discharge interpolated. Discharge, Mar. 18–23, estimated from weather records.

*Monthly discharge of Des Moines River near Boone, Iowa, for the year ending September 30, 1923*

[Drainage area, 5,480 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 190 | 65 | 105 | 0.019 | 0.02 |
| November | 365 | 155 | 298 | .054 | .06 |
| March | 6,520 | 241 | 1,730 | .316 | .36 |
| April | 3,470 | 665 | 1,440 | .263 | .29 |
| May | 1,000 | 365 | 594 | .108 | .12 |
| June | 2,160 | 465 | 963 | .176 | .20 |
| July | 665 | 62 | 336 | .061 | .07 |
| August | 321 | 96 | 164 | .030 | .03 |
| September | 1,590 | 155 | 610 | .111 | .12 |

### DES MOINES RIVER AT DES MOINES, IOWA

LOCATION.—In T. 78 N., R. 24 W., at Walnut Street Bridge in Des Moines, Polk County, one-fourth mile below dam of Des Moines Electric Co. and 1 mile above mouth of Raccoon River.

DRAINAGE AREA.—6,180 square miles (measured on map issued by United States Geological Survey; scale, 1: 500,000).

RECORDS AVAILABLE.—October 2, 1902, to August 3, 1903; October 1, 1914, to September 30, 1923, at Walnut Street Bridge. May 27, 1905, to July 20, 1906, at Interurban Bridge near Highland Park 5 miles upstream. The United States Weather Bureau maintained a gage at Locust Street Bridge from July 1, 1897, to January, 1912, and at Walnut Street Bridge since January, 1912.

GAGE.—The original gage was a staff gage at Locust Street Bridge. In January, 1912, a Friez water-stage recorder, replacing this, was installed one block downstream at south end of second pier from east abutment of Walnut Street Bridge, and set to read the same as the old gage. Gage zero is 774.74 feet above sea level.

DISCHARGE MEASUREMENTS.—Made at one of several bridges near the gage according to the stage.

CHANNEL AND CONTROL.—The back fill around the piers of Court Street Bridge, one block downstream, forms the control for extreme low stages. The remains of a low timber dam one-quarter mile below gage form the control during medium stages. Both may be drowned out during high stages in Raccoon River.

EXTREMES OF DISCHARGES.—Maximum discharge recorded during year, about 8,000 second-feet March 28; minimum stage, 0.9 foot October 30 (discharge, about 40 second-feet).

1915–1923: Maximum discharge, about 41,500 second-feet June 7, 1918; brief periods of zero flow have occurred since construction of dam above gage.

ICE.—Stage-discharge relation not affected by ice except when temporary ice jams are formed at bridges below gage.

REGULATION.—Considerable diurnal fluctuations during low water is caused by operation of power plant at dam one-fourth mile above gage.

ACCURACY.—Stage-discharge relation practically permanent, for all but flood periods. Rating curve well defined between 200 and 20,000 second-feet. Operation of water-stage recorder not satisfactory at low stages. During those periods daily staff gage readings were taken. Mean daily gage height obtained by inspection of recorder graph. Daily discharge ascertained by applying mean daily gage height to rating table except as explained in footnote to table of daily discharge. Records fair.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

*Discharge measurements of Des Moines River at Des Moines, Iowa, during the year ending September 30, 1923*

[Made by J. B. Spiegel]

| Date | Gage height | Discharge | Date | Gage height | Discharge |
|---|---|---|---|---|---|
| | *Feet* | *Sec.-ft.* | | *Feet* | *Sec.-ft.* |
| Jan. 24 | 1.50 | 202 | June 13 | 3.90 | 2,500 |
| May 2 | 3.00 | 1,410 | July 17 | 1.95 | 446 |

*Daily discharge, in second-feet, of Des Moines River at Des Moines, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 170 | 210 | 475 | | 140 | 3,460 | 1,520 | 700 | 975 | 210 | 385 |
| 2 | 170 | 415 | 415 | | 355 | 3,040 | 1,410 | 785 | 870 | 170 | 545 |
| 3 | 140 | 305 | 415 | | 355 | 3,040 | 1,300 | 785 | 860 | 210 | 545 |
| 4 | 140 | 355 | 415 | | 875 | 3,600 | 1,300 | 1,080 | 750 | 415 | 875 |
| 5 | 110 | 415 | 355 | | 875 | 3,740 | 1,080 | 1,180 | 735 | 210 | 830 |
| 6 | 110 | 475 | 355 | | 1,130 | 3,600 | 975 | 1,410 | 742 | 170 | 925 |
| 7 | 475 | 415 | 355 | | 975 | 3,460 | 875 | 1,640 | 660 | 170 | 875 |
| 8 | 355 | 415 | 355 | | 830 | 3,040 | 875 | 1,470 | 670 | 155 | 582 |
| 9 | 255 | 305 | 305 | | 785 | 2,630 | 875 | 1,350 | 670 | 150 | 475 |
| 10 | 210 | 305 | 255 | | 660 | 2,120 | 830 | 1,410 | 682 | 150 | 500 |
| 11 | 170 | 355 | 210 | | 660 | 1,880 | 1,350 | 1,640 | 682 | 155 | 475 |
| 12 | 170 | 415 | | | 830 | 1,760 | 1,880 | 1,880 | 545 | 170 | 445 |
| 13 | 170 | 700 | | | 875 | 1,640 | 1,640 | 2,370 | 510 | 210 | 385 |
| 14 | 210 | 620 | | | 830 | 1,640 | 1,410 | 2,630 | 510 | 255 | 305 |
| 15 | 170 | 620 | | | 415 | 1,640 | 1,410 | 2,500 | 490 | 330 | 255 |
| 16 | 170 | 545 | | | 255 | 1,520 | 1,410 | 2,120 | 475 | 385 | 232 |
| 17 | 170 | 545 | | | 330 | 1,520 | 1,410 | 2,060 | 475 | 330 | 255 |
| 18 | 140 | 545 | | | 330 | 1,410 | 1,300 | 1,700 | 445 | 305 | 305 |
| 19 | 140 | 475 | | | 210 | 1,300 | 1,180 | 1,500 | 415 | 305 | 355 |
| 20 | 140 | 475 | | | 332 | 1,300 | 1,180 | 1,300 | 355 | 305 | 510 |
| 21 | 140 | 545 | | | 355 | 1,240 | 1,130 | 1,250 | 385 | 355 | 930 |
| 22 | 170 | 545 | | | 975 | 1,350 | 1,080 | 1,300 | 355 | 250 | 975 |
| 23 | 140 | 545 | | | 1,640 | 1,350 | 975 | 1,350 | 260 | 270 | 1,470 |
| 24 | 110 | 475 | | | 3,320 | 1,410 | 875 | 1,240 | 265 | 260 | 1,410 |
| 25 | 110 | 475 | | 200 | 6,530 | 1,640 | 785 | 1,080 | 270 | 230 | 1,410 |
| 26 | 110 | 475 | | | 7,240 | 1,760 | 742 | 875 | 270 | 210 | 1,300 |
| 27 | 110 | 475 | | | 7,490 | 1,640 | 700 | 875 | 260 | 415 | 1,180 |
| 28 | 80 | 475 | | | 8,000 | 1,880 | 700 | 1,240 | 240 | 545 | 1,470 |
| 29 | 60 | 475 | | | 7,490 | 1,880 | 742 | 1,080 | 210 | 545 | 2,370 |
| 30 | 40 | 475 | | | 5,900 | 1,640 | 785 | 1,080 | 180 | 475 | 2,760 |
| 31 | 60 | | | | 4,320 | | 742 | | 190 | 355 | |

NOTE.—Discharge Mar. 25–29 obtained by comparison with similar flood in October, 1923. Discharge June 18–23, July 2–5, 23–31, Aug. 9, 10, 21–26, and Sept. 10 obtained by comparison with record of flow at auxiliary station half a mile upstream.

*Monthly discharge of Des Moines River at Des Moines, Iowa, for the year ending September 30, 1923*

[Drainage area, 6,180 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 475 | 40 | 159 | 0.026 | 0.03 |
| November | 700 | 210 | 462 | .075 | .08 |
| March | 8,000 | 140 | 2,110 | .341 | .39 |
| April | 3,740 | 1,240 | 2,100 | .339 | .38 |
| May | 1,880 | 700 | 1,110 | .180 | .21 |
| June | 2,630 | 700 | 1,430 | .231 | .26 |
| July | 975 | 180 | 497 | .080 | .09 |
| August | 545 | 150 | 280 | .045 | .05 |
| September | 2,760 | 232 | 844 | .137 | .15 |

### DES MOINES RIVER NEAR TRACY, IOWA

LOCATION.—In sec. 19, T. 75 N., R. 17 W., at highway bridge in Bellefontaine, Mahaska County, near Tracy, Marion County, 3 miles above mouth of Cedar Creek and 6 miles below mouth of English Creek, both of which enter from right.

DRAINAGE AREA.—12,400 square miles (measured on map issued by United States Geological Survey; scale, 1:500,000).

RECORDS AVAILABLE.—March 1, 1920, to September 30, 1923. From about April 22 to December 31, 1910, the United States Engineer Corps maintained daily readings at same site.

GAGE.—Chain gage attached to downstream side of bridge near right end of second span from right end of bridge; read by D. M. Coleman. Sea-leve elevation of zero of gage is 671.78 feet.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Solid rock bottom overlain in places with sand and gravel. Right bank high; left bank subject to overflow at high stages. Low-water control well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.3 feet at 7 p. m. March 26 and 7 a. m. March 27 (discharge, 26,300 second-feet); minimum discharge probably occurred during winter.

1920–1923: Maximum stage recorded, 14.74 feet May 14, 1920 (discharge 31,900 second-feet).

Maximum stage since 1851 about 25 feet May 31, 1903 (discharge, estimated 100,000 second-feet).

ICE.—Stage-discharge relation affected by ice during periods of extremely cold weather.

ACCURACY.—Stage-discharge relation changed March 26. Both rating curves fairly well defined between 1,500 and 25,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating tables. Records fair.

*Discharge measurements of Des Moines River near Tracy, Iowa, during the year ending September 30, 1923*

[Made by J. B. Spiegel]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Oct. 16 | 2.80 | 791 |
| July 17 | 3.55 | 1,620 |

*Daily discharge, in second-feet, of Des Moines River near Tracy, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 790 | 995 | 1,420 | 1,130 | 10,300 | 3,870 | 2,580 | 2,790 | 900 | 2,380 |
| 2 | 790 | 2,260 | 1,320 | 910 | 8,360 | 3,550 | 2,380 | 2,650 | 980 | 2,010 |
| 3 | 750 | 2,130 | 1,320 | 950 | 7,650 | 3,230 | 2,250 | 2,930 | 1,020 | 1,890 |
| 4 | 750 | 1,880 | 1,320 | 1,130 | 8,360 | 3,080 | 2,380 | 2,930 | 980 | 1,890 |
| 5 | 750 | 1,530 | 1,320 | 2,540 | 8,600 | 2,930 | 2,380 | 3,230 | 1,280 | 2,380 |
| 6 | 750 | 1,530 | 1,220 | 2,980 | 8,840 | 2,650 | 2,930 | 2,790 | 2,250 | 2,650 |
| 7 | 1,130 | 1,480 | 1,130 | 2,260 | 7,880 | 2,510 | 3,550 | 2,380 | 3,080 | 2,650 |
| 8 | 1,270 | 1,370 | 995 | 1,760 | 6,960 | 2,380 | 3,230 | 2,130 | 3,230 | 2,510 |
| 9 | 1,530 | 1,220 | 995 | 1,530 | 6,100 | 2,250 | 3,550 | 1,890 | 2,930 | 2,130 |
| 10 | 1,320 | 1,130 | 670 | 1,640 | 5,300 | 2,250 | 3,550 | 1,780 | 2,130 | 1,890 |
| 11 | 1,040 | 1,130 | 595 | 1,420 | 4,740 | 2,250 | 3,870 | 2,380 | 1,470 | 1,780 |
| 12 | 910 | 1,760 | ------- | 1,320 | 4,210 | 5,690 | 4,740 | 2,790 | 1,780 | 1,670 |
| 13 | 830 | 6,310 | ------- | 1,420 | 4,040 | 5,300 | 4,920 | 2,130 | 2,010 | 1,570 |
| 14 | 830 | 7,190 | ------- | 1,530 | 4,040 | 5,110 | 5,300 | 2,130 | 1,780 | 1,470 |
| 15 | 790 | 6,100 | ------- | 1,530 | 3,870 | 4,560 | 6,100 | 1,780 | 1,890 | 1,370 |
| 16 | 790 | 4,150 | ------- | 1,320 | 3,870 | 4,380 | 6,100 | 1,670 | 2,010 | 1,280 |
| 17 | 790 | 2,830 | ------- | 995 | 3,870 | 4,380 | 5,690 | 1,670 | 2,010 | 1,190 |
| 18 | 750 | 2,400 | ------- | 830 | 3,870 | 4,210 | 4,560 | 1,570 | 1,890 | 1,240 |
| 19 | 750 | 2,260 | ------- | 595 | 3,550 | 4,040 | 4,210 | 1,670 | 1,890 | 1,370 |
| 20 | 750 | 2,260 | ------- | 870 | 3,390 | 3,870 | 4,040 | 1,670 | 1,890 | 1,670 |
| 21 | 710 | 2,000 | ------- | 1,320 | 3,230 | 3,550 | 4,040 | 1,470 | 2,010 | 1,780 |
| 22 | 710 | 2,000 | ------- | 4,520 | 3,550 | 3,230 | 4,560 | 1,370 | 1,890 | 2,010 |
| 23 | 710 | 1,880 | ------- | 8,600 | 3,550 | 3,080 | 4,380 | 1,280 | 1,670 | 2,380 |
| 24 | 710 | 1,760 | ------- | 8,600 | 3,550 | 2,930 | 4,040 | 1,190 | 1,470 | 2,930 |
| 25 | 710 | 1,640 | ------- | 17,800 | 3,870 | 2,790 | 3,550 | 1,060 | 1,370 | 3,230 |
| 26 | 670 | 1,530 | ------- | 25,900 | 4,040 | 2,650 | 3,230 | 1,020 | 1,280 | 3,080 |
| 27 | 670 | 1,530 | ------- | 25,900 | 4,210 | 2,510 | 3,080 | 1,020 | 1,470 | 2,930 |
| 28 | 670 | 1,530 | ------- | 23,800 | 4,560 | 2,380 | 3,870 | 1,020 | 1,670 | 10,300 |
| 29 | 670 | 1,530 | ------- | 20,400 | 4,560 | 2,380 | 3,390 | 940 | 1,470 | 8,360 |
| 30 | 670 | 1,420 | ------- | 16,800 | 4,210 | 2,510 | 3,550 | 940 | 1,890 | 7,650 |
| 31 | 670 | ------- | ------- | 12,900 | ------- | 3,230 | ------- | 900 | 2,510 | ------- |

*Monthly discharge of Des Moines River near Tracy, Iowa, for the year ending September 30, 1923*

[Drainage area, 12,400 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 1,530 | 670 | 827 | 0.067 | 0.08 |
| November | 7,190 | 995 | 2,290 | .185 | .21 |
| March | 25,900 | 595 | 6,300 | .508 | .59 |
| April | 10,300 | 3,230 | 5,240 | .422 | .47 |
| May | 5,690 | 2,250 | 3,350 | .270 | .31 |
| June | 6,100 | 2,250 | 3,870 | .312 | .35 |
| July | 3,230 | 900 | 1,840 | .148 | .17 |
| August | 3,230 | 900 | 1,810 | .146 | .17 |
| September | 10,300 | 1,190 | 2,720 | .219 | .24 |

### DES MOINES RIVER AT OTTUMWA, IOWA

LOCATION.—At Market Street Bridge, Ottumwa, Wapello County. No large tributary within several miles.

DRAINAGE AREA.—13,200 square miles (measured on map issued by United States Geological Survey; scale, 1:500,000).

RECORDS AVAILABLE.—March 28, 1917, to September 30, 1923. Fragmentary high-water observations 1902 to 1916.

GAGE.—Chain gage attached to downstream handrail of bridge. Staff gage painted on northeast face of north pier used prior to August 2, 1917.

DISCHARGE MEASUREMENTS.—Made from Vine Street Bridge, 1,500 feet below gage.

CHANNEL AND CONTROL.—Channel fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.2 feet March 27 and 28 (discharge, 26,900 second-feet); minimum discharge, 405 second-feet February 21–24.

1917–1923: Maximum stage recorded, 16.5 feet June 11, 1917 (discharge, 58,700 second-feet); minimum discharge estimated less than 350 second-feet several days during December, 1917.

Maximum discharge since 1850, May 31, 1903 (discharge estimated, 100,000 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Power plant located short distance above gage probably produces some diurnal fluctuation at low stages.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined above 700 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as explained in footnote to table of daily discharge. Open-water records good; winter records fair.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

The following discharge measurement was made by J. B. Spiegel:

July 18, 1923: Gage-height, 2.33 feet; discharge, 1,890 second-feet.

*Daily discharge, in second-feet, of Des Moines River at Ottumwa, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,100 | 860 | 1,670 | 975 | 860 | 650 | 12,200 | 4,400 | 3,670 | 3,670 | 975 | 2,560 |
| 2 | 1,100 | 2,370 | 1,670 | 975 | 860 | 1,100 | 10,300 | 3,910 | 3,210 | 3,210 | 1,100 | 2,560 |
| 3 | 975 | 2,560 | 1,670 | 975 | 750 | 1,370 | 8,840 | 3,440 | 2,560 | 3,210 | 975 | 2,180 |
| 4 | 860 | 2,980 | 1,670 | 860 | 750 | 1,520 | 8,260 | 3,210 | 2,370 | 3,910 | 1,100 | 2,000 |
| 5 | 750 | 2,980 | 1,520 | 860 | 560 | 1,520 | 8,260 | 2,980 | 2,180 | 3,910 | 1,520 | 2,000 |
| 6 | 750 | 2,980 | 1,370 | 860 | 560 | 3,440 | 8,840 | 2,770 | 2,560 | 3,670 | 1,670 | 2,560 |
| 7 | 860 | 2,370 | 1,370 | 860 | 650 | 3,440 | 9,130 | 2,770 | 2,770 | 3,210 | 2,980 | 2,980 |
| 8 | 1,520 | 2,000 | 1,100 | 750 | 750 | 2,770 | 7,970 | 2,370 | 3,440 | 2,770 | 3,910 | 3,210 |
| 9 | 1,520 | 2,000 | 860 | 650 | 860 | 2,370 | 7,390 | 2,180 | 3,440 | 2,370 | 3,910 | 2,770 |
| 10 | 1,520 | 1,520 | 750 | 650 | 650 | 2,000 | 6,250 | 2,180 | 3,670 | 2,180 | 3,440 | 2,370 |
| 11 | 1,830 | 1,370 | 650 | 750 | 650 | 1,670 | 5,710 | 2,180 | 3,910 | 2,000 | 2,560 | 2,000 |
| 12 | 1,670 | 1,670 | 560 | 860 | 650 | 1,830 | 5,180 | 4,660 | 4,660 | 2,370 | 1,830 | 2,000 |
| 13 | 1,230 | 2,180 | 560 | 860 | 650 | 2,000 | 4,660 | 6,810 | 5,180 | 3,440 | 1,670 | 1,830 |
| 14 | 975 | 9,430 | 560 | 860 | 600 | 2,000 | 4,400 | 5,980 | 5,180 | 2,560 | 2,000 | 1,830 |
| 15 | 975 | 8,550 | 750 | 860 | 550 | 2,980 | 4,400 | 5,710 | 5,980 | 2,370 | 2,000 | 1,520 |
| 16 | 860 | 7,390 | 750 | 860 | 500 | 3,440 | 4,150 | 5,180 | 6,530 | 2,000 | 2,000 | 1,520 |
| 17 | 750 | 5,710 | 650 | 750 | 520 | 4,150 | 4,150 | 4,660 | 6,250 | 1,830 | 2,180 | 1,370 |
| 18 | 650 | 4,660 | 650 | 860 | 440 | 2,980 | 4,150 | 4,920 | 5,980 | 1,830 | 2,180 | 1,370 |
| 19 | 650 | 2,980 | 650 | 860 | 440 | 1,670 | 3,910 | 4,400 | 5,180 | 1,670 | 2,180 | 1,370 |
| 20 | 650 | 1,830 | 650 | 860 | 440 | 1,370 | 3,670 | 4,150 | 4,660 | 1,670 | 2,000 | 1,370 |
| 21 | 650 | 2,560 | 650 | 860 | 405 | 1,370 | 3,440 | 3,910 | 4,400 | 1,670 | 2,000 | 1,830 |
| 22 | 860 | 2,370 | 650 | 750 | 405 | 5,180 | 3,440 | 3,670 | 4,400 | 1,670 | 2,180 | 2,000 |
| 23 | 975 | 2,370 | 700 | 750 | 405 | 9,430 | 3,440 | 3,440 | 4,920 | 1,520 | 2,000 | 2,180 |
| 24 | 860 | 2,180 | 700 | 750 | 405 | 11,600 | 3,910 | 3,210 | 4,660 | 1,520 | 2,000 | 2,180 |
| 25 | 860 | 2,000 | 700 | 750 | 480 | 16,000 | 3,910 | 2,980 | 4,400 | 1,230 | 1,670 | 2,770 |
| 26 | 860 | 1,830 | 700 | 750 | 560 | 25,300 | 4,150 | 2,770 | 3,910 | 1,230 | 1,520 | 3,440 |
| 27 | 860 | 1,670 | 750 | 860 | 560 | 26,900 | 4,400 | 2,560 | 4,150 | 1,230 | 1,520 | 3,670 |
| 28 | 860 | 1,830 | 750 | 860 | 650 | 26,900 | 4,660 | 2,370 | 6,250 | 1,230 | 1,670 | 3,910 |
| 29 | 750 | 1,830 | 750 | 750 | ------- | 23,800 | 4,920 | 2,370 | 6,530 | 1,100 | 2,000 | 14,200 |
| 30 | 750 | 1,670 | 750 | 860 | ------- | 20,700 | 4,660 | 2,370 | 4,150 | 1,100 | 1,670 | 7,100 |
| 31 | 750 | ------- | 860 | 860 | ------- | 16,300 | ------- | 2,370 | ------- | 1,100 | 1,830 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 23 to Feb. 28; discharge estimated from record of flow at Keosauqua and weather records.

*Monthly discharge of Des Moines River at Ottumwa, Iowa, for the year ending September 30, 1923*

[Drainage area, 13,200 square miles.]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 1,830 | 650 | 975 | 0.074 | 0.09 |
| November | 9,430 | 860 | 2,960 | .224 | .25 |
| December | 1,670 | 560 | 905 | .069 | .08 |
| January | 975 | 650 | 826 | .063 | .07 |
| February | 860 | 405 | 591 | .045 | .05 |
| March | 26,900 | 650 | 7,350 | .557 | .64 |
| April | 12,200 | 3,440 | 5,760 | .436 | .49 |
| May | 6,810 | 2,180 | 3,580 | .272 | .31 |
| June | 6,530 | 2,180 | 4,340 | .329 | .37 |
| July | 3,910 | 1,100 | 2,210 | .167 | .19 |
| August | 3,910 | 975 | 2,010 | .152 | .18 |
| September | 14,200 | 1,370 | 2,820 | .214 | .24 |
| The year | 26,900 | 405 | 2,870 | .218 | 2.96 |

### DES MOINES RIVER AT KEOSAUQUA, IOWA

LOCATION.—In sec. 36, T. 69 N., R. 10 W., at county bridge in Keosauqua, Van Buren County, one-fourth mile above old dam site and Government locks. No important tributary enters Des Moines River for several miles up or down stream.

DRAINAGE AREA.—At gaging station 13,900 square miles; at mouth, 14,300 square miles (measured on map issued by United States Geological Survey; scale, 1:500,000).

RECORDS AVAILABLE.—May 29, 1903, to July 21, 1906; April 5 to December 31, 1910; August 3, 1911, to September 30, 1923.

GAGE.—Chain gage attached to upstream handrail of bridge; read by Frank Schreckengast.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Channel shifts considerably at flood stages. Control is a gravel riffle one-fourth mile below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.2 feet at 8 a. m. March 28 (discharge, 26,200 second-feet); minimum discharge, about 300 second-feet December 13.

1903–1906; 1910–1922: Maximum stage recorded, 27.85 feet June 1, 1903 (discharge, about 97,000 second-feet); minimum discharge, 160 second-feet August 28 to September 6, 1911.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed March 28. Both rating curves fairly well defined above 700 second-feet. Gage read to half-tenths once daily except Sunday. Daily discharge obtained by applying daily gage height to rating table except as explained in footnote to table of daily discharge. Open-water records good; winter records fair.

*Discharge measurements of Des Moines River at Keosauqua, Iowa, during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 4 | P. L. Mercer | 0.38 | 749 | May 31 | P. L. Mercer | 1.41 | 2,430 |
| Dec. 20 | C. Herlofson | [a].75 | 867 | July 18 | J. B. Spiegel | .93 | 1,630 |
| Feb. 9 | P. L. Mercer | [a].71 | 903 | | | | |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Des Moines River at Keosauqua, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,080 | 835 | 2,060 | 800 | 850 | 850 | 15,000 | 4,480 | 2,450 | 3,970 | 880 | 2,230 |
| 2 | 1,170 | 835 | 1,850 | 800 | 850 | 1,170 | 11,300 | 4,220 | 3,490 | 3,490 | 960 | 2,900 |
| 3 | 910 | 2,720 | 1,850 | 800 | 400 | 1,350 | 9,810 | 3,970 | 2,900 | 3,020 | 880 | 2,450 |
| 4 | 910 | 3,060 | 1,850 | 800 | 500 | 1,350 | 8,940 | 3,490 | 2,340 | 3,490 | 960 | 2,120 |
| 5 | 760 | 2,610 | 1,850 | 800 | 800 | 1,350 | 8,650 | 3,250 | 2,340 | 3,970 | 1,310 | 2,120 |
| 6 | 760 | 2,170 | 1,600 | 700 | 700 | 2,170 | 9,230 | 3,020 | 3,250 | 3,970 | 1,500 | 2,790 |
| 7 | 835 | 1,850 | 1,600 | 700 | 600 | 3,650 | 9,230 | 2,900 | 2,560 | 3,490 | 1,910 | 3,020 |
| 8 | 1,260 | 2,060 | 1,200 | 700 | 700 | 3,420 | 8,360 | 2,560 | 3,020 | 3,020 | 3,490 | 2,900 |
| 9 | 1,440 | 1,950 | 900 | 700 | 900 | 2,840 | 7,780 | 2,340 | 3,490 | 2,560 | 3,970 | 2,790 |
| 10 | 1,640 | 1,440 | 800 | 600 | 800 | 2,500 | 6,650 | 2,120 | 3,970 | 2,340 | 3,490 | 2,680 |
| 11 | 2,060 | 1,170 | 700 | 600 | 800 | 2,500 | 6,090 | 2,340 | 4,220 | 2,230 | 3,490 | 2,230 |
| 12 | 1,740 | 1,850 | 600 | 650 | 700 | 2,840 | 5,540 | 2,450 | 3,970 | 2,020 | 1,700 | 2,020 |
| 13 | 1,260 | 3,420 | 300 | 700 | 600 | 3,180 | 4,740 | 6,090 | 5,000 | 5,000 | 1,500 | 1,800 |
| 14 | 910 | 9,850 | 500 | 800 | 600 | 2,840 | 4,480 | 6,370 | 5,000 | 3,250 | 2,340 | 1,600 |
| 15 | 910 | 9,280 | 400 | 850 | 400 | 2,840 | 4,480 | 6,090 | 5,540 | 3,020 | 2,230 | 1,600 |
| 16 | 910 | 7,580 | 400 | 900 | 400 | 3,400 | 4,220 | 5,540 | 5,810 | 2,450 | 2,020 | 1,500 |
| 17 | 835 | 5,400 | 450 | 700 | 400 | 3,400 | 3,970 | 5,000 | 6,650 | 1,800 | 2,120 | 1,310 |
| 18 | 910 | 4,130 | 600 | 850 | 400 | 3,700 | 3,970 | 4,740 | 6,090 | 1,700 | 2,230 | 1,220 |
| 19 | 760 | 3,300 | 760 | 1,300 | 400 | 3,000 | 3,970 | 4,740 | 5,270 | 1,700 | 2,120 | 1,130 |
| 20 | 835 | 2,500 | 900 | 900 | 400 | 1,200 | 3,730 | 4,480 | 4,480 | 1,600 | 2,020 | 1,220 |
| 21 | 760 | 3,060 | 800 | 1,100 | 400 | 1,500 | 3,490 | 4,220 | 4,480 | 1,910 | 1,910 | 1,220 |
| 22 | 760 | 2,950 | 800 | 1,800 | 400 | 6,000 | 3,020 | 3,970 | 3,970 | 1,700 | 2,120 | 1,910 |
| 23 | 835 | 2,720 | 700 | 1,400 | 400 | 9,000 | 2,560 | 3,490 | 4,480 | 1,600 | 2,120 | 2,020 |
| 24 | 760 | 2,500 | 700 | 800 | 400 | 13,100 | 3,970 | 3,250 | 4,480 | 1,400 | 1,910 | 2,120 |
| 25 | 760 | 2,390 | 700 | 900 | 600 | 13,100 | 3,970 | 3,020 | 4,480 | 1,310 | 1,700 | 2,790 |
| 26 | 690 | 2,270 | 700 | 800 | 700 | 22,800 | 3,970 | 2,900 | 3,970 | 1,040 | 1,500 | 3,490 |
| 27 | 690 | 2,170 | 700 | 900 | 750 | 25,800 | 4,480 | 2,790 | 3,970 | 1,220 | 1,400 | 3,970 |
| 28 | 760 | 2,170 | 800 | 900 | 800 | 26,200 | 4,480 | 2,560 | 5,000 | 1,040 | 1,500 | 3,250 |
| 29 | 560 | 2,060 | 800 | 1,000 | ------- | 24,800 | 5,000 | 2,450 | 7,490 | 960 | 1,600 | 10,700 |
| 30 | 380 | 2,060 | 900 | 850 | ------- | 21,400 | 5,000 | 2,680 | 5,000 | 880 | 1,700 | 10,100 |
| 31 | 440 | ------- | 850 | 850 | ------- | 18,500 | ------- | 2,560 | ------- | 805 | 1,600 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 6 to Mar. 1 and Mar. 16–23; discharge estimated from gage heights corrected for effect of ice by means of two discharge measurements, observer's notes, and weather records. Gage not read on Sundays; discharge interpolated or estimated by comparison with records of flow at Ottumwa.

*Monthly discharge of Des Moines River at Keosauqua, Iowa, for the year ending September 30, 1923*

[Drainage area, 13,900 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 2,060 | 380 | 945 | 0.068 | 0.08 |
| November | 9,850 | 835 | 3,080 | .222 | .25 |
| December | 2,060 | 300 | 955 | .069 | .08 |
| January | 1,800 | 600 | 869 | .063 | .07 |
| February | 900 | 400 | 595 | .043 | .04 |
| March | 26,200 | 850 | 7,480 | .538 | .62 |
| April | 15,000 | 2,560 | 6,000 | .432 | .48 |
| May | 6,370 | 2,120 | 3,680 | .265 | .31 |
| June | 7,490 | 2,340 | 4,310 | .310 | .35 |
| July | 5,000 | 805 | 2,320 | .167 | .19 |
| August | 3,970 | 880 | 1,940 | .140 | .16 |
| September | 10,700 | 1,130 | 2,770 | .199 | .22 |
| The year | 26,200 | 300 | 2,920 | .210 | 2.85 |

### RACCOON RIVER AT VAN METER, IOWA

LOCATION.—In SW. ¼ sec. 22, T. 78 N., R. 27 W., at highway bridge one-third mile from railroad station in Van Meter, Dallas County, 1 mile below junction of North and South Raccoon Rivers, and 30 miles above junction of Raccoon and Des Moines Rivers.

DRAINAGE AREA.—At gaging station, 3,410 square miles; at mouth 3,590 square miles (measured on map issued by United States Geological Survey; scale, 1:500,000).

RECORDS AVAILABLE.—April 25, 1915, to September 30, 1923.

GAGE.—Gurley 7-day water-stage recorder installed May 31, replacing a chain gage attached to downstream handrail of bridge 25 feet from right abutment.. Gage read and recorder inspected by Fred I. Smith.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; subject to change. River divided into two channels at low and medium stages by an island. Right bank high; left bank subject to overflow at stage of 13 feet. At extremely high stages this overflow will extend for several hundred feet beyond left end of bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.50 feet at 7 a. m. March 27 (discharge, 10,100 second-feet); minimum discharge probably occurred during winter.

1915–1923: Maximum stage recorded, 17.5 feet June 7, 1917 (discharge, 31,800 second-feet); minimum stage, 1.56 feet, October 22, 1918 (discharge, about 28 second-feet).

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation permanent during the year. Rating curve well defined between 100 and 15,000 second-feet. Gage read to hundredths twice daily prior to May 31; operation of water-stage recorder satisfactory after that date. Mean daily gage height obtained by inspection of recorder graph. Daily discharge ascertained by applying mean daily gage height to rating table except as explained in footnote to table of daily discharge. Records prior to May 31 good; after that date excellent.

*Discharge measurements of Raccoon River at Van Meter, Iowa, during the year ending September 30, 1923*

[Made by J. B. Spiegel]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Jan. 24 | * 2.68 | 200 |
| May 1 | 4.10 | 1,240 |
| May 31 | 3.66 | 952 |

* Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Raccoon River at Van Meter, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Jan. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 210 | 300 | | | 2,750 | 1,340 | 960 | 1,820 | 324 | 1,500 |
| 2 | 195 | 365 | | | 2,450 | 1,180 | 995 | 2,060 | 410 | 1,500 |
| 3 | 150 | 410 | | | 2,650 | 1,030 | 995 | 1,820 | 415 | 1,820 |
| 4 | 150 | 410 | | 1,590 | 2,750 | 960 | 1,030 | 1,640 | 820 | 2,200 |
| 5 | 150 | 410 | | 960 | 2,550 | 820 | 925 | 1,500 | 742 | 2,160 |
| 6 | 165 | 410 | | 570 | 2,250 | 788 | 960 | 1,340 | 660 | 1,960 |
| 7 | 245 | 410 | | 510 | 1,960 | 752 | 1,550 | 1,180 | 904 | 1,680 |
| 8 | 410 | 410 | | 460 | 1,680 | 690 | 1,640 | 1,070 | 678 | 1,500 |
| 9 | 262 | 460 | | 510 | 1,500 | 630 | 1,420 | 1,030 | 618 | 1,260 |
| 10 | 245 | 510 | | 510 | 1,420 | 630 | 1,460 | 925 | 820 | 1,260 |
| 11 | 245 | 510 | | 510 | 1,340 | 855 | 1,730 | 807 | 890 | 1,100 |
| 12 | 210 | 600 | | 660 | 1,260 | 1,960 | 2,300 | 897 | 1,070 | 995 |
| 13 | 210 | 690 | | 855 | 1,260 | 2,250 | 2,850 | 890 | 1,590 | 890 |
| 14 | 210 | 690 | | 820 | 1,340 | 1,870 | 3,160 | 890 | 1,820 | 820 |
| 15 | 210 | 690 | | 410 | 1,340 | 1,870 | 3,050 | 890 | 1,780 | 755 |
| 16 | 210 | 660 | | 540 | 1,340 | 2,060 | 2,060 | 890 | 1,640 | 690 |
| 17 | 210 | 660 | | 320 | 1,340 | 1,870 | 2,160 | 1,340 | 1,500 | 690 |
| 18 | 210 | 925 | | 250 | 1,260 | 1,870 | 1,870 | 1,180 | 1,340 | 722 |
| 19 | 210 | 1,030 | | 200 | 1,180 | 1,780 | 2,110 | 890 | 2,010 | 820 |
| 20 | 210 | 1,030 | | 250 | 1,180 | 1,590 | 3,050 | 755 | 1,780 | 1,100 |
| 21 | 210 | 925 | | 700 | 1,180 | 1,500 | 3,270 | 660 | 1,420 | 1,500 |
| 22 | 262 | 788 | | 1,180 | 1,100 | 1,340 | 2,850 | 576 | 1,140 | 2,300 |
| 23 | 228 | 660 | | 1,590 | 1,100 | 1,180 | 2,450 | 540 | 995 | 2,450 |
| 24 | 210 | 630 | 200 | 1,680 | 1,340 | 1,100 | 2,110 | 485 | 883 | 2,350 |
| 25 | 210 | 570 | | 9,620 | 1,590 | 960 | 1,780 | 455 | 781 | 2,060 |
| 26 | 210 | 510 | | 8,880 | 2,060 | 890 | 1,730 | 420 | 729 | 1,820 |
| 27 | 180 | 510 | | 9,780 | 2,350 | 788 | 1,780 | 401 | 729 | 1,640 |
| 28 | 150 | 510 | | 8,190 | 2,160 | 788 | 1,420 | 392 | 1,500 | 2,300 |
| 29 | 150 | 510 | | 6,760 | 1,680 | 788 | 1,260 | 365 | 2,550 | 3,950 |
| 30 | 180 | 510 | | 4,910 | 1,500 | 855 | 1,260 | 342 | 2,160 | 5,150 |
| 31 | 228 | | | 3,600 | | 855 | | 324 | 1,680 | |

NOTE.—Discharge Jan. 24 from current-meter measurement; Mar. 18–21 estimated.

*Monthly discharge of Raccoon River at Van Meter, Iowa, for the year ending September 30, 1923*

[Drainage area, 3,410 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 262 | 150 | 211 | 0.062 | 0.07 |
| November | 1,030 | 300 | 590 | .173 | .19 |
| March 4–31 | 9,780 | 200 | 2,390 | .701 | .73 |
| April | 2,750 | 1,100 | 1,690 | .496 | .55 |
| May | 2,250 | 630 | 1,220 | .358 | .41 |
| June | 3,270 | 925 | 1,870 | .548 | .61 |
| July | 2,060 | 324 | 928 | .272 | .31 |
| August | 2,550 | 324 | 1,170 | .343 | .40 |
| September | 5,150 | 690 | 1,700 | .499 | .56 |

76612—26—WSP 565——10

### SUGAR CREEK NEAR KEOKUK, IOWA

LOCATION.—At single span highway bridge in sec. 7, T. 65 N., R. 5 W., 3½ miles above mouth of creek, and 6 miles northwest of Keokuk, Lee County, on road to Argyle.

DRAINAGE AREA.—At gaging station, 113 square miles; at mouth, 120 square miles (measured on topographic county map; scale, one-half inch=1 mile).

RECORDS AVAILABLE.—March 29, 1922, to September 30, 1923.

GAGE.—Gurley seven-day water-stage recorder attached to right abutment of bridge, installed June 25, 1923, replacing chain gage attached to downstream side of bridge 48 feet from right abutment. Gage read and recorder inspected by Mrs. J. B. Williams.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of sand; channel shifting. Left bank subject to overflow at high stages. During June and July, 1923, an artificial control of heavy timber and riprap construction was built 100 feet below gage. A trapezoidal weir with an angle iron crest was built in the control for more accurately measuring low-water flow. Elevation of crest in lowest part is 1.01 feet referred to gage datum. There is some leakage through control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.00 feet, 4 p. m. March 15 (discharge, 740 second-feet); creek dry during all of October and parts of November, June, July, August, and September; frozen solid at intervals during winter.

1922–23: Maximum stage recorded, 8.05 feet July 12 (discharge, 1,830 second-feet); creek dry at various times.

Maximum known stage about 20.6 feet June 9, 1905 (discharge, about 15,000 second-feet). This flood was caused by the same storm which passed over the adjoining drainage area of Devil's Creek and caused the destructive flood in that stream.

ACCURACY.—Until artificial control was built stage-discharge relation was not permanent, although rating curve was fairly well defined above 100 second-feet. Since the installation of control, rating curve has been fairly well defined through range of stage which occurred. Daily discharge ascertained by applying mean daily gage height to rating table or by shifting control method. Open-water records subject to considerable error due to shifting channel conditions prior to installation of control. Open-water records fair; winter records poor.

*Discharge measurements of Sugar Creek near Keokuk, Iowa, during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Dec. 6 | P. L. Mercer | 0.58 | 0.3 | Aug. 8 | Davis and Herlofson | 1.43 | 3.7 |
| Apr. 15 | A. Davis | .73 | 2.3 | Sept. 10 | P. L. Mercer | 1.40 | 3.7 |
| 26 | Davis and Herlofson | .66 | 1.4 | 27 | do | 1.83 | 27.2 |
| May 14 | P. L. Mercer | 1.02 | 12.5 | | | | |

*Daily discharge, in second-feet, of Sugar Creek near Keokuk, Iowa, for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0 | 0.0 | 0.5 | 0.0 | 11.0 | 7.2 | 3.6 | 0.8 | 0.4 | 0.5 | 0.0 | 0.0 |
| 2 | .0 | .0 | .5 | .0 | 6.6 | 7.2 | 6.0 | .5 | .3 | .2 | .0 | .0 |
| 3 | .0 | .7 | .4 | .0 | .0 | 4.8 | 6.0 | .6 | .3 | 15 | .0 | .0 |
| 4 | .0 | .5 | .5 | .0 | .0 | 14 | 3.6 | .4 | .3 | 15 | .0 | .0 |
| 5 | .0 | .4 | .3 | .0 | .0 | 21 | 3.6 | .8 | 1.2 | 1.6 | 5.3 | .0 |
| 6 | .0 | .3 | .2 | .0 | .0 | 7.2 | 2.7 | 1.0 | 12 | 3.5 | 2.4 | .0 |
| 7 | .0 | .2 | .4 | .0 | .3 | 6.0 | 7.8 | .9 | 2.4 | .2 | .8 | .0 |
| 8 | .0 | .1 | .3 | .0 | .3 | 1.5 | 2.7 | .8 | 3.6 | 3.3 | 5.3 | .0 |
| 9 | .0 | .1 | .0 | .3 | .1 | 3.6 | .9 | .8 | 1.5 | .3 | .6 | .0 |
| 10 | .0 | .1 | .0 | .2 | .1 | 6.0 | 1.5 | .9 | 4.2 | .1 | .3 | 3.3 |
| 11 | .0 | .1 | .0 | .4 | .1 | 11 | 2.4 | 1.0 | 5.4 | .1 | .1 | 2.0 |
| 12 | .0 | .7 | .0 | .3 | .1 | 266 | 1.8 | 90 | 3.0 | .1 | .0 | .5 |
| 13 | .0 | 62 | .0 | .3 | .3 | 116 | 1.2 | 17 | 5.4 | .3 | .0 | .2 |
| 14 | .0 | 36 | .0 | .5 | .2 | 72 | 2.1 | 12 | 1.8 | .1 | .0 | .0 |
| 15 | .0 | 15 | .0 | .4 | .1 | 320 | 2.3 | 2.1 | 1.3 | .0 | .0 | .0 |
| 16 | .0 | 5.4 | .0 | .3 | .1 | 320 | 2.7 | 2.0 | 1.0 | .0 | .1 | .0 |
| 17 | .0 | 2.1 | .0 | .3 | .1 | 123 | .9 | 1.8 | .6 | .0 | .3 | .0 |
| 18 | .0 | 4.2 | .0 | .3 | .0 | 20 | .3 | 1.5 | .1 | .0 | .0 | .1 |
| 19 | .0 | 1.8 | .0 | .3 | .0 | 50 | 1.5 | 1.3 | .3 | .0 | .0 | .0 |
| 20 | .0 | .7 | .0 | .3 | .0 | 30 | .6 | 1.2 | .1 | .0 | .0 | .0 |
| 21 | .0 | .5 | .0 | .1 | .1 | 51 | 3.0 | 1.1 | .4 | .0 | .0 | .3 |
| 22 | .0 | .6 | .0 | .0 | .1 | 90 | 3.0 | 1.0 | .2 | .0 | .0 | .0 |
| 23 | .0 | .6 | .0 | .0 | .1 | 60 | 4.2 | .9 | .0 | .0 | .0 | .0 |
| 24 | .0 | .6 | .0 | .2 | 1.8 | 47 | 4.2 | .9 | .0 | .0 | .0 | .0 |
| 25 | .0 | .4 | .0 | .1 | 1.8 | 31 | 1.4 | .6 | 25 | .0 | .0 | .0 |
| 26 | .0 | .6 | .0 | .2 | 2.4 | 20 | 1.4 | .6 | 1.0 | .0 | .0 | .0 |
| 27 | .0 | .6 | .0 | 33 | 1.5 | 16 | .5 | .6 | 5.0 | .0 | .0 | 19 |
| 28 | .0 | .4 | .0 | 25 | 1.5 | 11 | .7 | 1.1 | 50 | .0 | .0 | 7.9 |
| 29 | .0 | .5 | .0 | 15 | ------- | 11 | .6 | .9 | 10 | .0 | .0 | 1.4 |
| 30 | .0 | .4 | .0 | 23 | ------- | 7.2 | .6 | .5 | 2.4 | .0 | .0 | 5.2 |
| 31 | .0 | ------- | .0 | 8.4 | ------- | 10 | ------- | .5 | ------- | .0 | .0 | ------- |

NOTE.—Creek dry during all of October and parts of November, June, July, August and September. Frozen solid or seriously affected by ice Dec. 9 to Jan. 8, Jan. 22 and 23, Feb. 3–23, and Mar. 18–20; discharge estimated.

*Monthly discharge of Sugar Creek near Keokuk, Iowa, for the year ending September 30, 1923*

[Drainage area, 113 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 0 | 0 | 0 | 0 | 0 |
| November | 62 | 0 | 4.52 | .040 | .04 |
| December | .5 | 0 | .11 | .001 | .001 |
| January | 33 | 0 | 3.51 | .031 | .04 |
| February | 11 | 0 | 1.02 | .009 | .01 |
| March | 320 | 3.6 | 56.8 | .503 | .58 |
| April | 7.8 | .3 | 2.46 | .022 | .02 |
| May | 90 | .4 | 4.71 | .042 | .05 |
| June | 50 | 0 | 4.64 | .041 | .05 |
| July | 15 | 0 | 1.3 | .012 | .01 |
| August | 5.3 | 0 | .49 | .004 | .005 |
| September | 19 | 0 | 1.33 | .012 | .01 |
| The year | 320 | 0 | 6.82 | .060 | .82 |

**FOX RIVER NEAR WAYLAND, MO.**

LOCATION.—In NE. ¼ sec. 25, T. 65 N., R. 7 W., at highway bridge 1 mile above Chicago, Burlington & Quincy Railroad bridge, 2½ miles northwest of Wayland, Clark County, and 3 miles below Brush Creek.

DRAINAGE AREA.—392 square miles (measured on maps compiled by United States Geological Survey, scale, 1: 500,000 and topographic maps).

RECORDS AVAILABLE.—February 22, 1922, to September 30, 1923.

GAGE.—Chain gage bolted to handrail on upstream side of bridge; read by Lewis Schaaf.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of clean sand; shifting. No well-defined control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.75 feet at 8 a. m. March 16 (discharge, 1,980 second-feet); minimum stage, 2.00 feet at 7.15 a. m. and 5.30 p. m. October 21 (discharge, 1.0 second-foot).

1922–1923: Maximum stage recorded, 11.00 feet July 12, 1922 (discharge, 2,400 second-feet); minimum stage, that of October 21, 1922.

ACCURACY.—Stage-discharge relation permanent during year; seriously affected by ice during winter. Rating curve well defined above 16 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except as explained in footnote to table of daily discharge. Records good except for extreme low stages and periods of ice effect, for which they are fair.

*Discharge measurements of Fox River near Wayland, Mo., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 18 | V. L. Austin | 2.04 | 1.1 | Mar. 30 | E. L. Williams | 3.08 | 91. |
| Dec. 29 | W. R. Denison | [a] 2.24 | 3.2 | June 14 | H. C. Beckman | 2.55 | 30. |
| Feb. 22 | do | [a] 2.42 | 4.5 | Sept. 2 | W. S. Frame | 2.18 | 3.9 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Fox River near Wayland, Mo., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.6 | 9 | 5 | 7 | 61 | 49 | 59 | 20 | 8 | 86 | 6 | 3.4 |
| 2 | 1.4 | 58 | 4.0 | 7 | 56 | 40 | 61 | 18 | 61 | 65 | 3.8 | 3.4 |
| 3 | 1.4 | 45 | 5 | 8 | 28 | 31 | 62 | 17 | 30 | 32 | 2.6 | 3.2 |
| 4 | 1.4 | 36 | 3.8 | 7 | 16 | 59 | 55 | 16 | 56 | 60 | 3.8 | 3.0 |
| 5 | 1.3 | 15 | 3.2 | 6 | 9 | 58 | 54 | 14 | 47 | 43 | 18 | 2.6 |
| 6 | 1.2 | 14 | 3.0 | 9 | 4 | 70 | 42 | 13 | 35 | 90 | 11 | 48 |
| 7 | 1.6 | 11 | 6 | 6 | 4 | 48 | 49 | 10 | 23 | 68 | 21 | 36 |
| 8 | 1.4 | 10 | 7 | 6 | 4 | 39 | 52 | 11 | 21 | 37 | 17 | 42 |
| 9 | 1.4 | 8 | 6 | 6 | 2 | 39 | 44 | 11 | 18 | 22 | 17 | 37 |
| 10 | 1.5 | 6 | 3.8 | 4.5 | 2 | 29 | 37 | 10 | 19 | 17 | 11 | 24 |
| 11 | 1.4 | 6 | 2 | 4.0 | 2 | 45 | 38 | 14 | 84 | 18 | 12 | 17 |
| 12 | 1.4 | 12 | 2 | 6 | 2 | 1,050 | 34 | 382 | 79 | 22 | 12 | 12 |
| 13 | 1.4 | 57 | 2 | 8 | 2 | 1,110 | 30 | 153 | 45 | 46 | 8 | 8 |
| 14 | 1.8 | 240 | 2 | 3.4 | 2 | 810 | 29 | 90 | 37 | 67 | 6 | 6 |
| 15 | 2.2 | 358 | 2 | 3.0 | 2 | 1,210 | 31 | 81 | 28 | 61 | 6 | 4.5 |
| 16 | 1.9 | 153 | 2 | 5 | 2 | 1,700 | 30 | 62 | 23 | 33 | 8 | 3.2 |
| 17 | 1.4 | 130 | 2 | 3.8 | 2 | 1,180 | 28 | 42 | 19 | 19 | 12 | 2.8 |
| 18 | 1.3 | 64 | 2 | 2 | 2 | 1,310 | 26 | 28 | 18 | 10 | 7 | 2.4 |
| 19 | 1.2 | 42 | 2 | 2 | 2 | 1,050 | 25 | 26 | 14 | 8 | 4.5 | 2.4 |
| 20 | 1.1 | 32 | 2 | 2 | 2 | 555 | 22 | 22 | 10 | 6 | 3.8 | 3.6 |
| 21 | 1.0 | 24 | 2 | 2 | 4 | 382 | 22 | 20 | 8 | 5 | 3.2 | 8 |
| 22 | 1.4 | 18 | 2 | 2 | 4 | 480 | 21 | 20 | 5 | 4.0 | 3.2 | 6 |
| 23 | 1.6 | 13 | 2 | 4 | 4 | 990 | 24 | 21 | 3.6 | 3.0 | 2.2 | 4.5 |
| 24 | 1.4 | 10 | 2 | 3.8 | 4 | 660 | 31 | 18 | 3.8 | 2.6 | 1.9 | 3.8 |
| 25 | 1.7 | 8 | 2 | 4.5 | 6 | 382 | 28 | 12 | 4.5 | 2.2 | 1.7 | 3.2 |
| 26 | 1.8 | 10 | 2 | 3.8 | 6 | 230 | 31 | 10 | 4.0 | 1.9 | 1.7 | 3.0 |
| 27 | 1.7 | 8 | 3 | 20 | 6 | 171 | 49 | 10 | 6 | 2.4 | 1.6 | 530 |
| 28 | 1.6 | 6 | 3 | 83 | 20 | 137 | 49 | 12 | 45 | 2.2 | 1.6 | 190 |
| 29 | 1.5 | 6 | 3 | 107 | ------- | 100 | 29 | 14 | 358 | 2.0 | 2.4 | 55 |
| 30 | 1.6 | 6 | 3 | 79 | ------- | 88 | 25 | 16 | 114 | 13 | 6 | 1,050 |
| 31 | 1.9 | ------- | 3 | 60 | ------- | 76 | ------- | 9 | ------- | 7 | 6 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 11-31, Jan. 18-23, and Feb. 4-24; discharge ascertained by applying to rating table mean daily gage heights corrected for ice effect by means of discharge measurements, observer's notes, and weather records.

*Monthly discharge of Fox River near Wayland, Mo., for the year ending September 30, 1923*

[Drainage area, 392 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 2.2 | 1.0 | 1.50 | 0.0038 | 0.004 |
| November | 358 | 6 | 47.2 | .120 | .13 |
| December | 7 | 2 | 3.03 | .0077 | .009 |
| January | 107 | 2 | 15.3 | .039 | .04 |
| February | 61 | 2 | 9.29 | .024 | .02 |
| March | 1,700 | 29 | 457 | 1.17 | 1.35 |
| April | 62 | 21 | 37.2 | .095 | .11 |
| May | 382 | 9 | 38.8 | .099 | .11 |
| June | 358 | 3.6 | 40.9 | .104 | .12 |
| July | 90 | 1.9 | 27.3 | .070 | .08 |
| August | 21 | 1.6 | 7.16 | .018 | .02 |
| September | 1,050 | 2.4 | 70.6 | .180 | .20 |
| The year | 1,700 | 1.0 | 62.9 | .160 | 2.19 |

### WYACONDA RIVER NEAR CANTON, MO.

LOCATION.—In SE. ¼ SW. ¼ sec. 33, T. 62 N., R. 6 W., at highway bridge, three-fourths mile below Sugar Creek, 3 miles southwest of Canton, Lewis County, and 15 miles above mouth of river.

DRAINAGE AREA.—447 square miles (measured on maps eompiled by United Geological Survey, scale, 1:500,000, and on topographic maps).

RECORDS AVAILABLE.—February 20, 1922, to September 30, 1923.

GAGE.—Chain gage attached to wooden beam between vertical members on upstream side of bridge; read by Fred Schroeder.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and mud; free from vegetation; not permanent. No well-defined control. Banks wooded near edge and cultivated beyond; left bank subject to overflow at extreme high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.10 feet at 5 p. m. March 16 and 7.30 a. m. September 28 (discharge, 2,630 second-feet); minimum discharge, 0.8 second-foot October 15 and August 27–29.

1922–23: Maximum stage recorded, 11.66 feet March 14, 1922 (discharge, 3,270 second-feet); minimum discharge, that of October 15, 1922, and August 27–29, 1923.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter. Rating curves fairly well defined above 14 second-feet. Gage read to hundredths twice daily; readings fairly reliable. Daily discharge December 21 to September 30, except as noted in footnote to table of daily discharge, ascertained by applying mean daily gage height to rating table; shifting-control method used October 1 to December 20. Records fair.

*Discharge measurements of Wyaconda River near Canton, Mo., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 18 | Denison and Austin | 1.47 | 1.6 | Mar. 30 | E. L. Williams | 1.91 | 72 |
| Dec. 28 | W. R. Denison | 1.42 | 5.4 | June 14 | H. C. Beckman | 1.54 | 18 |
| Feb. 21 | do | 1.36 | 3.6 | Sept. 1 | W. S. Frame | 1.52 | 26 |

*Daily discharge, in second-feet, of Wyaconda River near Canton, Mo., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.6 | 22 | 6 | 9 | 84 | 12 | 46 | 17 | 9 | 144 | 1.5 | 27 |
| 2 | 1.5 | 46 | 4.8 | 9 | 31 | 13 | 43 | 16 | 8 | 61 | 1.8 | 20 |
| 3 | 1.6 | 51 | 8 | 9 | 11 | 17 | 39 | 15 | 6 | 58 | 1.6 | 16 |
| 4 | 1.6 | 57 | 9 | 10 | 6 | 30 | 37 | 16 | 4.4 | 50 | 1.8 | 12 |
| 5 | 1.4 | 26 | 8 | 5 | 2 | 53 | 34 | 10 | 6 | 860 | 3.5 | 11 |
| 6 | 7 | 21 | 7 | 6 | 2 | 67 | 46 | 8 | 10 | 465 | 8 | 108 |
| 7 | 7 | 19 | 6 | 7 | 2 | 64 | 37 | 6 | 8 | 278 | 3.5 | 130 |
| 8 | 6 | 14 | 6 | 6 | 2 | 61 | 35 | 5 | 6 | 89 | 147 | 172 |
| 9 | 5 | 12 | 5 | 5 | 2 | 43 | 30 | 4 | 5 | 66 | 98 | 80 |
| 10 | 1.8 | 10 | 4.4 | 6 | 2 | 40 | 25 | 6 | 7 | 47 | 73 | 66 |
| 11 | 1.2 | 10 | 3.2 | 6 | 1 | 43 | 21 | 218 | 16 | 29 | 41 | 64 |
| 12 | 1.0 | 82 | 2.4 | 8 | 1 | 1,800 | 21 | 164 | 51 | 35 | 35 | 54 |
| 13 | 1.0 | 175 | 2.4 | 9 | 1 | 1,620 | 22 | 315 | 40 | 680 | 23 | 45 |
| 14 | 1.0 | 465 | 2.0 | 9 | 1 | 1,340 | 20 | 175 | 18 | 490 | 18 | 30 |
| 15 | .8 | 440 | 1.8 | 11 | 1 | 1,160 | 19 | 70 | 17 | 265 | 20 | 1.1 |
| 16 | .9 | 340 | 1.8 | 9 | 2 | 2,550 | 17 | 46 | 16 | 42 | 20 | .9 |
| 17 | 1.7 | 230 | 1.9 | 11 | 2 | 1,970 | 15 | 43 | 16 | 28 | 20 | .9 |
| 18 | 2.4 | 186 | 1.9 | 12 | 2 | 1,070 | 13 | 43 | 15 | 12 | 18 | .9 |
| 19 | 3.2 | 94 | 1.9 | 12 | 2 | 830 | 12 | 42 | 12 | 11 | 16 | 1.4 |
| 20 | 2.8 | 30 | 1.8 | 12 | 2 | 680 | 12 | 12 | 7 | 10 | 8 | 2.3 |
| 21 | 2.0 | 30 | 2.4 | 12 | 3 | 465 | 11 | 14 | 6 | 8 | 4.4 | 3.8 |
| 22 | 2.8 | 20 | 1.8 | 10 | 3 | 340 | 14 | 12 | 12 | 8 | 2.9 | 4.7 |
| 23 | 2.4 | 15 | 2.0 | 8 | 4 | 440 | 17 | 8 | 18 | 12 | 1.8 | 2.0 |
| 24 | 1.8 | 14 | 2.8 | 8 | 4 | 278 | 22 | 6 | 17 | 11 | 1.6 | 1.5 |
| 25 | 2.0 | 12 | 4.0 | 8 | 8 | 253 | 31 | 6 | 11 | 6 | 1.0 | 1.4 |
| 26 | 1.7 | 19 | 4.0 | 8 | 15 | 218 | 36 | 6 | 2.4 | 7 | .9 | 1.0 |
| 27 | 1.7 | 18 | 3.2 | 10 | 12 | 164 | 34 | 8 | 2.4 | 6 | .9 | 1,550 |
| 28 | 1.8 | 15 | 6 | 19 | 10 | 109 | 21 | 20 | 64 | 8 | .9 | 2,390 |
| 29 | 2.8 | 12 | 4.8 | 43 | ------- | 89 | 20 | 11 | 72 | 3.2 | .8 | 1,100 |
| 30 | 2.0 | 12 | 4.8 | 64 | ------- | 66 | 19 | 10 | 102 | 1.9 | 98 | 1,760 |
| 31 | 3.2 | ------- | 2.8 | 93 | ------- | 53 | ------- | 12 | ------- | 1.5 | 52 | ------- |

NOTE.—Stage-discharge relation affected by ice Feb. 4–20; discharge estimated from gage heights, observer's notes, and weather records. Discharge June 15, Aug. 30, 31, and Sept. 2-4 estimated; gage readings probably in error. Results of discharge measurements used June 14 and Sept. 1.

*Monthly discharge of Wyaconda River near Canton, Mo., for the year ending September 30, 1923*

[Drainage area, 447 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 7 | 0.8 | 2.41 | 0.0054 | 0.006 |
| November | 465 | 10 | 83.2 | .186 | .21 |
| December | 9 | 1.8 | 4.00 | .0089 | .01 |
| January | 93 | 5 | 14.6 | .033 | .04 |
| February | 84 | 1 | 7.79 | .017 | .02 |
| March | 2,550 | 12 | 514 | 1.15 | 1.33 |
| April | 46 | 11 | 25.6 | .057 | .06 |
| May | 315 | 4 | 43.4 | .097 | .11 |
| June | 102 | 2.4 | 19.5 | .044 | .05 |
| July | 860 | 1.5 | 122 | .273 | .31 |
| August | 147 | .8 | 23.4 | .052 | .06 |
| September | 2,390 | .9 | 255 | .570 | .64 |
| The year | 2,550 | .8 | 92.9 | .208 | 2.85 |

### NORTH FABIUS RIVER AT MONTICELLO, MO.

LOCATION.—In SE. ¼ sec. 6, T. 61 N., R. 7 W., at highway bridge 1 mile south of Monticello, Lewis County, and 22 miles above junction with Middle Fabius River.

DRAINAGE AREA.—452 square miles (measured on maps compiled by United States Geological Survey, scale, 1 : 500,000, and on topographic maps).

RECORDS AVAILABLE.—February 18, 1922, to September 30, 1923.

GAGE.—Chain gage fastened to upstream side of bridge; read by Floyd Nelson.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of rock, sand, and silt; clean and fairly permanent. Control is a coarse gravel bar 1½ miles below gage; clean and fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.70 feet at 4.30 p. m. March 16 (discharge, 3,590 second-feet); minimum discharge, 2 second-feet several times during October and December.

1922–1923: Maximum stage recorded, 18.60 feet July 13, 1922 (discharge, 4,500 second-feet); minimum stage, 0.52 foot July 9, 1922 (discharge, 1 second-foot).

ACCURACY.—Stage-discharge relation permanent during year; slightly affected by ice during winter. Rating curve fairly well defined above 12 second-feet. Gage read to hundredths twice daily; readings rather unreliable after June 1. Daily discharge ascertained by applying mean daily gage height to rating table except as explained in footnote to table of daily discharge. Records fair prior to June 1; poor thereafter.

*Discharge measurements of North Fabius River at Monticello, Mo., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 18 | Denison and Austin | 0.77 | 5.3 | Mar. 30 | E. L. Williams | 1.66 | 95 |
| Dec. 28 | W. R. Denison | .94 | 10 | June 14 | H. C. Beckman | 1.35 | 48 |
| Feb. 21 | do | .96 | 9.1 | Sept. 2 | Beckman and Frame | 1.00 | 18 |

*Daily discharge, in second-feet, of North Fabius River at Monticello, Mo., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4 | 25 | 37 | 28 | 76 | 35 | 62 | 32 | 15 | 53 | 4 | ------- |
| 2 | 3 | 65 | 32 | 26 | 69 | 25 | 55 | 27 | 11 | 41 | 4 | ------- |
| 3 | 2 | 73 | 29 | 30 | 29 | 21 | 59 | 22 | 8 | 44 | 3 | ------- |
| 4 | 2 | 47 | 34 | 26 | 22 | 24 | 57 | 17 | 10 | 740 | 142 | ------- |
| 5 | 3 | 36 | 30 | 20 | 17 | 86 | 51 | 13 | 18 | 1,670 | 110 | ------- |
| 6 | 8 | 32 | 23 | 10 | 17 | 110 | 46 | 10 | 75 | 1,580 | 283 | ------- |
| 7 | 13 | 52 | 21 | 8 | 16 | 104 | 42 | 16 | 92 | 1,290 | 196 | ------- |
| 8 | 4 | 64 | 15 | 12 | 14 | 98 | 46 | 21 | 64 | 942 | 142 | 18 |
| 9 | 3 | 55 | 12 | 12 | 12 | 86 | 42 | 28 | 36 | 698 | 122 | 28 |
| 10 | 3 | 48 | 10 | 10 | 7 | 45 | 46 | 38 | 48 | 475 | 116 | 31 |
| 11 | 2 | 27 | 9 | 12 | 8 | 455 | 42 | 45 | ------- | 155 | 98 | 24 |
| 12 | 15 | 62 | 8 | 13 | 12 | 2,110 | 42 | 343 | ------- | 1,210 | 73 | 17 |
| 13 | 16 | 535 | 7 | 16 | 10 | 2,730 | 40 | 435 | ------- | 1,420 | 51 | 16 |
| 14 | 13 | 1,500 | 4 | 22 | 6 | 1,040 | 36 | 328 | ------- | 298 | 37 | 13 |
| 15 | 4 | 555 | 4 | 24 | 5 | 989 | 32 | 298 | ------- | 175 | 29 | 10 |
| 16 | 3 | 268 | 4 | 29 | 6 | 2,700 | 28 | 268 | ------- | 122 | ------- | 6 |
| 17 | 3 | 116 | 4 | 28 | 7 | 635 | 28 | 162 | 44 | 104 | ------- | 5 |
| 18 | 4 | 86 | 2 | 27 | 7 | 535 | 31 | 49 | 39 | 57 | ------- | 6 |
| 19 | 4 | 70 | 2 | 25 | 7 | 475 | 26 | 33 | 34 | 28 | ------- | 4 |
| 20 | 3 | 64 | 2 | 22 | 10 | 415 | 22 | 26 | 30 | 17 | ------- | 5 |
| 21 | 3 | 57 | 2 | 26 | 10 | 360 | 27 | 22 | 35 | 14 | ------- | 5 |
| 22 | 3 | 48 | 2 | 27 | 10 | 313 | 24 | 17 | 25 | 12 | ------- | 4 |
| 23 | 5 | 42 | 2 | 26 | 12 | 635 | 27 | 13 | 24 | 10 | ------- | 6 |
| 24 | 2 | 39 | 2 | 28 | 12 | 396 | 33 | 16 | 20 | 8 | ------- | 1,040 |
| 25 | 8 | 36 | 3 | 26 | 16 | 298 | 38 | 17 | 16 | 8 | ------- | 2,460 |
| 26 | 8 | 36 | 3 | 22 | 24 | 283 | 44 | 15 | 14 | 7 | ------- | 396 |
| 27 | 6 | 34 | 3 | 37 | 44 | 268 | 48 | 15 | 61 | 8 | ------- | 268 |
| 28 | 4 | 30 | 8 | 168 | 40 | 253 | 44 | 13 | 224 | 8 | ------- | 162 |
| 29 | 3 | 31 | 22 | 175 | ------- | 210 | 40 | 30 | 196 | 7 | ------- | 110 |
| 30 | 2 | 36 | 22 | 74 | ------- | 155 | 36 | 28 | 92 | 6 | ------- | 86 |
| 31 | 7 | ------- | 26 | 72 | ------- | 92 | ------- | 17 | ------- | 6 | ------- | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 13–21 and Feb. 18–21; discharge ascertained by applying to rating table mean daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records.

*Monthly discharge of North Fabius River at Monticello, Mo., for the year ending September 30, 1923*

[Drainage area, 452 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 16 | 2 | 5.26 | 0.012 | 0.01 |
| November | 1,500 | 25 | 139 | .308 | .34 |
| December | 37 | 2 | 12.4 | .027 | .03 |
| January | 175 | 8 | 34.9 | .077 | .09 |
| February | 76 | 5 | 18.8 | .042 | .04 |
| March | 2,730 | 21 | 516 | 1.14 | 1.31 |
| April | 62 | 22 | 39.8 | .088 | .10 |
| May | 435 | 10 | 77.9 | .172 | .20 |
| July | 1,670 | 6 | 362 | .801 | .92 |
| August 1–15 | 283 | 3 | 94 | .208 | .12 |
| September 8–30 | 2,460 | 4 | 205 | .454 | .39 |

SALT RIVER NEAR NEW LONDON, MO.

LOCATION.—In NE. ¼ NW. ¼ sec. 36, T. 56 N., R. 5 W., at highway bridge on Hannibal-New London road, 1¼ miles below Turkey Creek, and 2 miles north of New London, Ralls County.

DRAINAGE AREA.—2,480 square miles (measured on topographic and United States soil survey maps).

RECORDS AVAILABLE.—February 16, 1922, to September 30, 1923.

GAGE.—Chain gage bolted to handrail on upstream side of bridge; read by D. W. Lundberg and W. D. Webb.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading 1 mile below gage.

CHANNEL AND CONTROL.—Bed composed of sand and silt; clean and fairly permanent. Control is a clean gravel bar 200 feet below gage.

EXTREMES OF STAGE.—Maximum stage recorded during year, 15.50 feet at 5 p. m., March 12; minimum stage, 1.60 feet July 28, 29, August 2 and 3.

ACCURACY.—Stage-discharge relation not permanent. Gage read to hundredths twice daily. Data insufficient for determination of daily discharge.

*Discharge measurements of Salt River near New London, Mo., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 17 | Denison and Austin | 1.98 | 40 | Mar. 31 | E. L. Williams | 2.63 | 264 |
| Dec. 28 | W. R. Denison | 1.89 | 31 | June 14 | H. C. Beckman | 2.38 | 165 |
| Feb. 20 | do | 2.07 | 53 | Sept. 1 | W. S. Frame | 2.14 | 83 |

*Daily gage height, in feet, of Salt River near New London, Mo., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.96 | 1.79 | 2.03 | 1.88 | 1.96 | 1.83 | 2.45 | 2.45 | ------- | ------- | 1.70 | 2.10 |
| 2 | 1.95 | 2.04 | 1.99 | 1.86 | 1.97 | 1.86 | 2.40 | 2.51 | ------- | 2.90 | 1.61 | 2.14 |
| 3 | 1.94 | 1.99 | 1.96 | 1.85 | 1.99 | 1.86 | 2.32 | 2.44 | ------- | 2.85 | 1.62 | 2.14 |
| 4 | 1.92 | 1.90 | 1.91 | 1.84 | 2.04 | 1.96 | ------- | 2.37 | ------- | 2.75 | 1.64 | 2.07 |
| 5 | 1.91 | 1.87 | 1.89 | 1.82 | 2.09 | 1.95 | ------- | 2.26 | ------- | 6.92 | 1.64 | 2.11 |
| 6 | 2.38 | 1.94 | 1.87 | 1.82 | 2.13 | 2.10 | ------- | 2.18 | ------- | ------- | 2.60 | 2.04 |
| 7 | 4.17 | 2.09 | 1.84 | 1.82 | 2.13 | 2.17 | 4.90 | ------- | 2.89 | ------- | 2.00 | 2.50 |
| 8 | 3.84 | 2.35 | 1.81 | 1.87 | 2.09 | 2.71 | 3.92 | ------- | 2.73 | ------- | 2.52 | 2.25 |
| 9 | 3.38 | 2.50 | 1.80 | 1.91 | 2.07 | 2.84 | 3.30 | ------- | 2.50 | ------- | 2.79 | 2.45 |
| 10 | 2.88 | 2.30 | 1.96 | 1.93 | 2.03 | 2.71 | 2.85 | 2.12 | 2.43 | ------- | 3.26 | 2.78 |
| 11 | 2.30 | 2.65 | 2.16 | 1.93 | 1.99 | 2.60 | 2.72 | 2.10 | 2.34 | ------- | 6.70 | 2.46 |
| 12 | 2.27 | 4.90 | 2.25 | 1.91 | 1.99 | 13.53 | 2.62 | 2.11 | 2.40 | ------- | 6.12 | 2.18 |
| 13 | 2.20 | 4.42 | 2.17 | 1.88 | 2.03 | 13.86 | 2.57 | 2.47 | 2.32 | ------- | 4.70 | 2.21 |
| 14 | 2.10 | 5.25 | 2.15 | 1.89 | 2.05 | 9.28 | 2.46 | 2.36 | 2.37 | 2.50 | 3.65 | 2.11 |
| 15 | 2.01 | 5.70 | 2.13 | 1.92 | 2.09 | 8.25 | 2.41 | 2.56 | 2.42 | 2.80 | 3.00 | 2.11 |
| 16 | 1.93 | 5.38 | 2.06 | 1.95 | 2.12 | 12.25 | 2.35 | 2.80 | 2.40 | 2.48 | 10.65 | 2.03 |
| 17 | 1.95 | 4.72 | 2.01 | 1.96 | 2.10 | 10.75 | 2.25 | 2.59 | 3.30 | 2.15 | 11.50 | 1.90 |
| 18 | 1.93 | 3.96 | 1.97 | 1.98 | 2.09 | 7.80 | 2.12 | 2.51 | 3.95 | 2.46 | 8.90 | 2.27 |
| 19 | 1.91 | 3.02 | 1.92 | 1.97 | 2.07 | 6.65 | 2.27 | 2.47 | 3.80 | 2.45 | 7.10 | 2.17 |
| 20 | 1.88 | 2.81 | 1.85 | 1.95 | 2.00 | 5.95 | 2.29 | 2.42 | 3.30 | 2.28 | 5.50 | 2.36 |
| 21 | 1.85 | 2.62 | 1.84 | 1.96 | 1.96 | 5.15 | 2.27 | 2.34 | 3.03 | 2.16 | 4.40 | 2.34 |
| 22 | 1.83 | 2.54 | 1.86 | 1.99 | 1.93 | 3.60 | 2.19 | 2.28 | 2.58 | 2.09 | 3.45 | 2.26 |
| 23 | 1.79 | 2.47 | 1.87 | 2.03 | 1.89 | 3.40 | 2.36 | 2.14 | 2.15 | 2.00 | 2.85 | 2.15 |
| 24 | 1.78 | 2.41 | 1.84 | 2.03 | 1.86 | 3.33 | 3.48 | 2.36 | 1.92 | 1.93 | 2.60 | 1.99 |
| 25 | 1.76 | 2.37 | 1.86 | 2.01 | 1.88 | 3.26 | 3.12 | 2.69 | ------- | 1.90 | 2.47 | 1.98 |
| 26 | 1.75 | 2.30 | 1.87 | 2.02 | 1.91 | 3.24 | 2.77 | 2.98 | ------- | 1.86 | 2.41 | 1.98 |
| 27 | 1.72 | 2.22 | 1.88 | 2.04 | 1.91 | 3.15 | 2.87 | ------- | ------- | 1.82 | 2.37 | 2.05 |
| 28 | 1.71 | 2.17 | 1.88 | 1.99 | 1.88 | 2.95 | 2.93 | ------- | ------- | 1.60 | 2.29 | 2.27 |
| 29 | 1.68 | 2.14 | 1.87 | 1.95 | ------- | 2.87 | 2.75 | ------- | ------- | 1.65 | 2.18 | 2.13 |
| 30 | 1.67 | 2.10 | 1.87 | 1.93 | ------- | 2.66 | 2.31 | ------- | ------- | 1.71 | 2.10 | 2.35 |
| 31 | 1.66 | ------- | 1.87 | 1.93 | ------- | 2.57 | ------- | ------- | ------- | 1.73 | 2.10 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 10-20 and Feb. 4-10.

### CUIVRE RIVER NEAR TROY, MO.

LOCATION.—In SW. ¼ sec. 18, T. 49 N., R. 1 E., at Frenchman Bluff highway bridge, 1½ miles above Sugar Creek, 3 miles northeast of Troy, Lincoln County, and 4 miles below West Fork.

DRAINAGE AREA.—908 square miles (measured on topographic maps).

RECORDS AVAILABLE.—February 15, 1922, to September 30, 1923.

GAGE.—Chain gage bolted to handrail on upstream side of bridge; read by C. D. Barrett and Hester Kolb.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of silt, sand, and gravel; clean except for drift. Left bank high and rocky; right bank wooded; subject to overflow at extreme high stages. Control is a coarse gravel bar 300 feet below gage; clean except for brush growing on exposed part; fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 22.46 feet at noon March 12 (discharge, 22,600 second-feet); minimum stage, 1.20 feet at 5 p. m. December 6 (discharge, 5 second-feet).

1922–23: Maximum stage recorded, 23.90 feet March 14, 1922 (discharge, 24,900 second-feet); minimum stage that of December 6, 1922.

ACCURACY.—Stage-discharge relation permanent during year; slightly affected by ice. Rating curve well defined between 25 and 18,000 second-feet and extended beyond these limits. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except as noted in footnote to table of daily discharge. Records good.

*Discharge measurements of Cuivre River near Troy, Mo., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Oct. 16 | Denison and Austin | 1.97 | 29 | June 13 | H. C. Beckman | 3.17 | 217 |
| Dec. 27 | W. R. Denison | 1.92 | 26 | Aug. 31 | W. S. Frame | 2.13 | 47 |
| Feb. 20 | do | 2.34 | 63 | | | | |

*Daily discharge, in second-feet, of Cuivre River near Troy, Mo., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 395 | 21 | 50 | 121 | 58 | 107 | 114 | 64 | 114 | 10 | 56 |
| 2 | 6 | 1,040 | 12 | 48 | 363 | 48 | 80 | 107 | 463 | 82 | 11 | 52 |
| 3 | 6 | 395 | 9 | 97 | 177 | 60 | 107 | 97 | 72 | 613 | 10 | 67 |
| 4 | 6 | 249 | 7 | 74 | 157 | 139 | 74 | 82 | 62 | 188 | 199 | 88 |
| 5 | 6 | 139 | 6 | 74 | 121 | 499 | 2,260 | 80 | 54 | 613 | 199 | 733 |
| 6 | 5,340 | 463 | 5 | 48 | 82 | 945 | 1,340 | 77 | 48 | 333 | 14,400 | 2,660 |
| 7 | 3,660 | 223 | 2,820 | 44 | 74 | 1,490 | 693 | 74 | 52 | 148 | 945 | 1,240 |
| 8 | 1,090 | 177 | 1,140 | 40 | 62 | 693 | 395 | 72 | 40 | 85 | 395 | 463 |
| 9 | 653 | 88 | 855 | 37 | 52 | 395 | 275 | 62 | 26 | 64 | 463 | 223 |
| 10 | 177 | 62 | 499 | 33 | 37 | 303 | 223 | 58 | 37 | 49 | 499 | 139 |
| 11 | 85 | 51 | 177 | 32 | 29 | 613 | 177 | 56 | 148 | 42 | 855 | 103 |
| 12 | 64 | 157 | 148 | 30 | 23 | 22,000 | 157 | 855 | 535 | 262 | 395 | 77 |
| 13 | 46 | 249 | 121 | 30 | 1,090 | 4,740 | 613 | 249 | 199 | 103 | 177 | 67 |
| 14 | 42 | 945 | 88 | 69 | 773 | 1,190 | 613 | 68 | 88 | 56 | 945 | 58 |
| 15 | 40 | 249 | 62 | 499 | 275 | 3,140 | 318 | 114 | 535 | 60 | 6,900 | 52 |
| 16 | 33 | 157 | 52 | 348 | 232 | 6,300 | 249 | 103 | 429 | 44 | 18,000 | 46 |
| 17 | 32 | 139 | 42 | 333 | 189 | 1,720 | 199 | 85 | 188 | 91 | 14,600 | 38 |
| 18 | 21 | 121 | 26 | 121 | 146 | 980 | 157 | 97 | 110 | 52 | 945 | 50 |
| 19 | 20 | 100 | 25 | 91 | 103 | 613 | 139 | 223 | 77 | 33 | 463 | 52 |
| 20 | 18 | 74 | 23 | 85 | 60 | 463 | 139 | 148 | 56 | 25 | 303 | 77 |
| 21 | 16 | 62 | 32 | 67 | 52 | 412 | 177 | 103 | 44 | 21 | 211 | 80 |
| 22 | 16 | 52 | 27 | 54 | 46 | 363 | 157 | 82 | 38 | 19 | 139 | 54 |
| 23 | 15 | 48 | 26 | 48 | 44 | 289 | 412 | 72 | 33 | 16 | 139 | 46 |
| 24 | 14 | 46 | 25 | 44 | 46 | 249 | 773 | 64 | 167 | 14 | 121 | 44 |
| 25 | 13 | 44 | 25 | 33 | 38 | 236 | 363 | 62 | 148 | 11 | 94 | 32 |
| 26 | 13 | 42 | 26 | 37 | 44 | 199 | 249 | 62 | 107 | 10 | 88 | 37 |
| 27 | 12 | 37 | 27 | 35 | 50 | 167 | 211 | 110 | 3,060 | 12 | 80 | 33 |
| 28 | 11 | 26 | 24 | 35 | 52 | 157 | 177 | 72 | 900 | 11 | 62 | 32 |
| 29 | 11 | 25 | 23 | 33 | ------- | 139 | 157 | 139 | 379 | 12 | 56 | 30 |
| 30 | 10 | 24 | 22 | 33 | ------- | 139 | 121 | 85 | 199 | 11 | 52 | 318 |
| 31 | 10 | ------- | 46 | 46 | ------- | 114 | ------- | 100 | ------- | 10 | 50 | ------- |

NOTE.—Discharge estimated Dec. 13–15 on account of ice, and Feb. 16–19 on account of no gage readings.

*Monthly discharge of Cuivre River near Troy, Mo., for the year ending September 30, 1923*

[Drainage area, 908 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 5,340 | 6 | 371 | 0.409 | 0.47 |
| November | 1,040 | 24 | 196 | .216 | .24 |
| December | 2,820 | 5 | 208 | .229 | .26 |
| January | 499 | 30 | 85.4 | .094 | .11 |
| February | 1,090 | 23 | 162 | .178 | .19 |
| March | 22,000 | 48 | 1,580 | 1.74 | 2.01 |
| April | 2,260 | 74 | 370 | .407 | .45 |
| May | 855 | 56 | 121 | .133 | .15 |
| June | 3,060 | 26 | 279 | .307 | .34 |
| July | 613 | 10 | 103 | .113 | .13 |
| August | 18,000 | 10 | 1,990 | 2.19 | 2.52 |
| September | 2,660 | 30 | 235 | .259 | .29 |
| The year | 22,000 | 5 | 475 | .523 | 7.16 |

### DES PLAINES RIVER AT LEMONT, ILL.

LOCATION.—In sec. 20, T. 37 N., R. 11 E., at concrete highway bridge at Stephens Street, a quarter of a mile north of main section of Lemont, Cook County, and 8 miles above junction of Des Plaines River and the Chicago Drainage Canal.

DRAINAGE AREA.—705 square miles.

RECORDS AVAILABLE.—November 4, 1914, to September 30, 1923.

GAGE.—Staff gage attached to bridge; read by William Weck, jr.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge and by wading below dam.

CHANNEL AND CONTROL.—Concrete dam 500 feet below gage; permanent except for slight repairs in August, 1920.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.78 feet August 13 (discharge, 3,750 second-feet); minimum stage, 2.50 feet at various times (discharge, 6 second-feet).

1915–1923: Maximum open-water stage recorded, 6.5 feet March 18, 1919 (discharge, 5,520 second-feet); minimum discharge, no flow, occurred September 7, 8, 14–21, and 24–27, 1919, and July 25–31, 1921.

ICE.—Stage-discharge relation not seriously affected by ice.

DIVERSIONS.—During extreme high water part of flow spills over into the Chicago Drainage Canal at Willow Springs 7 miles above the station. Records of this overflow furnished by the Sanitary District of Chicago, for the years 1915 to 1919 were published in Water-Supply Paper 505. An estimate of the overflow during the years 1920 to 1923 has been made from gage heights at Lemont, assuming that the relation between such gage heights and amount of overflow was the same as in 1918 and 1919, and is given below:

*Overflow from Des Plaines River into Chicago Drainage Canal at Willow Springs, Ill.*

| Date | Overflow | Date | Overflow |
|---|---|---|---|
| 1920 | *Sec.-ft.* | 1921 | *Sec.-ft.* |
| Mar. 12 | 740 | Apr. 27 | 50 |
| 13 | 480 | 28 | 150 |
| 14 | 1,060 | 29 | 150 |
| 15 | 280 | 30 | 50 |
| 16 | 480 | Dec. 18 | 480 |
| 17 | 150 | 19 | 1,440 |
| 18 | 25 | 20 | 480 |
| 25 | 50 | | |
| 26 | 2,650 | 1922 | |
| 27 | 3,100 | Apr. 1 | 150 |
| 28 | 2,240 | 2 | 280 |
| 29 | 2,240 | 3 | 150 |
| 30 | 740 | 11 | 740 |
| 31 | 480 | 12 | 150 |
| Apr. 1 | 50 | 13 | 50 |
| 1921 | | 1923 | |
| Apr. 25 | 50 | Aug. 13 | 1,840 |
| 26 | 50 | 14 | 1,440 |

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 50 and 5,500 second-feet; fairly well defined below 50 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as explained in footnote to table of daily discharge. Records good for medium and high stages, fair for low stages.

No discharge measurements were made at this station during the year.

*Daily discharge, in second-feet, of Des Plaines River at Lemont, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 18 | 60 | 31 | 64 | 63 | 790 | 68 | 31 | 48 | 18 | 385 |
| 2 | 6 | 25 | 68 | 31 | 68 | 93 | 660 | 78 | 31 | 48 | 18 | 350 |
| 3 | 12 | 31 | 68 | 31 | 64 | 106 | 620 | 93 | 25 | 37 | 6 | 245 |
| 4 | 18 | 31 | 60 | 34 | 60 | 120 | 620 | 93 | 6 | 25 | 6 | 180 |
| 5 | 18 | 18 | 60 | 37 | 54 | 150 | 620 | 93 | 6 | 18 | 18 | 212 |
| 6 | 31 | 6 | 48 | 37 | 48 | 212 | 580 | 78 | 31 | 18 | 31 | 315 |
| 7 | 48 | 18 | 48 | 37 | 48 | 280 | 540 | 68 | 93 | 18 | 31 | 385 |
| 8 | 68 | 18 | 48 | 37 | 48 | 245 | 700 | 68 | 120 | 6 | 93 | 371 |
| 9 | 68 | 31 | 48 | 37 | 40 | 180 | 835 | 68 | 245 | 6 | 68 | 350 |
| 10 | 93 | 31 | 68 | 42 | 31 | 138 | 880 | 68 | 180 | 18 | 245 | 315 |
| 11 | 108 | 31 | 93 | 48 | 40 | 315 | 880 | 68 | 120 | 18 | 880 | 315 |
| 12 | 93 | 48 | 93 | 48 | 48 | 580 | 835 | 93 | 93 | 25 | 2,310 | 245 |
| 13 | 60 | 68 | 93 | 48 | 48 | 620 | 790 | 120 | 93 | 31 | 3,750 | 350 |
| 14 | 48 | 68 | 93 | 42 | 48 | 620 | 790 | 120 | 93 | 31 | 3,540 | 385 |
| 15 | 37 | 83 | 93 | 37 | 42 | 620 | 790 | 150 | 78 | 31 | 2,310 | 385 |
| 16 | 31 | 83 | 93 | 42 | 36 | 745 | 620 | 245 | 68 | 48 | 1,780 | 245 |
| 17 | 31 | 93 | 93 | 48 | 30 | 880 | 580 | 540 | 48 | 48 | 745 | 212 |
| 18 | 25 | 108 | 80 | 48 | 25 | 1,300 | 540 | 700 | 31 | 37 | 580 | 212 |
| 19 | 18 | 93 | 68 | 48 | 25 | 1,480 | 540 | 580 | 25 | 25 | 540 | 168 |
| 20 | 18 | 93 | 76 | 42 | 25 | 1,600 | 500 | 422 | 18 | 6 | 422 | 120 |
| 21 | 6 | 78 | 83 | 37 | 28 | 1,780 | 460 | 245 | 6 | 6 | 350 | 385 |
| 22 | 6 | 68 | 88 | 42 | 31 | 2,040 | 422 | 212 | 6 | 18 | 245 | 500 |
| 23 | 6 | 68 | 93 | 48 | 28 | 2,310 | 385 | 212 | 25 | 31 | 212 | 620 |
| 24 | 31 | 68 | 93 | 40 | 25 | 2,310 | 315 | 150 | 18 | 68 | 120 | 790 |
| 25 | 40 | 68 | 93 | 31 | 28 | 2,170 | 245 | 150 | 6 | 120 | 150 | 790 |
| 26 | 48 | 60 | 93 | 46 | 31 | 1,910 | 232 | 132 | 25 | 120 | 245 | 700 |
| 27 | 48 | 48 | 76 | 60 | 31 | 1,660 | 180 | 120 | 31 | 108 | 980 | 620 |
| 28 | 31 | 48 | 60 | 60 | 31 | 1,300 | 150 | 108 | 48 | 93 | 620 | 540 |
| 29 | 31 | 37 | 64 | 60 | ------- | 1,190 | 150 | 93 | 68 | 78 | 540 | 500 |
| 30 | 25 | 37 | 68 | 60 | ------- | 1,140 | 68 | 93 | 48 | 31 | 500 | 422 |
| 31 | 18 | ------- | 31 | 60 | ------- | 880 | ------- | 93 | ------- | 25 | 422 | ------- |

NOTE.—Gage read every other day Dec. 18 to Mar. 3; discharge interpolated for days when gage was not read. Discharge estimated from observer's notes and weather records Dec. 13–17, Jan. 9 and 10, Feb. 14–16 on account of gage readings being taken to top of ice.

*Monthly discharge of Des Plaines River at Lemont, Ill., for the year ending September 30, 1923*

[Drainage area, 705 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 108 | 6 | 36.5 | 0.052 | 0.06 |
| November | 108 | 6 | 52.5 | .074 | .08 |
| December | 93 | 31 | 74.0 | .105 | .12 |
| January | 60 | 31 | 43.5 | .062 | .07 |
| February | 68 | 25 | 40.2 | .057 | .06 |
| March | 2,310 | 63 | 936 | 1.33 | 1.53 |
| April | 880 | 68 | 544 | .772 | .86 |
| May | 700 | 68 | 175 | .248 | .29 |
| June | 245 | 6 | 57.2 | .081 | .09 |
| July | 120 | 6 | 40.0 | .057 | .07 |
| August | 3,750 | 6 | 702 | .996 | 1.15 |
| September | 790 | 120 | 387 | .549 | .61 |
| The year | 3,750 | 6 | 259 | .367 | 4.99 |

NOTE.—See paragraph on "Diversions."

**DES PLAINES RIVER AT JOLIET, ILL.**

LOCATION.—In NE. ¼ sec. 9, T. 35 N., R. 10 E., at Jackson Street Bridge, Joliet, Will County, 1,200 feet upstream from Cass Street Bridge.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—December 3, 1914, to September 30, 1923, on original chain gage September 5 to December 19, 1914.

GAGE.—Gurley seven-day water-stage recorder installed December 3, 1914. Chain gage attached to upstream side of bridge at Cass Street read from September 5 to December 19, 1914.

DISCHARGE MEASUREMENTS.—Made from upstream side of Cass Street Bridge.

CHANNEL AND CONTROL.—Channel excavated in solid rock, with a concrete wall on either side; permanent.

EXTREMES OF DISCHARGE.—Maximum mean daily discharge during days of record for the year 10,800 second-feet August 14, minimum mean daily discharge 6,560 second-feet, May 6.

1914–1923: Maximum mean daily discharge during days of record, 18,400 second-feet, March 18, 1919; minimum mean daily discharge, 5,420 second-feet, April 25, 1915.

ICE.—Stage-discharge relation not affected by ice.

REGULATION.—Flow past gage is largely regulated by operation of power plant of Chicago Sanitary District at Lockport, which utilizes flow of Chicago Drainage Canal and, to a lesser extent, by operation of Economy Light & Power Co.'s plant, 100 feet above gage.

DIVERSIONS.—Water is diverted to Illinois and Michigan Canal at Dam No. 1 100 feet above gage.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Operation of water-stage recorder satisfactory except as explained in the footnote to table of daily discharge. Daily discharge ascertained by use of discharge integrator. Records excellent, except for a few short periods when recording gage was not operating, for which they are fair.

No discharge measurements were made at this station during the year.

*Daily discharge, in second-feet, of Des Plaines River at Joliet, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 8,240 | 8,840 | [b]8,400 | [a]7,500 | 8,020 | 7,790 | 7,620 | 8,560 | 8,360 | 7,360 | 8,060 | 8,750 |
| 2 | 9,230 | 9,250 | [a]8,260 | [a]8,500 | 8,320 | 7,920 | 8,320 | 8,380 | 7,540 | [a]8,410 | 8,150 | 8,640 |
| 3 | 8,920 | 8,790 | 7,050 | [a]8,500 | 7,840 | 7,840 | 8,950 | 8,300 | 7,320 | | 8,090 | 8,330 |
| 4 | 8,880 | 8,760 | 8,530 | [a]8,500 | 7,460 | 6,980 | 9,020 | 8,410 | 8,550 | {8,250 | 7,850 | 9,040 |
| 5 | 8,940 | 7,570 | 8,320 | [a]8,500 | 8,740 | 8,060 | 9,170 | 7,920 | 8,770 | | 7,980 | [b]8,950 |
| 6 | 8,830 | 8,730 | [a]8,400 | [a]8,500 | 8,430 | 8,640 | 8,920 | 6,560 | 8,820 | [a]8,400 | 8,380 | [b]8,900 |
| 7 | 8,300 | 9,100 | [b]8,400 | [a]7,500 | 7,880 | 8,120 | 8,900 | 8,330 | 8,920 | [a]8,400 | 8,550 | [a]8,800 |
| 8 | 8,780 | 8,740 | [a]8,500 | [a]8,500 | 7,880 | 8,390 | 8,140 | 8,640 | [a]8,580 | | 8,440 | 8,800 |
| 9 | 9,560 | 8,520 | 9,100 | [a]8,600 | 7,820 | 8,220 | 9,620 | 8,500 | 7,760 | | 9,000 | 8,760 |
| 10 | 9,790 | 8,740 | 7,200 | 8,620 | 7,780 | 7,440 | 9,310 | 8,390 | 7,450 | {8,250 | 7,160 | 9,350 |
| 11 | 9,390 | 8,360 | 8,160 | 8,260 | 6,840 | 6,840 | 9,560 | 8,750 | 8,520 | | 9,560 | 9,120 |
| 12 | 9,490 | 7,410 | [a]7,990 | 8,260 | 7,700 | 7,820 | 9,160 | 7,800 | 8,630 | [a]8,400 | 10,400 | [a]8,900 |
| 13 | 9,160 | 9,250 | | 8,150 | 7,880 | 10,000 | 9,150 | 6,610 | 8,590 | 8,340 | 10,500 | 8,760 |
| 14 | 8,560 | [b]9,000 | | 7,430 | 7,540 | [a]9,500 | 8,720 | 8,470 | 8,430 | 8,150 | 10,800 | 8,440 |
| 15 | 8,200 | [b]8,750 | | 8,140 | [a]7,500 | [b]9,000 | | 8,580 | 8,350 | 7,500 | 10,300 | 8,740 |
| 16 | 9,080 | [a]8,500 | | 8,060 | [b]7,500 | [b]9,000 | | 9,930 | [a]8,500 | 8,520 | 9,440 | 8,520 |
| 17 | 8,850 | 8,500 | {8,250 | 7,980 | [a]7,800 | [a]9,000 | {8,750 | 8,980 | | 8,570 | 9,380 | 8,660 |
| 18 | 8,460 | 8,630 | | 7,830 | 6,770 | 8,720 | | 8,600 | | 8,740 | 8,780 | 8,100 |
| 19 | 8,140 | 7,440 | | 7,920 | 7,940 | 9,680 | | 8,390 | | 8,460 | 8,670 | 8,110 |
| 20 | 8,880 | 8,520 | | 7,910 | 7,700 | 8,440 | [a]8,600 | 7,560 | {8,250 | 8,780 | 7,500 | 8,740 |
| 21 | 8,610 | 9,520 | | 7,200 | 7,830 | 8,150 | 8,400 | 6,630 | | 7,380 | 8,670 | 9,180 |
| 22 | 7,680 | 8,540 | [a]8,500 | 8,080 | 7,710 | 9,110 | 7,020 | 8,720 | [a]8,200 | 7,460 | 8,380 | 8,450 |
| 23 | 8,930 | 8,360 | [a]8,250 | 8,220 | 7,900 | 9,420 | 8,900 | 8,860 | 7,940 | 8,510 | 8,640 | 8,710 |
| 24 | 8,520 | 8,630 | [a]7,500 | 8,090 | 7,850 | 9,300 | 9,010 | 8,900 | 7,370 | 8,160 | 8,530 | 9,240 |
| 25 | 8,230 | 8,580 | [a]7,500 | 8,470 | 7,020 | 9,180 | 8,680 | [a]8,820 | 8,280 | 8,550 | 8,040 | 9,160 |
| 26 | 8,260 | 7,280 | [a]8,250 | 8,410 | 8,720 | 10,600 | 8,670 | [a]8,500 | 8,770 | 8,580 | 7,940 | 8,900 |
| 27 | 8,580 | 8,500 | [a]8,500 | 7,600 | 8,100 | 9,860 | 8,460 | 7,900 | 8,520 | 8,480 | 8,680 | 8,730 |
| 28 | 8,390 | [a]8,500 | [a]8,500 | 7,260 | 8,320 | 9,680 | 7,720 | 8,520 | [a]8,500 | 7,650 | 8,900 | [b]8,750 |
| 29 | 7,320 | [b]8,500 | [a]8,200 | 8,180 | ------- | 8,890 | 6,660 | 8,880 | [a]8,250 | 7,520 | [a]8,700 | [a]9,000 |
| 30 | 8,740 | [b]8,500 | [a]8,000 | 7,950 | ------- | 8,850 | 8,130 | 7,660 | 7,700 | 8,570 | 8,620 | 8,560 |
| 31 | 8,710 | ------- | [a]7,500 | 8,360 | ------- | 9,320 | ------- | 8,380 | ------- | 8,280 | 8,840 | ------- |

[a] Discharge partly estimated because of incomplete gage record. [b] No record, discharge estimated.

NOTE.—Daily discharge in the above table does not include the flow in the Illinois and Michigan Canal (see "Diversions" in the station description). Braced figures give estimated mean discharge for period indicated.

*Monthly discharge, in second-feet, of Des Plaines River at Joliet, Ill., for the year ending September 30, 1923*

| Month | Maximum | Minimum | Mean | Month | Maximum | Minimum | Mean |
|---|---|---|---|---|---|---|---|
| October | 9,790 | 7,320 | 8,700 | May | 9,930 | 6,560 | 8,300 |
| November | 9,520 | 7,280 | 8,540 | June | | 7,320 | 8,260 |
| December | | | 8,170 | July | | | 8,220 |
| January | | 7,200 | 8,100 | August | 10,800 | 7,160 | 8,740 |
| February | 8,740 | 6,770 | 7,810 | September | 9,350 | 8,100 | 8,770 |
| March | 10,600 | 6,980 | 8,700 | | | | |
| April | 9,620 | 6,660 | 8,600 | The year | 10,800 | 6,560 | 8,410 |

### ILLINOIS RIVER AT MORRIS, ILL.

LOCATION.—In sec. 9, T. 33 N., R. 7 E. third principal meridian, at highway bridge in Morris, Grundy County, 7 miles below station formerly maintained near Minooka and 10 miles below mouth of Kankakee River.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—October 1, 1919, to September 30, 1923; January 1, 1903, to December 13, 1904, for the station near Minooka. Present gage established by United States Weather Bureau on March 1, 1916; staff gage at apparently same datum was read by United States Engineer Corps December 10, 1899, to November 30, 1900, and April 20, 1903, to December 11, 1904.

GAGE.—Chain gage attached to bridge, read by employee of United States Weather Bureau.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Right bank high; left bank overflowed at extremely high stages. Control probably a few miles below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.8 feet March 17 (discharge, 26,600 second-feet); minimum stage, 5.7 feet February 12 (discharge, 8,600 second-feet).

1919–1923: Maximum stage recorded, 20.1 feet April 12, 1922 (discharge 60,000 second-feet); minimum stage, 5.2 feet August 9, 1920 (discharge, 7,600 second-feet).

A discharge of 67,800 second-feet occurred at 8 a. m. March 26, 1904, at station near Minooka.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—The flow at this station includes the flow from the Chicago Drainage Canal. Operation of power plants at Lockport and Joliet above gage causes a considerable diurnal fluctuation at low and medium stages.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 8,000 and 50,000 second-feet, fairly well defined beyond these limits. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for medium and high stages, fair for low stages.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

No discharge measurements were made at this station during the year.

*Daily discharge, in second-feet, of Illinois River at Morris, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10,100 | 10,500 | 9,420 | 9,420 | 10,100 | 10,800 | 14,400 | 10,500 | 14,100 | 9,420 | 9,420 | 10,500 |
| 2 | 9,640 | 10,800 | 10,100 | 8,800 | 9,860 | 10,800 | 12,900 | 10,800 | 13,400 | 9,200 | 9,200 | 11,000 |
| 3 | 10,300 | 11,000 | 10,300 | 9,860 | 9,860 | 11,200 | 13,100 | 10,500 | 12,900 | 9,860 | 10,100 | 11,200 |
| 4 | 10,300 | 10,500 | 9,200 | 9,860 | | 13,600 | 13,800 | 10,500 | 11,700 | 10,100 | 9,860 | 11,400 |
| 5 | 10,500 | 11,200 | 10,300 | 9,860 | | 11,000 | 13,600 | 10,300 | 11,700 | 9,420 | 9,420 | 11,900 |
| 6 | 10,500 | 9,640 | 10,100 | 9,640 | 9,500 | 12,200 | 13,600 | 10,500 | 11,900 | 9,640 | 9,640 | 12,400 |
| 7 | 10,300 | 10,100 | 10,300 | 10,300 | | 12,200 | 13,600 | 8,800 | 14,800 | 9,860 | 9,640 | 12,600 |
| 8 | 10,100 | 11,000 | 10,500 | 9,200 | 9,420 | 11,400 | 14,100 | 10,500 | 18,200 | 9,640 | 11,400 | 12,200 |
| 9 | 9,640 | 10,100 | 10,500 | 9,860 | 9,200 | 11,400 | 13,400 | 10,500 | 14,800 | 9,420 | 11,000 | 11,900 |
| 10 | 10,300 | 10,500 | 10,800 | 9,860 | 9,200 | 11,200 | 15,100 | 10,300 | 12,600 | 9,860 | 11,700 | 11,900 |
| 11 | 11,400 | 10,500 | 9,420 | 9,640 | 9,860 | 10,800 | 14,400 | 10,100 | 11,700 | 10,300 | 9,860 | 11,700 |
| 12 | 11,000 | 10,800 | 10,300 | 9,640 | 8,600 | 11,000 | 14,100 | 11,200 | 11,900 | 10,100 | 12,600 | 11,700 |
| 13 | 11,200 | 8,800 | 9,640 | 9,640 | 9,200 | 22,000 | 13,600 | 9,860 | 11,700 | 10,500 | 12,600 | 11,400 |
| 14 | 10,800 | 11,400 | 9,860 | 9,860 | 9,420 | 20,900 | 13,100 | 11,400 | 11,400 | 9,860 | 13,600 | 11,000 |
| 15 | 11,400 | 10,800 | 10,100 | 9,640 | | 19,800 | 12,600 | 14,100 | 11,200 | 9,860 | 13,400 | 10,500 |
| 16 | 9,860 | 10,800 | 10,100 | 9,420 | | 24,900 | 11,700 | 20,600 | 11,200 | 9,200 | 12,600 | 11,200 |
| 17 | 10,800 | 10,800 | 10,100 | 9,200 | | 26,600 | 12,600 | 24,400 | 9,860 | 9,860 | 11,400 | 10,500 |
| 18 | 11,000 | 10,800 | 10,300 | 9,420 | | 25,500 | 11,200 | 23,300 | 10,100 | 9,860 | 11,700 | 10,500 |
| 19 | 10,500 | 11,200 | 9,860 | 9,860 | | 24,900 | 11,900 | 22,500 | 10,500 | 9,860 | 11,000 | 10,100 |
| 20 | 9,860 | 9,640 | 9,860 | 9,860 | 9,300 | 23,600 | 11,700 | 21,200 | 10,500 | 9,860 | 10,300 | 10,100 |
| 21 | 11,000 | 10,500 | 10,100 | 10,100 | | 22,200 | 11,400 | 19,300 | 10,300 | 9,860 | 10,300 | 10,500 |
| 22 | 11,000 | 11,000 | 9,200 | 9,000 | | 20,600 | 11,700 | 18,200 | 10,300 | 9,420 | 10,100 | 11,000 |
| 23 | 9,860 | 10,800 | 9,640 | 9,200 | | 20,400 | 10,500 | 16,700 | 10,100 | 9,200 | 9,860 | 10,500 |
| 24 | 9,860 | 10,800 | 9,640 | 9,640 | | 19,800 | 11,400 | 15,600 | 9,640 | 9,860 | 9,860 | 11,000 |
| 25 | 10,100 | 10,800 | 10,100 | 9,420 | | 19,300 | 11,400 | 14,600 | 9,200 | 9,200 | 9,860 | 11,200 |
| 26 | 9,860 | 10,800 | 9,200 | 9,640 | 9,200 | 18,200 | 11,200 | 13,800 | 10,100 | 9,420 | 9,640 | 11,400 |
| 27 | 10,100 | 9,420 | 9,420 | 9,640 | 11,000 | 18,500 | 11,200 | 13,600 | 10,100 | 9,860 | 9,000 | 11,200 |
| 28 | 10,300 | 10,500 | 9,640 | 10,100 | 10,800 | 17,200 | 11,200 | 15,100 | 10,100 | 9,860 | 9,640 | 10,800 |
| 29 | 10,500 | 10,500 | 10,100 | 8,800 | ------- | 16,100 | 10,500 | 15,100 | 9,640 | 9,420 | 9,860 | 10,800 |
| 30 | 8,800 | 10,800 | 10,100 | 9,640 | ------- | 15,400 | 9,200 | 15,400 | 9,640 | 9,200 | 10,100 | 11,400 |
| 31 | 10,300 | ------- | 9,200 | 9,640 | ------- | 14,800 | ------- | 14,800 | ------- | 9,640 | 10,300 | ------- |

NOTE.—Discharge estimated on account of ice Feb. 4–7 and 15–25, from records of Des Plaines River at Joliet and Kankakee River at Custer Park.

*Monthly discharge, in second-feet, of Illinois River at Morris, Ill., for the year ending September 30, 1923*

| Month | Maximum | Minimum | Mean | Month | Maximum | Minimum | Mean |
|---|---|---|---|---|---|---|---|
| October | 11,400 | 8,800 | 10,400 | May | 24,400 | 8,800 | 14,300 |
| November | 11,400 | 8,800 | 10,600 | June | 18,200 | 9,200 | 11,500 |
| December | 10,800 | 9,200 | 9,910 | July | 10,300 | 9,200 | 9,700 |
| January | 10,300 | 8,800 | 9,600 | August | 13,600 | 9,000 | 10,600 |
| February | ------- | 8,600 | 9,500 | September | 12,600 | 10,100 | 11,200 |
| March | 26,600 | 10,800 | 17,000 | The year | 26,600 | 8,600 | 11,400 |
| April | 15,100 | 9,200 | 12,500 | | | | |

### ILLINOIS RIVER AT PEORIA, ILL.

LOCATION.—In sec. 2, T. 8 N., R. 8 E., at foot of Grant Street, Peoria, Peoria County, 3½ miles above station formerly maintained at Peoria & Pekin Union Railroad bridge and 4½ miles above mouth of Kickapoo Creek.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—March 8, 1910, to September 30, 1923; also March 10, 1903, to July 21, 1906, for station at Peoria & Pekin Union Railroad bridge.

GAGE.—Vertical staff gage attached to wooden pile; read by employee of United States Engineer Corps.

DISCHARGE MEASUREMENTS.—Made from downstream side of Lower Free Bridge, 2 miles below gage.

CHANNEL AND CONTROL.—Bed of river, which forms control for medium and high stages, composed of mud; may shift. Dam at Copperas Creek probably forms control for lowest stages; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.4 feet March 26 and 28 (discharge, 26,700 second-feet); minimum stage, 9.60 feet August 6 (discharge, 9,440 second-feet.

1903–1906: Maximum discharge recorded, 57,600 second-feet March 28 and 29, 1904; minimum discharge recorded, 6,170 second-feet July 18, 19, and 20, 1906.

1910–1923: Maximum stage recorded, 24.80 feet April 15–17, 1922 (discharge, 56,700 second-feet); minimum discharge somewhat less than 7,250 second-feet occurred during period December 11, 1916, to January 10, 1917.

The highest known flood occurred in 1844, when a stage of about 26.6 feet on the present gage was reached.

REGULATION.—The flow at this station includes the water diverted from Lake Michigan through the Chicago Drainage Canal. No diurnal fluctuation is noticeable.

ACCURACY.—Stage-discharge relation practically permanent during year, except as affected by ice. Rating curve well defined between 9,000 and 25,000 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Open-water records good; winter records fair.

COOPERATION.—Gage-height record furnished by United States Engineer Corps.

*Discharge measurements of Illinois River at Peoria, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Oct. 17 | 10.35 | [a] 10,400 |
| Apr. 25 | 13.65 | 17,100 |

[a] Measurement made at Havana, 43 miles below gage, on Oct. 19; assumed 40 hours time interval and 100 second-feet inflow between stations.

*Daily discharge, in second-feet, of Illinois River at Peoria, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10,200 | 10,300 | 10,800 | | 10,600 | 11,800 | 22,500 | 14,900 | 17,000 | 11,600 | 9,720 | 9,860 |
| 2 | 10,000 | 10,200 | 10,900 | | 10,800 | 12,100 | 21,800 | 14,500 | 16,800 | 11,500 | 9,720 | 10,200 |
| 3 | 10,000 | 10,400 | 10,800 | | 10,900 | 12,300 | 22,000 | 14,500 | 16,300 | 11,200 | 9,720 | 10,400 |
| 4 | 10,000 | 10,400 | 10,900 | | 10,600 | 12,500 | 22,000 | 14,500 | 16,100 | 11,200 | 9,580 | 10,600 |
| 5 | 10,000 | 10,300 | 10,900 | | 10,600 | 12,700 | 22,000 | 14,100 | 15,900 | 11,200 | 9,720 | 10,600 |
| 6 | 10,000 | 10,300 | 10,900 | 10,600 | 10,400 | 12,900 | 21,000 | 13,700 | 15,700 | 11,000 | 9,440 | 10,600 |
| 7 | 10,300 | 10,300 | 10,900 | | 10,400 | 12,900 | 20,000 | 13,100 | 15,300 | 11,000 | 9,580 | 10,800 |
| 8 | 10,300 | 10,600 | 10,900 | | 10,600 | 12,900 | 20,500 | 12,900 | 15,500 | 11,200 | 9,720 | 10,900 |
| 9 | 10,300 | 10,600 | 11,000 | | 10,600 | 12,500 | 20,000 | 13,100 | 15,500 | 10,900 | 9,720 | 11,000 |
| 10 | 10,300 | 10,300 | 10,900 | | 10,800 | 12,900 | 19,800 | 12,500 | 15,700 | 10,800 | 9,860 | 11,200 |
| 11 | 10,300 | 10,300 | 10,400 | | 10,800 | 13,100 | 19,500 | 12,500 | 15,700 | 10,800 | 10,000 | 11,200 |
| 12 | 10,300 | 10,800 | 10,800 | | 10,900 | 14,500 | 19,800 | 13,700 | 15,300 | 10,800 | 9,720 | 11,200 |
| 13 | 10,000 | 10,900 | 10,800 | 10,600 | 10,900 | 15,500 | 19,800 | 12,900 | 14,900 | 10,800 | 10,300 | 11,400 |
| 14 | 10,000 | 10,900 | 10,600 | 10,600 | | 16,300 | 19,800 | 12,700 | 14,700 | 10,600 | 10,200 | 11,400 |
| 15 | 10,300 | 10,900 | 10,600 | 10,600 | | 17,800 | 19,200 | 12,500 | 14,500 | 10,600 | 10,600 | 11,200 |
| 16 | 10,400 | 10,900 | 10,600 | 10,600 | | 19,000 | 19,000 | 13,100 | 14,500 | 10,600 | 10,600 | 11,200 |
| 17 | 10,600 | 10,800 | 10,600 | 10,400 | | 19,800 | 18,800 | 13,300 | 13,900 | 10,400 | 10,900 | 11,200 |
| 18 | 10,600 | 10,900 | | 10,300 | | 21,800 | 18,500 | 13,900 | 13,700 | 10,300 | 10,900 | 11,000 |
| 19 | 10,400 | 10,900 | | 10,600 | 10,900 | 23,100 | 18,000 | 15,100 | 13,300 | 10,300 | 10,900 | 11,000 |
| 20 | 10,600 | 11,200 | | 10,600 | | 23,400 | 17,500 | 15,900 | 13,300 | 10,200 | 10,900 | 10,900 |
| 21 | 10,400 | 11,000 | | 10,600 | | 24,300 | 17,000 | 17,000 | 13,100 | 10,200 | 10,300 | 11,400 |
| 22 | 10,300 | 10,900 | | 10,600 | | 24,900 | 17,000 | 17,500 | 12,900 | 10,000 | 10,600 | 11,200 |
| 23 | 10,600 | 10,900 | | 10,600 | | 25,500 | 17,500 | 18,000 | 12,900 | 10,000 | 10,600 | 11,200 |
| 24 | 10,300 | 11,200 | 10,600 | 10,400 | | 26,100 | 17,000 | 18,000 | 12,500 | 10,000 | 10,600 | 11,200 |
| 25 | 10,400 | 11,200 | | 10,400 | | 25,500 | 16,500 | 18,000 | 12,100 | 10,000 | 10,600 | 11,000 |
| 26 | 10,600 | 10,900 | | 10,400 | 11,500 | 26,700 | 16,300 | 17,500 | 12,100 | 9,860 | 10,600 | 11,200 |
| 27 | 10,400 | 11,000 | | 10,600 | 11,600 | 26,100 | 16,100 | 17,500 | 12,100 | 9,720 | 10,400 | 11,200 |
| 28 | 10,400 | 11,000 | | 10,600 | 11,600 | 26,700 | 15,900 | 17,500 | 12,500 | 9,860 | 10,300 | 11,400 |
| 29 | 10,300 | 10,400 | | 10,600 | ------- | 24,300 | 15,700 | 17,200 | 12,000 | 9,720 | 10,300 | 11,600 |
| 30 | 10,400 | 10,400 | | 10,600 | ------- | 25,500 | 15,300 | 17,200 | 11,800 | 9,720 | 10,300 | 11,500 |
| 31 | 10,300 | ------- | | 10,600 | ------- | 24,600 | ------- | 17,200 | ------- | 9,720 | 10,300 | ------- |

NOTE.—Discharge estimated on account of ice Dec. 18 to Jan. 12 and Feb. 14–25, from records of flow of Illinois River at Morris.

*Monthly discharge, in second-feet, of Illinois River at Peoria, Ill., for the year ending September 30, 1923*

| Month | Maximum | Minimum | Mean | Month | Maximum | Minimum | Mean |
|---|---|---|---|---|---|---|---|
| October | 10,600 | 10,000 | 10,300 | May | 18,000 | 12,500 | 15,000 |
| November | 11,200 | 10,200 | 10,700 | June | 17,000 | 11,800 | 14,300 |
| December | | | 10,700 | July | 11,600 | 9,720 | 10,500 |
| January | | | 10,600 | August | 10,900 | 9,440 | 10,200 |
| February | | | 10,900 | September | 11,600 | 9,860 | 11,000 |
| March | 26,700 | 11,800 | 19,000 | | | | |
| April | 22,500 | 15,300 | 18,900 | The year | 26,700 | 9,440 | 12,700 |

ILLINOIS RIVER AT HAVANA, ILL.

LOCATION.—In sec. 1, T. 21 N., R. 9 W., at highway bridge in Havana, Mason County, half a mile below mouth of Spoon River.

DRAINAGE AREA.—Prior to January 17, 1900, 17,200 square miles; since that date increased by diversion from St. Lawrence River basin through the Chicago Drainage Canal.

RECORDS AVAILABLE.—October 1, 1921, to September 30, 1923. Gage readings October, 1878, to May, 1881; January, 1896, to December, 1904, published in House Document 263, Fifty-ninth Congress; gage readings since December, 1904, in files of United States Engineer Corps.

GAGE.—Vertical staff gage attached to pile 30 feet downstream from draw pier of bridge; read by employee of United States Engineer Corps.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Channel sandy and somewhat shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.3 feet March 27–29 (discharge, 29,300 second-feet); minimum stage, 7.3 feet August 2–5 (discharge, 9,880 second-feet).

1921–1923: Maximum stage recorded, 22.4 feet April 20, 1922 (discharge, 65,000 second-feet); minimum stage, 7.2 feet August 31 to September 10, 1922 (discharge, 9,720 second-feet).

Maximum stage recorded since 1844, that of April 20, 1922.

REGULATION.—Flow at this station includes the flow of the Chicago Drainage Canal.

ACCURACY.—Stage-discharge relation practically permanent during year except as affected by ice. Rating curve well defined above and extended below 10,000 second-feet. Gage read to tenths once daily. Daily discharge determined by applying daily gage height to rating table. Open-water records good; winter records fair.

COOPERATION.—Gage-height record furnished by United States Engineer Corps.

The following discharge measurement was made by H. E. Grosbach:
October 19, 1922: Gage height, 7.67 feet; discharge, 10,500 second-feet.

*Daily discharge, in second-feet, of Illinois River at Havana, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10,400 | 10,600 | 11,500 | | 11,300 | 12,500 | 27,600 | 17,200 | 19,900 | 13,700 | 10,000 | 10,000 |
| 2 | 10,200 | 10,600 | 11,500 | | 11,300 | 12,800 | 27,300 | 16,900 | 19,900 | 13,500 | 9,880 | 10,600 |
| 3 | 10,200 | 10,600 | 11,500 | | 11,300 | 12,800 | 26,600 | 16,400 | 19,600 | 13,000 | 9,880 | 10,600 |
| 4 | 10,200 | 10,600 | 11,500 | | 11,300 | 13,000 | 25,900 | 16,100 | 19,300 | 12,800 | 9,880 | 10,600 |
| 5 | 10,200 | 10,600 | 11,500 | | 11,300 | 13,200 | 25,600 | 15,800 | 18,700 | 12,500 | 9,880 | 10,600 |
| 6 | 10,200 | 10,600 | 11,500 | | 11,300 | 13,200 | 25,200 | 15,600 | 18,400 | 12,300 | 10,000 | 10,600 |
| 7 | 10,600 | 10,600 | 11,300 | 11,000 | | 13,500 | 24,600 | 15,300 | 19,000 | 12,100 | 10,000 | 10,700 |
| 8 | 10,400 | 10,600 | 11,300 | | | 13,700 | 23,900 | 15,000 | 18,700 | 12,100 | 10,400 | 10,700 |
| 9 | 10,400 | 10,600 | 11,300 | | | 13,700 | 23,600 | 14,700 | 18,100 | 11,900 | 10,600 | 10,900 |
| 10 | 10,200 | 10,600 | 11,300 | | | 13,700 | 23,300 | 14,200 | 17,800 | 11,900 | 10,600 | 11,300 |
| 11 | 10,200 | 10,600 | 11,300 | | | 14,200 | 23,000 | 14,200 | 17,500 | 11,700 | 10,700 | 11,300 |
| 12 | 10,200 | 11,100 | 11,300 | | | 16,400 | 22,700 | 17,200 | 17,500 | 11,700 | 10,700 | 11,500 |
| 13 | 10,200 | 11,700 | 11,300 | | | 19,600 | 22,700 | 16,400 | 17,200 | 11,700 | 10,700 | 11,500 |
| 14 | 10,200 | 12,100 | 11,300 | 11,100 | | 20,800 | 22,300 | 16,100 | 16,600 | 11,700 | 10,700 | 11,500 |
| 15 | 10,200 | 11,900 | 11,300 | 11,100 | | 21,400 | 22,000 | 15,800 | 16,100 | 11,500 | 10,700 | 11,500 |
| 16 | 10,400 | 11,900 | 11,300 | 11,100 | 11,300 | 22,700 | 21,700 | 15,800 | 15,800 | 11,500 | 10,900 | 11,500 |
| 17 | 10,400 | 11,700 | 11,300 | 11,100 | | 23,900 | 21,400 | 15,800 | 15,600 | 11,500 | 10,900 | 11,500 |
| 18 | 10,400 | 11,100 | | 10,900 | | 24,900 | 21,400 | 15,800 | 15,300 | 11,300 | 11,100 | 11,300 |
| 19 | 10,400 | 11,100 | | 10,900 | | 25,200 | 20,800 | 16,600 | 15,300 | 11,100 | 11,100 | 11,300 |
| 20 | 10,600 | 11,100 | | 10,900 | | 26,200 | 20,500 | 17,500 | 15,000 | 10,900 | 11,300 | 11,300 |
| 21 | 10,600 | 11,300 | | 10,700 | | 26,900 | 19,900 | 18,100 | 15,000 | 10,700 | 11,300 | 11,500 |
| 22 | 10,700 | 11,300 | | 10,700 | | 27,600 | 19,600 | 18,400 | 14,700 | 10,600 | 11,500 | 11,500 |
| 23 | 10,700 | 11,500 | | 10,700 | | 28,000 | 19,600 | 19,000 | 14,500 | 10,600 | 11,500 | 11,500 |
| 24 | 10,700 | 11,500 | 10,900 | 10,700 | | 28,300 | 19,300 | 19,900 | 14,200 | 10,600 | 11,500 | 11,500 |
| 25 | 10,700 | 11,500 | | 10,700 | | 28,600 | 19,300 | 19,900 | 14,000 | 10,600 | 11,300 | 11,500 |
| 26 | 10,600 | 11,500 | | 10,700 | 12,500 | 29,000 | 19,000 | 19,900 | 14,000 | 10,400 | 10,400 | 11,500 |
| 27 | 10,600 | 11,500 | | 10,700 | 12,300 | 29,300 | 18,700 | 19,900 | 14,000 | 10,200 | 10,200 | 11,500 |
| 28 | 10,600 | 11,500 | | 10,700 | 12,300 | 29,300 | 18,400 | 20,200 | 14,000 | 10,200 | 10,600 | 12,100 |
| 29 | 10,600 | 11,500 | | 10,900 | | 29,300 | 18,100 | 20,200 | 14,000 | 10,000 | 10,200 | 12,300 |
| 30 | 10,600 | 11,500 | | 11,100 | | 29,000 | 17,500 | 20,500 | 13,700 | 10,000 | 10,000 | 12,500 |
| 31 | 10,600 | | | 11,300 | | 28,300 | | 20,200 | | 10,000 | 10,000 | |

NOTE.—Stage-discharge relation affected by ice Dec. 18 to Jan. 13 and Feb. 17–25; discharge estimated by comparison with records of flow of Illinois River at Morris.

*Monthly discharge, in second-feet, of Illinois River at Havana, Ill., for the year ending September 30, 1923*

| Month | Maximum | Minimum | Mean | Month | Maximum | Minimum | Mean |
|---|---|---|---|---|---|---|---|
| October | 10,700 | 10,200 | 10,400 | May | 20,500 | 14,200 | 17,200 |
| November | 12,100 | 10,600 | 11,200 | June | 19,900 | 13,700 | 16,400 |
| December | | | 11,200 | July | 13,700 | 10,000 | 11,400 |
| January | | 10,700 | 10,900 | August | 11,500 | 9,880 | 10,600 |
| February | | | 11,400 | September | 12,500 | 10,000 | 11,300 |
| March | 29,300 | 12,500 | 21,300 | | | | |
| April | 27,600 | 17,500 | 22,000 | The year | 29,300 | 9,880 | 13,800 |

### ILLINOIS RIVER AT BEARDSTOWN, ILL.

LOCATION.—In sec. 15, T. 18 N., R. 12 W., at highway bridge on State Street, Beardstown, Cass County, 9½ miles below mouth of Sangamon River.

DRAINAGE AREA.—Prior to January 17, 1900, 23,445 square miles; since that date the natural run-off increased by diversion from St. Lawrence River basin through the Chicago Drainage Canal.

RECORDS AVAILABLE.—October 1, 1920, to September 30, 1923. Gage read October 28, 1878, to May 30, 1881; November 9, 1881, to June 26, 1884; January 5, 1885, to June 30, 1891; by employees of United States Engineer Corps; July 1, 1891, to September 30, 1923, by employees of United States Weather Bureau; gage-height records, 1878 to 1904, published in House Document 263, Fifty-ninth Congress, since 1904 in annual reports of United States Weather Bureau.

GAGE.—Vertical staff gage attached to pile on inside of cribbing 40 feet above center span of bridge; read by employee of United States Weather Bureau.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and mud. Control at low and medium stages formed by La Grange Dam, about 11 miles downstream; probably permanent. The stage at Beardstown is slightly affected in occasional seasons of high water in the Mississippi by backwater from the latter stream and occasionally by backwater from Crooked Creek, which enters 5 miles below Beardstown.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.4 feet March 28 (discharge, 38,300 second-feet); minimum stage, 7.7 feet December 19–22, (discharge, 9,620 second-feet).

1920–1923: Maximum stage recorded, 25.1 feet April 20, 1922 (discharge, 109,000 second-feet); minimum discharge, that of December 19–22, 1922.

Maximum stage subsequent to 1844, that of April 20, 1922; on April 4, 1904, discharge was determined by United States Engineer Corps as 115,000 second-feet (gage height, 20.0 feet).

REGULATION.—The flow at this station includes the flow of the Chicago Drainage Canal.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 10,000 and 36,000 second-feet. Gage read to tenths once daily. Daily discharge determined by applying daily gage height to rating table. Records good.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

*Discharge measurements of Illinois River at Beardstown, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Oct. 20 | 8.09 | 10,900 |
| Apr. 27 | 10.90 | 21,300 |

*Daily discharge, in second-feet, of Illinois River at Beardstown, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 11,100 | 10,700 | 11,800 | 12,500 | 11,800 | 13,200 | 35,200 | 19,800 | 24,300 | 15,400 | 10,700 | 11,800 |
| 2 | 10,700 | 11,100 | 11,800 | 12,500 | 11,800 | 13,200 | 34,400 | 18,700 | 23,900 | 15,000 | 10,700 | 12,100 |
| 3 | 10,700 | 11,100 | 11,800 | 12,500 | 11,800 | 13,600 | 33,700 | 18,400 | 23,200 | 14,700 | 10,700 | 11,800 |
| 4 | 10,700 | 11,100 | 11,800 | 12,100 | 11,800 | 13,600 | 32,500 | 18,400 | 22,800 | 14,300 | 10,700 | 11,800 |
| 5 | 10,700 | 11,100 | 11,800 | 12,100 | 11,100 | 13,900 | 32,100 | 18,000 | 22,800 | 14,300 | 10,700 | 11,400 |
| 6 | 10,700 | 11,100 | 11,800 | 11,800 | 11,100 | 14,300 | 31,400 | 17,600 | 22,100 | 14,300 | 11,100 | 11,800 |
| 7 | 10,700 | 11,100 | 11,800 | 11,800 | 11,100 | 13,900 | 30,600 | 17,300 | 21,700 | 13,900 | 11,400 | 11,800 |
| 8 | 10,700 | 11,100 | 11,800 | 12,100 | 11,800 | 14,300 | 30,200 | 16,900 | 21,700 | 13,900 | 13,900 | 11,800 |
| 9 | 10,700 | 11,100 | 11,800 | 11,800 | 10,700 | 14,300 | 28,700 | 16,200 | 21,300 | 13,600 | 14,300 | 11,800 |
| 10 | 11,100 | 11,100 | 11,800 | 11,800 | 10,700 | 14,300 | 27,600 | 15,800 | 20,600 | 13,600 | 13,200 | 11,400 |
| 11 | 11,100 | 11,100 | 11,800 | 11,800 | 10,700 | 14,300 | 28,000 | 15,400 | 20,200 | 12,900 | 13,600 | 11,400 |
| 12 | 11,100 | 11,400 | 11,800 | 11,800 | 10,700 | 19,500 | 27,600 | 18,000 | 19,800 | 12,500 | 13,200 | 12,900 |
| 13 | 11,100 | 12,500 | 11,800 | 11,800 | 11,800 | 22,100 | 27,200 | 18,700 | 19,100 | 12,900 | 12,900 | 12,900 |
| 14 | 11,100 | 13,200 | 11,800 | 11,800 | 11,800 | 23,200 | 26,900 | 19,100 | 18,400 | 12,900 | 12,900 | 12,900 |
| 15 | 11,100 | 13,200 | 11,800 | 11,800 | 11,800 | 24,700 | 26,100 | 19,500 | 18,400 | 12,500 | 12,500 | 12,500 |
| 16 | 11,000 | 13,200 | 11,100 | 11,800 | 11,800 | 26,100 | 25,800 | 19,800 | 18,000 | 12,500 | 12,500 | 12,500 |
| 17 | 10,700 | 13,200 | 9,980 | 11,800 | 11,100 | 28,400 | 25,400 | 19,800 | 17,300 | 12,500 | 12,900 | 12,100 |
| 18 | 10,700 | 12,900 | 9,980 | 11,800 | 11,100 | 29,900 | 25,000 | 20,200 | 17,300 | 12,500 | 12,900 | 12,100 |
| 19 | 10,700 | 12,100 | 9,620 | 11,400 | 10,700 | 31,400 | 25,000 | 20,600 | 16,900 | 12,100 | 12,500 | 12,500 |
| 20 | 10,700 | 11,800 | 9,620 | 11,800 | 11,100 | 32,500 | 24,300 | 21,700 | 16,900 | 12,100 | 12,500 | 12,500 |
| 21 | 10,700 | 11,400 | 9,620 | 11,800 | 11,100 | 33,300 | 23,900 | 22,800 | 16,500 | 12,100 | 12,500 | 12,500 |
| 22 | 11,100 | 11,400 | 9,620 | 11,400 | 11,100 | 34,400 | 23,600 | 23,600 | 16,200 | 11,400 | 12,500 | 12,500 |
| 23 | 11,100 | 11,400 | 11,100 | 11,400 | 12,100 | 35,200 | 23,200 | 24,300 | 15,800 | 11,400 | 12,100 | 12,500 |
| 24 | 11,100 | 11,400 | 11,400 | 11,400 | 12,100 | 36,300 | 22,800 | 24,700 | 15,800 | 11,400 | 12,100 | 12,100 |
| 25 | 11,100 | 11,400 | 11,800 | 11,400 | 12,900 | 36,700 | 22,400 | 24,700 | 15,800 | 11,100 | 11,800 | 12,100 |
| 26 | 11,100 | 11,400 | 11,800 | 11,400 | 13,200 | 37,900 | 21,700 | 24,700 | 15,800 | 10,700 | 11,400 | 12,100 |
| 27 | 11,100 | 11,400 | 11,800 | 11,400 | 13,200 | 37,900 | 21,300 | 24,700 | 14,300 | 10,700 | 11,400 | 13,900 |
| 28 | 11,100 | 11,800 | 11,800 | 11,400 | 13,200 | 38,300 | 21,000 | 25,400 | 16,200 | 10,700 | 11,400 | 15,800 |
| 29 | 11,100 | 11,800 | 12,100 | 11,400 | ------- | 37,900 | 20,600 | 25,000 | 15,800 | 10,700 | 11,400 | 15,400 |
| 30 | 11,100 | 11,800 | 12,500 | 11,400 | ------- | 37,100 | 20,200 | 25,400 | 15,800 | 10,700 | 11,400 | 15,400 |
| 31 | 10,700 | ------- | 12,500 | 11,400 | ------- | 36,300 | ------- | 25,000 | ------- | 10,700 | 11,400 | ------- |

*Monthly discharge, in second-feet, of Illinois River at Beardstown, Ill., for the year ending September 30, 1923*

| Month | Maximum | Minimum | Mean | Month | Maximum | Minimum | Mean |
|---|---|---|---|---|---|---|---|
| October | 11,100 | 10,700 | 10,900 | May | 25,400 | 15,400 | 20,700 |
| November | 13,200 | 10,700 | 11,700 | June | 24,300 | 14,300 | 18,800 |
| December | 12,500 | 9,620 | 11,400 | July | 15,400 | 10,700 | 12,600 |
| January | 12,500 | 11,400 | 11,800 | August | 14,300 | 10,700 | 12,100 |
| February | 13,200 | 10,700 | 11,600 | September | 15,800 | 11,400 | 12,500 |
| March | 38,300 | 13,200 | 25,500 | | | | |
| April | 35,200 | 20,200 | 26,600 | The year | 38,300 | 9,620 | 15,500 |

### KANKAKEE RIVER AT MOMENCE, ILL.

LOCATION.—In sec. 24, T. 31 N., R. 13 E., at highway bridge in Momence, Kankakee County, half a mile below Chicago & Eastern Illinois Railroad bridge and 1½ miles above Tower Creek.

DRAINAGE AREA.—2,340 square miles.

RECORDS AVAILABLE.—February 24, 1905, to July 20, 1906; December 3, 1914, to September 30, 1923.

GAGE.—Chain gage attached to bridge over left channel; read by Henry Hanson.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel, somewhat shifting; river at gage divided into two channels by an island. Aquatic plants sometimes grow in bed of river during summer.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded during year, 3.8 feet March 16, 18, and 19 (discharge, 4,430 second-feet); minimum stage, 1.51 feet October 5 and 6 (discharge, 369 second-feet).

1905–6; 1915–1923: Maximum open-water stage recorded, 6.4 feet January 22, 1916 (discharge estimated from extension of rating curve, 12,600 second-feet); minimum stage, 1.37 feet September 1, 16, and 17, 1919 (discharge, 306 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed slightly during March; seriously affected by ice during winter; affected by vegetation in channel during parts of spring and summer. Rating curve well defined between 400 and 1,400 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table; shifting-control method used March 20 to September 30. Records prior to December 14 good; subsequent to that date fair.

*Discharge measurements of Kankakee River at Momence, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge | Date | Gage height | Discharge |
|---|---|---|---|---|---|
| | *Feet* | *Sec.-ft.* | | *Feet* | *Sec.-ft.* |
| Jan. 16 | 2.01 | 843 | May 18 | 3.80 | 4,090 |
| Feb. 13 | [a] 2.70 | 884 | July 17 | 1.84 | 749 |
| Apr. 12 | 2.67 | 1,950 | | | |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Kankakee River at Momence, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 396 | 550 | 690 | | 795 | | 2,740 | 1,080 | 1,420 | 850 | 640 | 905 |
| 2 | 378 | 580 | 690 | 880 | 850 | | 2,620 | 1,080 | 1,350 | 795 | 690 | 905 |
| 3 | 387 | 640 | 690 | | 905 | | 2,510 | 1,020 | 1,280 | 795 | 630 | 1,140 |
| 4 | 378 | 640 | 690 | 850 | 905 | | 2,510 | 1,020 | 1,210 | 740 | 640 | 1,280 |
| 5 | 369 | 690 | 740 | 850 | | 1,400 | 2,400 | 1,020 | 1,140 | 795 | 795 | 1,280 |
| 6 | 369 | 690 | 740 | 850 | | | 2,400 | 960 | 1,210 | 850 | 795 | 1,210 |
| 7 | 387 | 630 | 850 | 850 | | | 2,400 | 960 | 1,660 | 905 | 740 | 1,280 |
| 8 | 441 | 690 | 905 | 795 | | | 2,300 | 960 | 2,300 | 960 | 1,020 | 1,350 |
| 9 | 495 | 640 | 960 | 795 | 850 | 1,500 | 2,200 | 960 | 1,580 | 960 | 1,020 | 1,280 |
| 10 | 540 | 630 | 960 | 905 | | 1,580 | 2,200 | 960 | 1,420 | 1,020 | 850 | 1,210 |
| 11 | 690 | 620 | 905 | 740 | | 1,660 | 2,100 | 960 | 1,500 | 1,020 | 905 | 1,140 |
| 12 | 795 | 640 | 960 | 850 | | 3,090 | 2,010 | 1,140 | 1,420 | 1,020 | 1,350 | 1,140 |
| 13 | 795 | 690 | 740 | 795 | | 3,340 | 1,920 | 1,500 | 1,350 | 960 | 1,210 | 1,080 |
| 14 | 740 | 740 | | 850 | | 3,600 | 1,830 | 1,580 | 1,280 | 905 | 1,020 | 1,020 |
| 15 | 740 | 850 | | 850 | | 3,340 | 1,830 | 1,660 | 1,210 | 905 | 905 | 1,020 |
| 16 | 690 | 850 | | 960 | | 4,430 | 1,740 | 3,090 | 1,140 | 850 | 795 | 960 |
| 17 | 640 | 795 | | 960 | | 4,150 | 1,660 | 3,870 | 1,080 | 905 | 740 | 960 |
| 18 | 630 | 795 | | 905 | | 4,430 | 1,580 | 4,150 | 1,020 | 795 | 690 | 905 |
| 19 | 620 | 795 | | 1,080 | | 4,430 | 1,580 | 4,150 | 1,020 | 740 | 690 | 960 |
| 20 | 610 | 795 | | 850 | | 3,870 | 1,500 | 3,600 | 960 | 740 | 640 | 905 |
| 21 | 590 | 795 | | 850 | 1,000 | 3,870 | 1,420 | 3,340 | 960 | 740 | 620 | 960 |
| 22 | 590 | 740 | 850 | 795 | | 3,870 | 1,420 | 3,340 | 905 | 690 | 620 | 1,020 |
| 23 | 610 | 740 | | 795 | | 4,150 | 1,350 | 3,090 | 905 | 640 | 600 | 1,020 |
| 24 | 610 | 740 | | 740 | | 4,150 | 1,350 | 2,740 | 905 | 690 | 620 | 1,020 |
| 25 | 590 | 690 | | 850 | | 3,870 | 1,280 | 2,400 | 850 | 690 | 590 | 1,020 |
| 26 | 600 | 690 | | 740 | | 3,870 | 1,210 | 2,200 | 850 | 640 | 580 | 1,020 |
| 27 | 600 | 690 | | 740 | | 3,870 | 1,210 | 2,100 | 850 | 640 | 560 | 960 |
| 28 | 580 | 690 | | 740 | | 3,600 | 1,140 | 2,010 | 850 | 690 | 640 | 905 |
| 29 | 580 | 690 | | 740 | ------- | 3,340 | 1,140 | 1,920 | 795 | 690 | 960 | 905 |
| 30 | 580 | 690 | | 740 | ------- | 3,340 | 1,080 | 1,740 | 795 | 690 | 1,020 | 905 |
| 31 | 570 | ------- | | 740 | ------- | 2,850 | ------- | 1,580 | ------- | 640 | 960 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Jan. 3 and Feb. 5 to Mar. 8; discharge estimated from gage-height record, discharge measurement, observer's notes, and gage-height record of Kankakee River at Custer Park. Braced figures show mean discharge for periods indicated.

*Monthly discharge of Kankakee River at Momence, Ill., for the year ending September 30, 1923*

[Drainage area, 2,340 square miles]

| Month | Discharge in second-feet | | | | Run-off in Inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 795 | 369 | 567 | 0.242 | 0.28 |
| November | 850 | 550 | 704 | .301 | .34 |
| December | ---------- | ---------- | 833 | .356 | .41 |
| January | 1,080 | 740 | 834 | .356 | .41 |
| February | ---------- | ---------- | 932 | .398 | .41 |
| March | 4,430 | ---------- | 2,950 | 1.26 | 1.45 |
| April | 2,740 | 1,080 | 1,820 | .778 | .87 |
| May | 4,150 | 960 | 2,010 | .859 | .99 |
| June | 2,300 | 795 | 1,170 | .500 | .56 |
| July | 1,020 | 640 | 805 | .344 | .40 |
| August | 1,350 | 560 | 791 | .338 | .39 |
| September | 1,350 | 905 | 1,060 | .453 | .50 |
| The year | 4,430 | 369 | 1,210 | .517 | 7.02 |

**KANKAKEE RIVER AT CUSTER PARK, ILL.**

LOCATION.—In sec. 19, T. 32 N., R. 10 E., at the Wabash Railroad bridge in Custer Park, Will County, half a mile above Horse Creek and 15 miles below dam and power plant at Kankakee.

DRAINAGE AREA.—4,870 square miles.

RECORDS AVAILABLE.—November 6, 1914, to September 30, 1923.

GAGE.—Chain gage, attached to bridge; read by J. H. Swords.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Solid rock strewn with boulders and gravel; right half of channel deep with fissures in bed; left half shallow; vegetation grows during summer.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.00 feet at 4 p. m. March 18 (discharge, 15,700 second-feet); minimum stage, 4.88 feet at 5 p. m. October 1 (discharge, 406 second-feet).

1914–1923: Maximum stage recorded, 15.05 feet April 11, 1922 (discharge, 31,200 second-feet); minimum stage, 4.09 feet November 15, 1914 (dischage, 250 second-feet).

REGULATION.—Operation of power plant at Kankakee causes slight fluctuation at gage.

ACCURACY.—Stage-discharge relation changed slightly during year by growth of vegetation in channel; affected by ice during winter. Rating curves fairly well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating tables, except for period of ice effect; shifting-control method used November 16–30 and May 16 to September 30. Open-water records good; winter records fair.

*Discharge measurements of Kankakee River at Custer Park, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Feb. 21 | [a] 5.82 | 1,040 |
| Apr. 19 | 6.27 | 2,390 |
| Aug. 2 | [b] 5.39 | 780 |

[a] Stage-discharge relation affected by ice.
[b] Stage-discharge relation affected by aquatic growth.

*Daily discharge, in second-feet, of Kankakee River at Custer Park, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 428 | 625 | 835 | | | | 3,770 | 1,650 | 3,670 | 1,130 | 670 | 1,270 |
| 2 | 444 | 625 | 835 | | | | 3,560 | 1,560 | 3,220 | 1,130 | 770 | 1,130 |
| 3 | 476 | 580 | 835 | | | 2,000 | 3,560 | 1,570 | 2,800 | 1,130 | 770 | 1,480 |
| 4 | 444 | 720 | 890 | | | | 3,360 | 1,570 | 2,420 | 940 | 720 | 2,060 |
| 5 | 444 | 670 | 890 | | | | 3,150 | 1,500 | 2,240 | 1,000 | 825 | 2,240 |
| 6 | 452 | 670 | 890 | | | | 3,770 | 1,500 | 2,610 | 940 | 1,130 | 2,420 |
| 7 | 540 | 670 | 1,080 | | | 2,400 | 4,210 | 1,420 | 6,170 | 1,060 | 1,410 | 2,150 |
| 8 | 540 | 580 | 1,140 | | | 2,400 | 4,670 | 1,350 | 4,880 | 1,060 | 1,890 | 2,150 |
| 9 | 540 | 625 | 1,080 | | | 2,230 | 4,210 | 1,500 | 3,220 | 1,060 | 1,890 | 2,060 |
| 10 | 720 | 625 | 1,350 | | | 2,230 | 3,770 | 1,420 | 2,610 | 1,270 | 1,720 | 1,980 |
| 11 | 940 | 670 | 1,140 | | | 2,580 | 3,350 | 1,420 | 2,420 | 1,340 | 1,800 | 1,980 |
| 12 | 880 | 720 | | | | 5,910 | 3,350 | 1,810 | 2,240 | 1,340 | 1,720 | 1,720 |
| 13 | 880 | 770 | | | | 8,790 | 3,150 | 2,580 | 2,150 | 1,200 | 2,240 | 1,640 |
| 14 | 880 | 770 | | | | 9,410 | 3,150 | 4,670 | 1,890 | 1,060 | 2,150 | 1,480 |
| 15 | 880 | 825 | | | 1,050 | 10,000 | 2,760 | 5,910 | 1,800 | 1,000 | 1,800 | 1,340 |
| 16 | 825 | 880 | | 1,100 | | 13,000 | 2,760 | 11,000 | 1,640 | 940 | 1,560 | 1,200 |
| 17 | 720 | 940 | | | | 13,600 | 2,580 | 12,000 | 1,560 | 880 | 1,270 | 1,200 |
| 18 | 720 | 940 | | | | 15,000 | 2,580 | 11,600 | 1,410 | 825 | 1,130 | 1,200 |
| 19 | 670 | 940 | | | | 14,300 | 2,400 | 11,000 | 1,340 | 880 | 1,000 | 1,200 |
| 20 | 625 | 1,000 | | | | 13,000 | 2,230 | 10,400 | 1,270 | 770 | 1,000 | 1,270 |
| 21 | 625 | 940 | 860 | | | 11,300 | 2,230 | 8,480 | 1,200 | 825 | 940 | 1,270 |
| 22 | 625 | 940 | | | | 9,720 | 2,060 | 7,290 | 1,130 | 770 | 770 | 1,480 |
| 23 | 720 | 940 | | | | 8,790 | 2,060 | 6,170 | 1,060 | 720 | 825 | 1,560 |
| 24 | 670 | 940 | | | | 8,180 | 2,060 | 5,150 | 1,130 | 720 | 670 | 1,560 |
| 25 | 670 | 880 | | | | 7,580 | 1,980 | 4,440 | 1,000 | 770 | 880 | 1,560 |
| 26 | 625 | 825 | | | | 6,720 | 1,890 | 3,990 | 940 | 670 | 880 | 1,480 |
| 27 | 625 | 940 | | | | 6,440 | 1,810 | 4,670 | 825 | 625 | 720 | 1,410 |
| 28 | 580 | 880 | | | | 5,650 | 1,730 | 4,670 | 1,060 | 720 | 770 | 1,340 |
| 29 | 625 | 880 | | | ------- | 5,150 | 1,730 | 4,190 | 940 | 770 | 880 | 1,340 |
| 30 | 670 | 880 | | | ------- | 4,670 | 1,730 | 5,150 | 1,000 | 770 | 1,060 | 1,270 |
| 31 | 625 | ------- | | | ------- | 4,210 | ------- | 4,440 | ------- | 720 | 1,340 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 12 to Mar. 6; discharge estimated from results of discharge measurements, gage-height record, observer's notes, and climatic record. Braced figures give mean discharge for period indicated.

*Monthly discharge of Kankakee River at Custer Park, Ill, for the year ending September 30, 1923*

[Drainage area, 4,870 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 940 | 428 | 649 | 0.133 | 0.15 |
| November | 1,000 | 580 | 796 | .163 | .18 |
| December | ---------- | ---------- | 909 | .187 | .22 |
| January | ---------- | ---------- | 1,100 | .226 | .26 |
| February | ---------- | ---------- | 1,050 | .216 | .22 |
| March | 15,000 | ---------- | 6,620 | 1.36 | 1.57 |
| April | 4,670 | 1,730 | 2,850 | .585 | .65 |
| May | 12,000 | 1,350 | 4,740 | .973 | 1.12 |
| June | 6,170 | 825 | 2,060 | .423 | .47 |
| July | 1,340 | 625 | 937 | .192 | .22 |
| August | 2,240 | 670 | 1,200 | .246 | .28 |
| September | 2,420 | 1,130 | 1,580 | .324 | .36 |
| The year | 15,000 | 428 | 2,050 | .421 | 5.70 |

### IROQUOIS RIVER NEAR CHEBANSE, ILL.

LOCATION.—In sec. 16, T. 29 N., R. 13 W., at highway bridge 4½ miles east of Chebanse, Kankakee County, 3 miles below Beaver Creek, and 6 miles above junction with Kankakee River.

DRAINAGE AREA.—2,120 square miles.

RECORDS AVAILABLE.—April 13 to September 30, 1923.

GAGE.—Chain gage attached to bridge; read by Charles Haselow.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders; low-water control just below gage. Banks low and wooded. Aquatic vegetation grows in channel during summer.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of record, 7.89 feet May 18 (discharge, 6,550 second-feet); minimum stage, 0.75 foot July 26 (discharge, 59 second-feet).

In the spring of 1913 a stage of about 19.6 feet was reached.

ACCURACY.—Stage-discharge relation not permanent; affected by aquatic growth during summer. Rating curve used prior to May 31 well defined between 1,000 and 7,000 second-feet; curve used subsequent to that date well defined throughout. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table; shifting-control method used June 1–30. Records good except for June for which they are fair.

*Discharge measurements of Iroquois River near Chebanse, Ill., during the year ending September 30, 1923*

| Date | Made by— | Gage height | Discharge | Date | Made by— | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| Mar. 29 | Grosbach and Blanchard. | 3.51 | 1,590 | May 18 | H. E. Grosbach | 7.89 | 6,550 |
| | | | | July 17 | do | .97 | 101 |
| Apr. 13 | H. E. Grosbach | 2.74 | 1,080 | Sept. 7 | do | 2.39 | 694 |

*Daily discharge, in second-feet, of Iroquois River near Chebanse, Ill., for the year ending September 30, 1923*

| Day | Apr. | May | June | July | Aug. | Sept. | Day | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 442 | 1,490 | 252 | 84 | 128 | 16 | 875 | 5,970 | 270 | 120 | 310 | 135 |
| 2 | | 442 | 1,200 | 232 | 88 | 176 | 17 | 820 | 6,400 | 270 | 106 | 204 | 125 |
| 3 | | 400 | 1,060 | 204 | 92 | 585 | 18 | 765 | 6,550 | 252 | 88 | 168 | 115 |
| 4 | | 380 | 930 | 190 | 80 | 870 | 19 | 710 | 6,250 | 235 | 92 | 112 | 110 |
| 5 | | 360 | 810 | 165 | 110 | 870 | 20 | 660 | 4,870 | 210 | 84 | 132 | 172 |
| 6 | | 380 | 810 | 179 | 485 | 750 | 21 | 660 | 3,460 | 168 | 76 | 70 | 290 |
| 7 | | 360 | 990 | 165 | 612 | 695 | 22 | 585 | 2,660 | 156 | 80 | 103 | 372 |
| 8 | | 340 | 870 | 179 | 668 | 695 | 23 | 610 | 1,900 | 144 | 72 | 95 | 330 |
| 9 | | 322 | 750 | 196 | 640 | 612 | 24 | 585 | 1,510 | 144 | 63 | 61 | 290 |
| 10 | | 360 | 560 | 270 | 612 | 485 | 25 | 560 | 1,300 | 150 | 68 | 78 | 221 |
| 11 | | 360 | 440 | 252 | 640 | 372 | 26 | 535 | 1,180 | 138 | 59 | 86 | 172 |
| 12 | | 465 | 395 | 210 | 750 | 252 | 27 | 488 | 1,580 | 162 | 80 | 99 | 153 |
| 13 | 1,060 | 2,260 | 372 | 172 | 1,060 | 193 | 28 | 488 | 2,080 | 144 | 92 | 112 | 147 |
| 14 | 1,060 | 3,360 | 330 | 141 | 870 | 179 | 29 | 465 | 2,460 | 218 | 80 | 122 | 135 |
| 15 | 995 | 3,560 | 310 | 110 | 485 | 159 | 30 | 488 | 2,260 | 204 | 72 | 138 | 130 |
| | | | | | | | 31 | | 1,900 | | 92 | 144 | |

*Monthly discharge of Iroquois River near Chebanse, Ill., for the year ending September 30, 1923*

[Drainage area, 2,120 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| April 13-30 | 1,060 | 465 | 689 | 0.325 | 0.22 |
| May | 6,550 | 322 | 2,130 | 1.00 | 1.15 |
| June | 1,490 | 138 | 473 | .223 | .25 |
| July | 252 | 59 | 137 | .065 | .07 |
| August | 1,060 | 61 | 300 | .142 | .16 |
| September | 870 | 110 | 331 | .156 | .17 |

### FOX RIVER AT ALGONQUIN, ILL.

LOCATION.—In NW. ¼ sec. 34, T. 43 N., R. 8 E. third principal meridian, at Chicago Street Bridge in Algonquin, McHenry County, 100 feet above Public Service Co.'s dam, and 300 feet above Crystal Lake outlet.

RECORDS AVAILABLE.—October 1, 1915, to September 30, 1923.

DRAINAGE AREA.—1,340 square miles (measured on United States Geological Survey map; scale, 1 : 500,000).

GAGE.—Staff gage attached to concrete abutment of bridge; read by Edward Pedersen.

CHANNEL AND CONTROL.—Control is a concrete dam 100 feet below gage; permanent since August, 1919.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading below dam.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.3 feet April 12–14 (discharge, 3,280 second-feet); minimum stage, 0.87 foot August 5 (discharge, 117 second-feet).

1916–1923: Maximum stage recorded, 5.3 feet March 31, 1916 (discharge 7,120 second-feet); minimum stage, 0.59 foot August 31, 1918 (discharge, 67 second-feet).

REGULATION.—Grist mill at dam runs on average of about 4 hours a day except Sundays during September to March, inclusive, and one day a week during remainder of year. Effect of operation of mill on gage height is appreciable only at low stages and gage is usually read when mill is not running.

ACCURACY.—Stage-discharge relation permanent except as affected by ice during winter. Rating curve well defined above and fairly well defined below 400 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for medium and high stages, fair for low stages.

The following discharge measurement was made by H. E. Grosbach: March 1, 1923: Gage height, 1.28 feet; discharge, 379 second-feet.

*Daily discharge, in second-feet, of Fox River at Algonquin, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 291 | 339 | 530 | 373 | 355 | 400 | 1,800 | 1,100 | 275 | 174 | 174 | 268 |
| 2 | 275 | 339 | 570 | 373 | 400 | 512 | 1,880 | 980 | 291 | 180 | 168 | 260 |
| 3 | 260 | 339 | 600 | 382 | 409 | 610 | 1,880 | 920 | 307 | 200 | 148 | 260 |
| 4 | 260 | 347 | 630 | 382 | 391 | 750 | 1,950 | 860 | 323 | 215 | 135 | 252 |
| 5 | 275 | 339 | 695 | 391 | 373 | 805 | 2,100 | 805 | 339 | 215 | 123 | 252 |
| 6 | 299 | 339 | 640 | 391 | 373 | 920 | 2,260 | 695 | 355 | 230 | 123 | 299 |
| 7 | 331 | 331 | 640 | 382 | 355 | 980 | 2,420 | 530 | 355 | 230 | 142 | 364 |
| 8 | 355 | 323 | 620 | 373 | | 1,040 | 2,750 | 492 | 339 | 230 | 168 | 391 |
| 9 | 373 | 323 | 590 | 373 | | 1,160 | 2,920 | 454 | 339 | 230 | 148 | 373 |
| 10 | 391 | 315 | 550 | 364 | | 1,300 | 3,100 | 418 | 323 | 230 | 161 | 364 |
| 11 | 409 | 307 | 512 | 364 | | 1,440 | 3,100 | 382 | 323 | 230 | 364 | 409 |
| 12 | 409 | 323 | 474 | 355 | | 1,580 | 3,280 | 347 | 307 | 230 | 373 | 464 |
| 13 | 391 | 339 | 445 | 355 | | 1,650 | 3,280 | 315 | 307 | 215 | 355 | 445 |
| 14 | 373 | 355 | 427 | 364 | | 1,650 | 3,280 | 283 | 291 | 215 | 339 | 445 |
| 15 | 355 | 373 | 409 | 373 | | 1,580 | 3,100 | 252 | 291 | 230 | 315 | 436 |
| 16 | 339 | 391 | 391 | 373 | 364 | 1,100 | 2,920 | 222 | 275 | 230 | 291 | 427 |
| 17 | 331 | 409 | 391 | 355 | | 1,040 | 2,580 | 215 | 275 | 215 | 275 | 427 |
| 18 | 323 | 427 | 364 | 347 | | 805 | 2,420 | 230 | 260 | 200 | 252 | 445 |
| 19 | 323 | 445 | 331 | 339 | | 550 | 2,260 | 252 | 245 | 187 | 222 | 464 |
| 20 | 315 | 464 | 299 | 339 | | 695 | 2,100 | 283 | 230 | 174 | 208 | 492 |
| 21 | 307 | 483 | 268 | 347 | | 920 | 2,100 | 307 | 230 | 187 | 238 | 530 |
| 22 | 299 | 502 | 275 | 355 | | 1,230 | 1,950 | 291 | 222 | 174 | 260 | 570 |
| 23 | 291 | 521 | 291 | 355 | | 1,300 | 1,880 | 275 | 215 | 161 | 245 | 610 |
| 24 | 283 | 502 | 307 | 364 | | 1,440 | 1,800 | 291 | 215 | 148 | 230 | 640 |
| 25 | 291 | 483 | 323 | 373 | | 1,440 | 1,720 | 307 | 208 | 135 | 230 | 695 |
| 26 | 291 | 464 | 331 | 373 | 382 | 1,510 | 1,650 | 291 | 200 | 123 | 245 | 695 |
| 27 | 307 | 445 | 339 | 373 | | 1,650 | 1,510 | 291 | 200 | 135 | 260 | 695 |
| 28 | 307 | 464 | 347 | 373 | | 1,800 | 1,440 | 275 | 187 | 148 | 275 | 640 |
| 29 | 323 | 483 | 355 | 355 | ------ | 1,650 | 1,370 | 260 | 187 | 161 | 283 | 695 |
| 30 | 323 | 502 | 355 | 355 | ------ | 1,650 | 1,230 | 245 | 187 | 174 | 275 | 695 |
| 31 | 331 | ------ | 364 | 355 | ------ | 1,720 | ------ | 260 | ------ | 187 | 275 | ------ |

NOTE.—Stage-discharge relation affected by ice Feb. 7 to Mar. 1; discharge estimated.

*Monthly discharge of Fox River at Algonquin, Ill., for the year ending September 30, 1923*

[Drainage area, 1,340 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 409 | 260 | 324 | 0.242 | 0.28 |
| November | 521 | 307 | 401 | .299 | .33 |
| December | 695 | 268 | 441 | .329 | .38 |
| January | 391 | 339 | 365 | .272 | .31 |
| February | ------ | ------ | 371 | .277 | .29 |
| March | 1,800 | 400 | 1,190 | .888 | 1.02 |
| April | 3,280 | 1,230 | 2,270 | 1.69 | 1.89 |
| May | 1,100 | 215 | 423 | .316 | .36 |
| June | 355 | 187 | 270 | .201 | .22 |
| July | 230 | 123 | 193 | .144 | .17 |
| August | 373 | 123 | 235 | .175 | .20 |
| September | 695 | 252 | 467 | .349 | .39 |
| The year | 3,280 | 123 | 578 | .431 | 5.84 |

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### FOX RIVER AT WEDRON, ILL.

LOCATION.—In sec. 9, T. 34 N., R. 4 E., at highway bridge in Wedron, La Salle County, 1,000 feet above Buck Creek.

DRAINAGE AREA.—2,500 square miles.

RECORDS AVAILABLE.—November 5, 1914, to September 30, 1923.

GAGE.—Chain gage attached to bridge; read by Charles Davis.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Control 1,000 feet downstream composed of coarse gravel and large boulders; practically permanent; affected at times by growth of aquatic plants.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.7 feet March 23 (discharge, 7,720 second-feet); minimum stage, 5.45 feet at 6 p. m. July 31 (discharge, 137 second-feet).

1915–1923: Maximum stage recorded, 17.22 feet January 22, 1916 (discharge not determined because of backwater from ice). Maximum open-water stage recorded, 14.2 feet March 26, 1920 (discharge, 17,900 second-feet). Minimum discharge recorded, 105 second-feet, November 20, 1914 (measured by current meter).

REGULATION.—Slight diurnal fluctuation is caused by operation of power plants at and above Aurora.

ACCURACY.—Stage-discharge relation affected by vegetation in channel in fall and summer; by ice during winter. Rating curves well defined above and fairly well defined below 200 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating tables except for period of ice effect. Records good for stages above ordinary low water, fair for extremely low stages during open water; winter records fair.

*Discharge measurements of Fox River at Wedron, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge | Date | Gage height | Discharge |
|---|---|---|---|---|---|
| | *Feet* | *Sec.-ft.* | | *Feet* | *Sec.-ft.* |
| Feb. 20 | [a] 6.01 | 320 | June 5 | 5.93 | 392 |
| Apr. 18 | 8.52 | 3,200 | Aug. 1 | 5.75 | 272 |

[a] Stage-discharge relation affected by ice.

*Daily discharge, in second-feet, of Fox River at Wedron, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 500 | 500 | 615 | | | | 2,460 | 1,360 | 390 | 236 | 209 | 390 |
| 2 | 472 | 472 | 785 | | | | 2,460 | 1,260 | 418 | 209 | 245 | 340 |
| 3 | 390 | 445 | 648 | | | | 2,330 | 1,260 | 390 | 174 | 200 | 268 |
| 4 | 365 | 445 | 715 | | | 715 | 2,460 | 1,160 | 245 | 418 | 227 | 236 |
| 5 | 390 | 418 | 785 | | | | 2,600 | 1,070 | 445 | 365 | 227 | 290 |
| 6 | 365 | 390 | 785 | | | | 2,600 | 1,020 | 555 | 340 | 236 | 940 |
| 7 | 500 | 418 | 820 | | | 1,100 | 2,600 | 785 | 615 | 472 | 196 | 820 |
| 8 | 500 | 418 | 750 | | | 1,150 | 3,210 | 900 | 715 | 445 | 245 | 785 |
| 9 | 390 | 418 | 500 | | | 1,240 | 3,560 | 680 | 555 | 365 | 214 | 680 |
| 10 | 390 | 418 | 290 | | | 3,210 | 3,750 | 680 | 472 | 315 | 227 | 680 |
| 11 | 585 | 418 | 290 | | | 2,600 | 3,750 | 648 | 445 | 340 | 268 | 445 |
| 12 | 555 | 418 | | | | 3,950 | 3,750 | 820 | 472 | 340 | 232 | 555 |
| 13 | 585 | 472 | | | | 3,380 | 3,950 | 680 | 472 | 315 | 209 | 445 |
| 14 | 615 | 585 | | | | 2,460 | 3,950 | 555 | 445 | 290 | 390 | 500 |
| 15 | 390 | 860 | | | 420 | 2,900 | 3,750 | 585 | 445 | 290 | 500 | 528 |
| 16 | 340 | 715 | 385 | 390 | | 4,350 | 3,560 | 680 | 418 | 245 | 418 | 472 |
| 17 | 340 | 615 | | | | 3,380 | 3,210 | 615 | 315 | 183 | 418 | 472 |
| 18 | 585 | 500 | | | | 4,150 | 3,210 | 615 | 268 | 290 | 418 | 418 |
| 19 | 585 | 528 | | | | 1,940 | 2,900 | 555 | 268 | 290 | 390 | 555 |
| 20 | 365 | 500 | | | | 1,460 | 2,750 | 472 | 585 | 340 | 245 | 500 |
| 21 | 418 | 555 | | | | 2,460 | 2,600 | 390 | 418 | 268 | 245 | 528 |
| 22 | 365 | 680 | | | | 4,150 | 2,460 | 445 | 290 | 268 | 390 | 615 |
| 23 | 365 | 555 | | | | 7,470 | 2,200 | 445 | 290 | 227 | 340 | 648 |
| 24 | 390 | 615 | | | | 6,280 | 2,200 | 418 | 268 | 200 | 390 | 750 |
| 25 | 418 | 680 | | | | 5,180 | 2,200 | 340 | 200 | 290 | 290 | 680 |
| 26 | 418 | 555 | 450 | | | 4,760 | 2,070 | 418 | 236 | 268 | 315 | 860 |
| 27 | 418 | 500 | | | | 3,380 | 1,820 | 445 | 290 | 232 | 290 | 980 |
| 28 | 365 | 445 | | | | 3,050 | 1,690 | 340 | 340 | 268 | 245 | 820 |
| 29 | 418 | 615 | | | ------- | 2,750 | 1,570 | 445 | 340 | 268 | 418 | 820 |
| 30 | 365 | 648 | | | ------- | 2,600 | 1,510 | 445 | 268 | 170 | 390 | 715 |
| 31 | 365 | ------- | | | ------- | 2,460 | ------- | 245 | ------- | 149 | 365 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 12 to Mar. 6; discharge estimated from gage-height record, one discharge measurement, observer's notes, and weather records. Braced figures give mean discharge for periods indicated.

*Monthly discharge of Fox River at Wedron, Ill., for the year ending September 30, 1923*

[Drainage area, 2,500 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 615 | 340 | 436 | 0.174 | 0.20 |
| November | 860 | 390 | 527 | .211 | .24 |
| December | 820 | 290 | 497 | .199 | .23 |
| January | ---------- | ---------- | 390 | .156 | .18 |
| February | ---------- | ---------- | 420 | .168 | .17 |
| March | 7,470 | ---------- | 2,780 | 1.11 | 1.28 |
| April | 3,950 | 1,510 | 2,770 | 1.11 | 1.24 |
| May | 1,360 | 245 | 670 | .268 | .31 |
| June | 715 | 245 | 396 | .158 | .18 |
| July | 472 | 149 | 286 | .114 | .13 |
| August | 500 | 196 | 303 | .121 | .14 |
| September | 980 | 236 | 591 | .236 | .26 |
| The year | 7,470 | 149 | 840 | .336 | 4.56 |

### VERMILION RIVER NEAR STREATOR, ILL.

LOCATION.—In sec. 1, T. 30 N., R. 3 E. third principal meridian, at highway bridge known as Bridge No. 3, 1½ miles south of Streator, LaSalle County, and 100 feet below the Santa Fe Railway bridge.

DRAINAGE AREA.—1,080 square miles.

RECORDS AVAILABLE.—July 27, 1914, to September 30, 1923.

GAGE.—Chain gage attached to highway bridge; read by Andrew Gall.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Channel composed of gravel and rocks. Brush and timber growing on banks above low-water stages. Control at low stages composed of loose rocks, shifts occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.7 feet May 18 (discharge, 2,570 second-feet); minimum discharge, no flow, August 24–27, and September 3 and 4.

1914–1923: Maximum stage recorded, 22.9 feet April 20, 1920 (discharge, 16,500 second-feet); minimum discharge, no flow, August 25–28, September 16–30, 1920, and August 24–27, September 3 and 4, 1923.

ACCURACY.—Stage-discharge relation changed slightly during March and again during August, probably due to shifting of loose rocks below gage; affected by ice for a short period during winter. Rating curve used October 1 to March 15 well defined above and fairly well defined below 25 second-feet; rating curve used March 16 to August 9 well defined above 150 second-feet, rating curve used August 10 to September 30 fairly well defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good except for very low stages and for period of ice effect, for which they are fair.

*Discharge measurements of Vermilion River near Streator, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Feb. 20 | 1.63 | 43.1 |
| Apr. 18 | 2.04 | 171 |
| June 4 | 2.90 | 395 |

*Daily discharge, in second-feet, of Vermilion River near Streator, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.5 | 1.4 | 6.6 | | 30 | 33 | 255 | 85 | 394 | 140 | 1.4 | 0.1 |
| 2 | .5 | 1.4 | 5.6 | | 22 | 46 | 242 | 82 | 394 | 130 | 1.2 | .1 |
| 3 | .5 | .8 | 5.6 | | | 71 | 242 | 73 | 394 | 151 | 1.4 | .0 |
| 4 | .5 | .8 | 7.9 | | | 62 | 242 | 67 | 394 | 173 | 1.7 | .0 |
| 5 | .6 | 1.0 | 7.9 | | | 54 | 242 | 62 | 336 | 184 | 14.0 | .1 |
| 6 | .5 | 1.0 | 5.6 | | | 64 | 268 | 57 | 364 | 151 | 33.0 | .1 |
| 7 | .8 | .8 | 9.4 | | | 61 | 322 | 65 | 350 | 87 | 26.0 | .1 |
| 8 | .8 | 1.4 | 6.6 | | 9 | 55 | 394 | 60 | 255 | 90 | 3.2 | .5 |
| 9 | .8 | 1.0 | 5.6 | | | 43 | 424 | 52 | 242 | 84 | 1.8 | .4 |
| 10 | 1.0 | .8 | 5.6 | | | 34 | 350 | 33 | 230 | 87 | 17.0 | .3 |
| 11 | 1.5 | .8 | 12.0 | | | 1,210 | 308 | 10 | 207 | 94 | 17.0 | .3 |
| 12 | 1.0 | 1.0 | | | | 2,390 | 268 | 85 | 184 | 74 | 21.0 | .2 |
| 13 | .8 | 1.2 | | | | 1,550 | 242 | 207 | 162 | 66 | 17.0 | .1 |
| 14 | .8 | 1.4 | | | | 1,550 | 218 | 578 | 140 | 64 | 24.0 | .1 |
| 15 | 1.0 | 1.0 | | 6 | 125 | 1,600 | 218 | 642 | 140 | 64 | 18.0 | .1 |
| 16 | .6 | 1.4 | | | | 2,150 | 196 | 1,910 | 120 | 60 | 8.5 | .1 |
| 17 | .8 | 1.0 | | | | 2,210 | 179 | 2,270 | 162 | 37 | 1.5 | .5 |
| 18 | .5 | 5.8 | | | 3 | 2,090 | 162 | 2,570 | 130 | 36 | 1.1 | .2 |
| 19 | .8 | 5.8 | | | 2 | 1,750 | 151 | 2,090 | 140 | 28 | 1.3 | .1 |
| 20 | .8 | 33.0 | | | 45 | 1,450 | 140 | 1,800 | 140 | 25 | 1.0 | .2 |
| 21 | .8 | 33.0 | 4.0 | | 37 | 1,250 | 130 | 1,460 | 140 | 26 | .6 | .1 |
| 22 | .8 | 24.0 | | | 27 | 1,170 | 120 | 1,130 | 140 | 20 | .1 | .1 |
| 23 | .8 | 18.0 | | | 24 | 850 | 120 | 890 | 120 | 12 | .1 | .1 |
| 24 | .8 | 12.0 | | | 23 | 780 | 120 | 710 | 102 | 6 | .0 | .1 |
| 25 | .8 | 6.8 | | | 27 | 454 | 113 | 642 | 16 | 6 | .0 | .1 |
| 26 | .8 | 6.8 | | | 37 | 642 | 102 | 546 | 3 | 5 | .0 | .4 |
| 27 | .6 | 8.2 | | | 31 | 514 | 99 | 815 | 207 | 2 | .0 | .3 |
| 28 | 1.0 | 6.8 | | | 31 | 424 | 92 | 850 | 184 | 1 | .1 | .5 |
| 29 | .9 | 5.8 | | 5 | ------- | 173 | 99 | 970 | 173 | 1 | .1 | .4 |
| 30 | .8 | 3.8 | | 11 | ------- | 220 | 88 | 850 | 162 | 1 | .1 | .3 |
| 31 | .8 | ------- | | 11 | ------- | 268 | ------- | 780 | ------- | 1 | .1 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 12 to Jan. 28 and Feb. 3–19; discharge estimated from gage-height and weather records. Braced figures show mean discharge for periods indicated. Discharge interpolated Oct. 29, Nov. 13, 23, Mar. 11, 30, Apr. 17, May 21, July 25, and Sept. 24.

*Monthly discharge of Vermilion River near Streator, Ill., for the year ending September 30, 1923*

[Drainage area, 1,080 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 1.5 | 0.5 | 0.77 | 0.001 | 0.001 |
| November | 33 | .8 | 6.27 | .006 | .007 |
| December | | | 5.11 | .005 | .006 |
| January | | | 6.29 | .006 | .007 |
| February | | | 41.8 | .039 | .04 |
| March | 2,390 | 33 | 813 | .753 | .87 |
| April | 424 | 88 | 205 | .190 | .21 |
| May | 2,570 | 10 | 724 | .670 | .77 |
| June | 394 | 3 | 204 | .189 | .21 |
| July | 184 | 1 | 61.5 | .057 | .07 |
| August | 33 | 0 | 6.85 | .006 | .007 |
| September | 0.5 | 0 | 0.20 | .0002 | .0002 |
| The year | 2,570 | 0 | 174 | .161 | 2.20 |

### MACKINAW RIVER NEAR GREEN VALLEY, ILL.

LOCATION.—In sec. 15, T. 23 N., R. 5 W., at Chicago and Northwestern Railway bridge 3 miles north of Green Valley, Tazewell County.

DRAINAGE AREA.—1,100 square miles (measured on United States Geological Survey map; scale, 1:500,000).

RECORDS AVAILABLE.—March 9, 1921, to September 30, 1923.

GAGE.—Chain gage attached to guardrail on downstream side of bridge; read by John Eggena.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—No well-defined control, channel is sandy and somewhat shifting; may be affected by backwater at high stages of Illinois River.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.6 feet March 13 (discharge, 4,800 second-feet); minimum discharge, 30 second-feet October 1–5, 13, and 14.

1921–1923: Maximum stage recorded, 10.11 feet April 2, 1922 (discharge, 6,690 second-feet); minimum discharge, 30 second-feet September 28 to October 5, October 13 and 14, 1922.

ACCURACY.—Stage-discharge relation changed March 14. Both rating curves well defined below and fairly well defined above 2,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for low and medium stages, fair for high stages.

*Discharge measurements of Mackinaw River near Green Valley, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Oct. 18 | 0.88 | 31.2 |
| Apr. 24 | 2.15 | 229 |
| May 31 | 4.24 | 1070 |

*Daily discharge, in second-feet, of Mackinaw River near Green Valley, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 30 | 32 | 36 | 44 | 37 | 52 | 345 | 176 | 835 | 207 | 49 | 47 |
| 2 | 30 | 32 | 36 | 42 | 48 | 65 | 345 | 167 | 645 | 196 | 49 | 51 |
| 3 | 30 | 32 | 36 | 42 | 52 | 80 | 375 | 167 | 645 | 176 | 56 | 59 |
| 4 | 30 | 32 | 36 | 41 | 46 | 91 | 375 | 167 | 520 | 158 | 51 | 47 |
| 5 | 30 | 32 | 38 | 41 | 43 | 104 | 375 | 142 | 560 | 134 | 167 | 94 |
| 6 | 31 | 32 | 38 | 39 | 40 | 85 | 480 | 134 | 645 | 127 | 58 | 120 |
| 7 | 33 | 32 | 36 | 38 | 38 | 75 | 600 | 134 | 735 | 120 | 49 | 158 |
| 8 | 31 | 32 | 36 | 36 | 38 | 70 | 735 | 134 | 480 | 113 | 785 | 345 |
| 9 | 31 | 32 | 36 | 38 | 37 | 65 | 600 | 134 | 410 | 100 | 240 | 176 |
| 10 | 31 | 32 | 36 | 38 | 34 | 60 | 520 | 134 | 315 | 100 | 218 | 127 |
| 11 | 31 | 35 | 36 | 38 | 35 | 65 | 445 | 142 | 278 | 89 | 735 | 89 |
| 12 | 31 | 60 | 34 | 38 | 38 | 3,900 | 410 | 3,600 | 265 | 89 | 229 | 73 |
| 13 | 30 | 60 | 34 | 38 | 85 | 4,600 | 345 | 1,620 | 252 | 78 | 158 | 58 |
| 14 | 30 | 65 | 34 | 38 | 420 | 2,610 | 345 | 2,430 | 240 | 73 | 127 | 53 |
| 15 | 31 | 75 | 34 | 42 | 245 | 1,760 | 345 | 2,000 | 229 | 68 | 89 | 49 |
| 16 | 31 | 60 | 34 | 45 | 160 | 3,240 | 302 | 3,600 | 207 | 68 | 84 | 47 |
| 17 | 31 | 56 | 34 | 40 | 118 | 2,610 | 290 | 2,790 | 186 | 68 | 78 | 44 |
| 18 | 32 | 52 | 34 | 40 | 142 | 2,520 | 252 | 3,600 | 186 | 63 | 68 | 38 |
| 19 | 32 | 52 | 34 | 38 | 118 | 1,690 | 252 | 3,240 | 186 | 63 | 63 | 42 |
| 20 | 32 | 46 | 33 | 37 | 85 | 1,300 | 240 | 2,000 | 167 | 56 | 58 | 47 |
| 21 | 32 | 42 | 31 | 43 | 75 | 1,180 | 240 | 1,620 | 176 | 53 | 58 | 44 |
| 22 | 32 | 41 | 31 | 40 | 80 | 1,060 | 240 | 1,120 | 150 | 53 | 53 | 42 |
| 23 | 32 | 41 | 31 | 35 | 70 | 945 | 229 | 1,000 | 127 | 53 | 51 | 42 |
| 24 | 34 | 39 | 33 | 43 | 56 | 890 | 218 | 785 | 120 | 51 | 49 | 44 |
| 25 | 34 | 39 | 33 | 42 | 56 | 835 | 207 | 690 | 113 | 51 | 47 | 44 |
| 26 | 32 | 38 | 34 | 40 | 56 | 735 | 196 | 735 | 106 | 49 | 45 | 42 |
| 27 | 32 | 38 | 34 | 40 | 56 | 600 | 186 | 735 | 240 | 53 | 49 | 49 |
| 28 | 32 | 36 | 33 | 40 | 52 | 560 | 186 | 3,600 | 252 | 54 | 47 | 89 |
| 29 | 32 | 36 | 33 | 40 | ------- | 480 | 186 | 1,300 | 252 | 54 | 42 | 113 |
| 30 | 32 | 38 | 33 | 40 | ------- | 445 | 186 | 1,420 | 252 | 49 | 42 | 100 |
| 31 | 32 | ------- | 41 | 38 | ------- | 410 | ------- | 1,060 | ------- | 49 | 40 | ------- |

NOTE—Stage-discharge relation affected by ice Feb. 17 and 18; discharge estimated.

*Monthly discharge of Mackinaw River near Green Valley, Ill., for the year ending September 30, 1923*

[Drainage area, 1,100 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 34 | 30 | 31.4 | 0.029 | 0.03 |
| November | 75 | 32 | 42.3 | .038 | .04 |
| December | 41 | 31 | 34.6 | .031 | .04 |
| January | 45 | 35 | 39.8 | .036 | .04 |
| February | 420 | 34 | 84.3 | .077 | .08 |
| March | 4,600 | 52 | 1,070 | .973 | 1.12 |
| April | 735 | 186 | 335 | .305 | .34 |
| May | 3,600 | 134 | 1,310 | 1.19 | 1.37 |
| June | 835 | 106 | 326 | .296 | .33 |
| July | 207 | 49 | 87.6 | .080 | .09 |
| August | 785 | 40 | 127 | .115 | .13 |
| September | 345 | 38 | 78.8 | .072 | .08 |
| The year | 4,600 | 30 | 300 | .273 | 3.69 |

### SPOON RIVER AT SEVILLE, ILL.

LOCATION.—In sec. 24, T. 6 N., R. 1 E. fourth principal meridian, at Toledo, Peoria & Western Railway bridge a quarter of a mile east of railway station at Seville, Fulton County.

DRAINAGE AREA.—1,600 square miles.

RECORDS AVAILABLE.—July 24, 1914, to September 30, 1923.

GAGE.—Chain gage attached to bridge; read by R. M. Boales.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—A loose rock and timber dam 1½ miles below gage probably forms control at medium stages; at other stages control is clay and sand, somewhat shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.66 feet March 13 (discharge, 7,040 second-feet); minimum stage, 2.64 feet October 18 (discharge, 24 second-feet).

1914–1923: Maximum stage recorded, 26.0 feet January 23, 1916; (discharge not determined because of backwater from ice). Maximum open-water stage recorded, 23.0 feet January 24, 1916 (discharge, 17,800 second-feet). Minimum stage recorded, 1.35 feet July 31 and August 27–29, 1914 (discharge, 3.8 second-feet).

Flood of September, 1911, reached a height of about 25.8 feet on present gage; flood of 1883 reached a stage somewhat over 30.0 feet on present gage.

ACCURACY.—Stage-discharge relation practically permanent during year; affected by ice during short periods in winter. Rating curve well defined below and fairly well defined above 3,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for period of ice effect. Records good for low and medium stages and fair for high stages during open-water period; fair for period of ice effect.

*Discharge measurements of Spoon River at Seville, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge | Date | Gage height | Discharge |
|---|---|---|---|---|---|
| | *Feet* | *Sec.-ft.* | | *Feet* | *Sec.-ft.* |
| Oct. 17 | 2.78 | 33.4 | Apr. 26 | 3.72 | 244 |
| 17 | 2.78 | 34.6 | June 1 | 3.52 | 177 |

*Daily discharge, in second-feet, of Spoon River at Seville, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 44 | 35 | 102 | | 210 | 800 | 520 | 180 | 180 | 520 | 50 | 104 |
| 2 | 44 | 70 | 98 | | 195 | 550 | 520 | 171 | 156 | 340 | 43 | 104 |
| 3 | 38 | 62 | 81 | | | 560 | 520 | 156 | 162 | 240 | 50 | 68 |
| 4 | 42 | 104 | 87 | | | 560 | 480 | 150 | 130 | 225 | 47 | 180 |
| 5 | 35 | 83 | 77 | | | 900 | 480 | 135 | 180 | 375 | 104 | 100 |
| | | | | 80 | | | | | | | | |
| 6 | 462 | 100 | 87 | | | 480 | 480 | 135 | 142 | 225 | 83 | 83 |
| 7 | 130 | 79 | 102 | | | 445 | 410 | 111 | 270 | 600 | 74 | 153 |
| 8 | 107 | 60 | 116 | | | 270 | 445 | 96 | 340 | 305 | 128 | 140 |
| 9 | 96 | 54 | 109 | | | 270 | 445 | 130 | 305 | 340 | 148 | 153 |
| 10 | 76 | 70 | 81 | | | 480 | 392 | 142 | 171 | 210 | 123 | 100 |
| 11 | 58 | 41 | 87 | | | 410 | 375 | 130 | 142 | 180 | 104 | 83 |
| 12 | 47 | 162 | | | 130 | 5,440 | 358 | 2,040 | 142 | 428 | 70 | 87 |
| 13 | 44 | 410 | | | | 7,040 | 340 | 1,200 | 142 | 855 | 74 | 72 |
| 14 | 38 | 560 | | | | 5,090 | 322 | 600 | 142 | 358 | 68 | 57 |
| 15 | 42 | 445 | | 185 | | 2,460 | 322 | 520 | 125 | 180 | 57 | 50 |
| 16 | 38 | 288 | | | | 4,320 | 305 | 428 | 116 | 130 | 600 | 50 |
| 17 | 35 | 225 | | | | 4,460 | 305 | 392 | 107 | 107 | 74 | 47 |
| 18 | 24 | 195 | | 150 | | 3,240 | 288 | 340 | 96 | 85 | 68 | 40 |
| 19 | 34 | 195 | | 130 | | 2,340 | 288 | 288 | 76 | 76 | 50 | 50 |
| 20 | 34 | 153 | | 109 | | 1,200 | 270 | 288 | 76 | 76 | 43 | 57 |
| 21 | 31 | 118 | 50 | 100 | | 1,420 | 255 | 288 | 225 | 70 | 40 | 57 |
| 22 | 30 | 111 | | 90 | | 1,360 | 255 | 240 | 445 | 63 | 37 | 50 |
| 23 | 37 | 96 | | | | 1,310 | 255 | 195 | 305 | 51 | 40 | 57 |
| 24 | 37 | 100 | | 80 | | 1,800 | 288 | 195 | 210 | 54 | 33 | 57 |
| 25 | 40 | 89 | | | 500 | 1,580 | 288 | 171 | 156 | 51 | 33 | 62 |
| 26 | 47 | 89 | | | | 1,150 | 255 | 162 | 305 | 44 | 29 | 57 |
| 27 | 41 | 100 | | 335 | | 950 | 225 | 162 | 180 | 54 | 37 | 270 |
| 28 | 44 | 58 | | | | 810 | 210 | 180 | 1,000 | 180 | 392 | 600 |
| 29 | 42 | 100 | | | ------- | 720 | 210 | 305 | 900 | 118 | 128 | 560 |
| 30 | 41 | 104 | | 410 | ------- | 680 | 195 | 240 | 600 | 76 | 100 | 810 |
| 31 | 40 | ------- | | 310 | ------- | 600 | ------- | 210 | ------- | 58 | 57 | ------- |

NOTE.—Stage-discharge relation effected by ice Dec. 12 to Jan. 17, Jan. 23–29, and Feb. 3 to Mar. 2; discharge estimated from gage-height record, observer's notes, and weather records. Gage not read Jan. 19, 21, 22, and 31; discharge interpolated.

*Monthly discharge of Spoon River at Seville, Ill., for the year ending September 30, 1923*

[Drainage area, 1,600 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 462 | 24 | 61.2 | 0.038 | 0.04 |
| November | 560 | 35 | 145 | .091 | .10 |
| December | 102 | ---------- | 65.4 | .041 | .05 |
| January | ---------- | ---------- | 160 | .100 | .12 |
| February | ---------- | ---------- | 241 | .151 | .16 |
| March | 7,040 | 270 | 1,730 | 1.08 | 1.24 |
| April | 520 | 195 | 343 | .214 | .24 |
| May | 2,040 | 96 | 322 | .201 | .23 |
| June | 1,000 | 76 | 251 | .157 | .17 |
| July | 855 | 44 | 215 | .134 | .15 |
| August | 600 | 29 | 96.3 | .060 | .07 |
| September | 810 | 40 | 145 | .091 | .10 |
| The year | 7,040 | 24 | 316 | .198 | 2.67 |

SANGAMON RIVER AT MONTICELLO, ILL.

LOCATION.—In sec. 12, T. 18 N., R. 5 E. third principal meridian, at Illinois Central Railroad bridge half a mile west of Monticello, Piatt County.

DRAINAGE AREA.—550 square miles.

RECORDS AVAILABLE.—February 4, 1908, to December 31, 1912; June 23, 1914, to September 30, 1923.

GAGE.—Chain gage attached to downstream side of bridge; read by David Coay to March 31, by M. Taylor after March 31.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge and wooden trestle approach or by wading.

CHANNEL AND CONTROL.—Measuring section is at a pool; control consists of fine gravel; likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.4 feet March 16 (discharge, 5,250 second-feet); minimum stage, 1.70 feet October 2–6 (discharge, 4 second-feet).

1908–1912; 1914–1923: Maximum stage recorded, 15.2 feet May 14, 1908 (discharge, 9,280 second-feet); minimum stage, 1.5 feet July 31 to August 3, 1914 (discharge, 1 second-foot).

Maximum stage during flood of March to April, 1913, 17.7 feet March 25 (discharge not known).

ACCURACY.—Stage-discharge relation changed slightly August 12. Both rating curves fairly well defined above 15 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

The following discharge measurement was made by H. E. Grosbach:
March 17, 1923: Gage height, 12.28 feet; discharge, 3,500 second-feet.

*Daily discharge, in second-feet, of Sangamon River at Monticello, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 13 | 31 | 28 | 109 | 77 | 394 | 175 | 575 | 137 | 37 | 74 |
| 2 | 4 | 13 | 28 | 31 | 109 | 77 | 374 | 155 | 517 | 109 | 31 | 70 |
| 3 | 4 | 13 | 24 | 37 | | 77 | 311 | 145 | 452 | 101 | 20 | 66 |
| 4 | 4 | 13 | 20 | 40 | | 93 | 275 | 145 | 387 | 85 | 15 | 59 |
| 5 | 4 | 13 | 22 | 43 | | 109 | 830 | 135 | 361 | 109 | 39 | 66 |
| 6 | 4 | 13 | 31 | 49 | 75 | 145 | 860 | 126 | 323 | 109 | 63 | 90 |
| 7 | 9 | 13 | 37 | 49 | | 195 | 720 | 117 | 323 | 77 | 37 | 99 |
| 8 | 9 | 13 | 37 | 49 | | 195 | 732 | 109 | 323 | 66 | 830 | 127 |
| 9 | 9 | 15 | 37 | 52 | | 215 | 745 | 109 | 239 | 56 | 1,510 | 96 |
| 10 | 15 | 15 | 40 | 56 | 89 | 205 | 593 | 109 | 233 | 43 | 1,570 | 66 |
| 11 | 28 | 15 | 43 | 56 | 91 | 500 | 504 | 109 | 227 | 56 | 3,560 | 62 |
| 12 | 28 | 15 | 43 | 56 | 93 | 800 | 478 | 517 | 205 | 70 | 2,420 | 49 |
| 13 | 31 | 15 | 43 | 56 | 239 | 1,270 | 439 | 2,730 | 185 | 60 | 1,270 | 43 |
| 14 | 37 | 40 | 37 | 100 | | 1,750 | 439 | 4,950 | 185 | 52 | 770 | 32 |
| 15 | 28 | 49 | 37 | 145 | | 3,300 | 400 | 3,820 | 165 | 42 | 387 | 30 |
| 16 | 20 | 52 | 37 | 126 | 200 | 5,250 | 361 | 3,690 | 155 | 31 | 323 | 29 |
| 17 | 15 | 60 | 32 | 126 | | 4,800 | 348 | 4,090 | 180 | 31 | 263 | 28 |
| 18 | 15 | 63 | 28 | 126 | | 4,310 | 323 | 4,950 | 205 | 25 | 203 | 66 |
| 19 | 15 | 54 | 28 | 117 | | 3,820 | 323 | 4,090 | 155 | 20 | 180 | 62 |
| 20 | 15 | 46 | 25 | 117 | 109 | 2,060 | 299 | 2,800 | 135 | 15 | 158 | 59 |
| 21 | 13 | 43 | 25 | 113 | 101 | 1,570 | 275 | 1,510 | 126 | 15 | 127 | 117 |
| 22 | 13 | 37 | 25 | 109 | 93 | 1,400 | 263 | 1,150 | 109 | 18 | 108 | 137 |
| 23 | 13 | 37 | 25 | 101 | 85 | 1,190 | 251 | 895 | 109 | 20 | 90 | 94 |
| 24 | 13 | 37 | 25 | 77 | 77 | 1,190 | 227 | 745 | 92 | 15 | 74 | 52 |
| 25 | 13 | 37 | 25 | 74 | 77 | 900 | 227 | 575 | 85 | 11 | 66 | 56 |
| 26 | 13 | 34 | 25 | 70 | 77 | 720 | 215 | 530 | 70 | 9 | 164 | 59 |
| 27 | 13 | 31 | 25 | 70 | 77 | 700 | 205 | 620 | 63 | 15 | 263 | 117 |
| 28 | 13 | 31 | 43 | 76 | 85 | 593 | 195 | 720 | 185 | 25 | 180 | 82 |
| 29 | 13 | 31 | 56 | 81 | ------- | 530 | 185 | 960 | 126 | 44 | 82 | 66 |
| 30 | 13 | 31 | 63 | 101 | ------- | 478 | 175 | 930 | 165 | 63 | 66 | 134 |
| 31 | 13 | ------- | 46 | 101 | ------- | 413 | ------- | 680 | ------- | 56 | 82 | ------- |

NOTE.—Gage not read on Sundays; discharge interpolated. Stage-discharge relation affected by ice Feb. 3–9 and 14–19; discharge estimated.

*Monthly discharge of Sangamon River at Monticello, Ill., for the year ending September 30, 1923*

[Drainage area, 550 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 37 | 4 | 14.3 | 0.026 | 0.03 |
| November | 63 | 13 | 29.7 | .054 | .06 |
| December | 63 | 20 | 33.6 | .061 | .07 |
| January | 145 | 28 | 78.5 | .143 | .16 |
| February | ------- | ------- | 116 | .211 | .22 |
| March | 5,250 | 77 | 1,260 | 2.29 | 2.64 |
| April | 860 | 175 | 399 | .725 | .81 |
| May | 4,950 | 109 | 1,370 | 2.49 | 2.87 |
| June | 575 | 63 | 222 | .404 | .45 |
| July | 137 | 9 | 51.1 | .093 | .11 |
| August | 3,560 | 15 | 483 | .878 | 1.01 |
| September | 137 | 28 | 72.9 | .133 | .15 |
| The year | 5,250 | 4 | 347 | .631 | 8.58 |

### SANGAMON RIVER AT RIVERTON, ILL.

LOCATION.—In southeast corner of SW. ¼ sec. 9, T. 16 N., R. 4 W. third principal meridian, at Wabash Railroad bridge about a quarter of a mile west of Riverton, Sangamon County, and 2½ miles below mouth of South Fork.

DRAINAGE AREA.—2,560 square miles.

RECORDS AVAILABLE.—February 13, 1908, to December 31, 1912; August 7, 1914, to September 30, 1923.

GAGE.—Chain gage attached to bridge; read by J. J. Washburn.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Measuring section is at a pool; control consists of fine gravel; shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 23.6 feet March 20 (discharge, 11,000 second-feet); minimum stage, 7.25 feet October 6 (discharge, 16 second-feet).

1908–1912; 1914–1923: Maximum stage recorded, 28.22 feet April 11, 1922 (discharge, 22,700 second-feet); minimum stage, 6.9 feet October 3–15, 1915 (discharge, 3 second-feet).

High water of 1883 reached a height of about 32 feet on the present gage, and that of 1875 is said to have been half a foot lower (discharge not determined).

REGULATION.—The flow during low-water periods is affected by storage at the municipal reservoir at Decatur.

ACCURACY.—Stage-discharge relation changed slightly several times during year; affected by ice for a short period. Rating curves used October 1 to March 10, March 11–31, and April 1 to May 25 fairly well defined; curve used May 26 to September 30 well defined above 500 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for period of ice effect. Records fair.

*Discharge measurements of Sangamon River at Riverton, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge | Date | Gage height | Discharge |
|---|---|---|---|---|---|
| | *Feet* | *Sec.-ft.* | | *Feet* | *Sec.-ft.* |
| Oct. 21 | 7.31 | 21.0 | Apr. 28 | 10.93 | 871 |
| Mar. 17 | 21.86 | 8,050 | June 4 | 12.28 | 1,370 |

*Daily discharge, in second-feet, of Sangamon River at Riverton, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 17 | 21 | 51 | 33 | 70 | 135 | 1,630 | 745 | 1,780 | 435 | 486 | 230 |
| 2 | 18 | 23 | 46 | 31 | 72 | 135 | 1,550 | 715 | 1,820 | 386 | 321 | 250 |
| 3 | 20 | 23 | 39 | 42 | 59 | 144 | 1,310 | 655 | 1,460 | 342 | 230 | 163 |
| 4 | 18 | 23 | 36 | 74 | 46 | 135 | 1,310 | 625 | 1,260 | 364 | 200 | 129 |
| 5 | 18 | 24 | 36 | 126 | 46 | 144 | 1,390 | 685 | 1,080 | 486 | 230 | 486 |
| 6 | 16 | 24 | 40 | 144 | 50 | 153 | 1,550 | 537 | 1,180 | 435 | 486 | 1,460 |
| 7 | 23 | 26 | 42 | 96 | 60 | 230 | 1,750 | 485 | 844 | 364 | 486 | 1,460 |
| 8 | 24 | 30 | 43 | 102 | 64 | 270 | 1,930 | 459 | 717 | 342 | 1,460 | 1,300 |
| 9 | 26 | 24 | 46 | 92 | 64 | 312 | 2,030 | 433 | 686 | 321 | 812 | 717 |
| 10 | 24 | 23 | 53 | 89 | 64 | 480 | 2,330 | 409 | 626 | 300 | 568 | 513 |
| 11 | 25 | 23 | 92 | 64 | 64 | 598 | 2,030 | 433 | 568 | 364 | 686 | 410 |
| 12 | 37 | 31 | 126 | 66 | 66 | 846 | 1,790 | 715 | 540 | 342 | 910 | 342 |
| 13 | 36 | 40 | 110 | 71 | 77 | 3,380 | 1,880 | 655 | 513 | 1,040 | 1,080 | 280 |
| 14 | 39 | 48 | 74 | 65 | 312 | 4,280 | 1,980 | 685 | 486 | 1,260 | 1,340 | 240 |
| 15 | 31 | 50 | 46 | 59 | 290 | 4,830 | 2,180 | 880 | 460 | 717 | 1,580 | 230 |
| 16 | 23 | 76 | 43 | 52 | 270 | 6,320 | 2,230 | 2,230 | 435 | 486 | 1,820 | 200 |
| 17 | 24 | 68 | 33 | 64 | 220 | 8,600 | 2,180 | 3,000 | 435 | 386 | 1,870 | 181 |
| 18 | 26 | 62 | 29 | 76 | 230 | 9,230 | 2,080 | 3,360 | 386 | 321 | 1,150 | 230 |
| 19 | 21 | 53 | 29 | 94 | 240 | 9,070 | 1,790 | 3,940 | 364 | 260 | 626 | 364 |
| 20 | 20 | 46 | 29 | 102 | 220 | 11,000 | 1,550 | 4,290 | 342 | 230 | 513 | 1,220 |
| 21 | 20 | 43 | 31 | 118 | 153 | 10,600 | 1,390 | 4,580 | 321 | 200 | 386 | 1,340 |
| 22 | 29 | 47 | 32 | 126 | 102 | 9,730 | 1,350 | 4,580 | 300 | 172 | 364 | 1,120 |
| 23 | 27 | 46 | 36 | 144 | 96 | 8,600 | 1,190 | 4,580 | 280 | 154 | 300 | 877 |
| 24 | 25 | 41 | 36 | 118 | 96 | 7,320 | 1,050 | 4,290 | 280 | 146 | 260 | 656 |
| 25 | 23 | 38 | 34 | 110 | 89 | 6,080 | 985 | 3,660 | 250 | 138 | 230 | 513 |
| 26 | 21 | 36 | 33 | 84 | 94 | 4,830 | 950 | 2,900 | 260 | 138 | 220 | 435 |
| 27 | 20 | 36 | 31 | 82 | 110 | 3,600 | 1,160 | 2,020 | 300 | 146 | 300 | 486 |
| 28 | 20 | 37 | 39 | 78 | 118 | 3,220 | 845 | 1,620 | 626 | 163 | 364 | 1,010 |
| 29 | 20 | 41 | 64 | 76 | ------- | 2,770 | 810 | 1,500 | 513 | 163 | 386 | 1,180 |
| 30 | 20 | 56 | 68 | 74 | ------- | 2,280 | 745 | 1,540 | 513 | 154 | 321 | 1,300 |
| 31 | 21 | ------- | 77 | 71 | ------- | 1,920 | ------- | 1,620 | ------- | 138 | 260 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 15–20 and Feb. 4–11; discharge estimated from gage-height record, observer's notes, and weather records.

*Monthly discharge of Sangamon River at Riverton, Ill., for the year ending September 30, 1923*

[Drainage area, 2,560 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 39 | 16 | 23.6 | 0.009 | 0.01 |
| November | 76 | 21 | 38.6 | .015 | .02 |
| December | 126 | 29 | 49.2 | .019 | .02 |
| January | 144 | 31 | 84.6 | .033 | .04 |
| February | 312 | 46 | 123 | .048 | .05 |
| March | 11,000 | 135 | 3,910 | 1.53 | 1.76 |
| April | 2,330 | 745 | 1,560 | .609 | .68 |
| May | 4,580 | 409 | 1,900 | .742 | .85 |
| June | 1,820 | 250 | 654 | .255 | .28 |
| July | 1,260 | 138 | 351 | .137 | .16 |
| August | 1,870 | 200 | 653 | .255 | .29 |
| September | 1,460 | 129 | 644 | .252 | .28 |
| The year | 11,000 | 16 | 840 | .328 | 4.44 |

SOUTH FORK OF SANGAMON RIVER AT POWER PLANT, NEAR TAYLORVILLE, ILL.

LOCATION.—In sec. 14, T. 13 N., R. 3 W., at Chicago & Illinois Midland Railroad bridge 6 miles northwest of Taylorville, Christian County, 500 feet east of power plant of Central Illinois Public Service Co., 5 miles below mouth of Bear Creek, and 8 miles below station formerly maintained at Wabash Railroad bridge.

DRAINAGE AREA.—510 square miles.

RECORDS AVAILABLE.—May 18, 1917, to September 30, 1923.

GAGE.—Chain gage attached to bridge; read by H. Hendricks.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of clay and mud; control fairly permanent at low stages until July, 1923, when channel at gage was filled with rock. Banks wooded and subject to overflow above medium stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 21.00 feet March 19 (discharge, 6,900 second-feet); minimum discharge, no flow, October 6–23.

1917–1923: Maximum discharge recorded, 11,800 second-feet March 15, 1922; minimum discharge, no flow, August 29 and October 6–23, 1922.

A stage of about 27.3 feet on present gage is said to have been reached January 31, 1916 (discharge, 11,300 second-feet).

DIVERSIONS.—An average of about half a second-foot is used for boiler feed and other purposes at power plant just above gage.

ACCURACY.—Stage-discharge relation changed by filling in channel at bridge where gage is located in July. Rating curve used October 1 to July 10 fairly well defined; curve used after July 10 poorly defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair for period October 1 to July 10, poor after July 10.

The following discharge measurement was made by H. E. Grosbach:

March 16,1923: Gage height, 18.48 feet; discharge, 4,590 second-feet.

*Daily discharge, in second-feet, of South Fork of Sangamon River at power plant, near Taylorville, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.2 | 1.2 | 5.2 | 100 | 34 | 86 | 214 | 142 | 547 | 34 | 174 | 30 |
| 2 | .2 | 1.7 | 5.2 | 67 | 36 | 67 | 196 | 128 | 300 | 28 | 156 | 32 |
| 3 | .4 | 1.7 | 4.4 | 61 | 36 | 124 | 196 | 114 | 180 | 20 | 69 | 34 |
| 4 | 1.2 | 1.7 | 5.2 | 55 | 34 | 180 | 196 | 107 | 142 | 28 | 58 | 30 |
| 5 | .6 | 1.7 | 5.2 | 49 | 35 | 210 | 205 | 100 | 93 | 26 | 202 | 210 |
| 6 | .0 | 1.7 | 46 | 44 | 36 | 241 | 270 | 100 | 86 | 25 | 345 | 393 |
| 7 | .0 | 1.7 | 86 | 44 | 34 | 270 | 322 | 93 | 86 | 24 | 333 | 393 |
| 8 | .0 | 1.7 | 100 | 55 | 29 | 415 | 300 | 86 | 70 | 26 | 156 | 275 |
| 9 | .0 | 1.7 | 128 | 61 | 29 | 415 | 300 | 86 | 68 | 172 | 165 | 132 |
| 10 | .0 | 8 | 100 | 29 | 32 | 290 | 223 | 86 | 67 | 156 | 95 | 88 |
| 11 | .0 | 14 | 70 | 32 | 39 | 214 | 205 | 86 | 61 | 58 | 102 | 66 |
| 12 | .0 | 21 | 61 | 34 | 39 | 1,240 | 188 | 100 | 67 | 58 | 95 | 50 |
| 13 | .0 | 27 | 49 | 29 | 142 | 2,460 | 205 | 107 | 79 | 48 | 69 | 72 |
| 14 | .0 | 34 | 17 | 49 | 128 | 2,520 | 451 | 114 | 128 | 58 | 58 | 95 |
| 15 | .0 | 17 | 13 | 39 | 100 | 2,580 | 697 | 100 | 93 | 75 | 58 | 95 |
| 16 | .0 | 17 | 7.4 | 42 | 90 | 4,150 | 755 | 355 | 79 | 69 | 58 | 46 |
| 17 | .0 | 17 | 5.2 | 32 | 80 | 6,500 | 601 | 601 | 52 | 75 | 56 | 36 |
| 18 | .0 | 25 | 3.5 | 37 | 70 | 6,500 | 601 | 547 | 44 | 69 | 53 | 308 |
| 19 | .0 | 21 | 2.2 | 42 | 64 | 6,900 | 415 | 415 | 42 | 69 | 38 | 580 |
| 20 | .0 | 17 | 1.7 | 47 | 29 | 4,590 | 360 | 360 | 39 | 69 | 38 | 520 |
| 21 | .0 | 13 | 1.2 | 52 | 39 | 2,280 | 300 | 300 | 39 | 69 | 38 | 520 |
| 22 | .0 | 7.4 | 2.2 | 46 | 42 | 1,530 | 300 | 180 | 29 | 64 | 34 | 275 |
| 23 | .0 | 6.3 | 2.2 | 44 | 49 | 990 | 300 | 149 | 26 | 58 | 30 | 132 |
| 24 | 5.2 | 5.2 | 3.5 | 39 | 49 | 680 | 300 | 135 | 26 | 81 | 15 | 56 |
| 25 | 7.4 | 5.2 | 4.4 | 34 | 44 | 631 | 214 | 128 | 28 | 58 | 12 | 50 |
| 26 | 5.2 | 4.4 | 5.2 | 29 | 44 | 547 | 188 | 114 | 20 | 48 | 15 | 40 |
| 27 | 4.4 | 4.4 | 93 | 34 | 86 | 415 | 156 | 107 | 46 | 22 | 17 | 36 |
| 28 | 1.7 | 5.2 | 135 | 34 | 86 | 403 | 172 | 128 | 49 | 18 | 17 | 124 |
| 29 | 1.4 | 5.2 | 128 | 29 | ------- | 344 | 156 | 149 | 52 | 346 | 15 | 124 |
| 30 | 1.2 | 6.3 | 118 | 34 | ------- | 311 | 149 | 415 | 55 | 675 | 17 | 95 |
| 31 | 1.2 | ------- | 109 | 34 | ------- | 300 | ------- | 523 | ------- | 455 | 15 | ------- |

NOTE.—No gage-height record Oct. 5, 9–12, 14, 20, 21, 29, Nov. 5, 8, 10–13, 20, Dec. 6, 20, 25, 30, 31, Jan. 18, 20, Feb. 5, 16, 17, Mar. 3, 5, 20, Apr. 14, 20, May 20, June 9, 28, July 5, 6, 20, 22, 29, Aug. 5, 20, Sept. 5, 13, and 18; discharge interpolated.

*Monthly discharge of South Fork of Sangamon River at power plant, near Taylorville, Ill., for the year ending September 30, 1923*

[Drainage area, 510 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 7.4 | 0.0 | 0.98 | 0.002 | 0.002 |
| November | 34 | 1.2 | 9.85 | .019 | .02 |
| December | 135 | 1.2 | 42.5 | .083 | .10 |
| January | 100 | 29 | 43.8 | .086 | .10 |
| February | 142 | 29 | 55.5 | .109 | .11 |
| March | 6,900 | 67 | 1,560 | 3.06 | 3.53 |
| April | 755 | 149 | 304 | .596 | .66 |
| May | 601 | 86 | 199 | .390 | .45 |
| June | 547 | 20 | 89.8 | .176 | .20 |
| July | 675 | 18 | 99.4 | .195 | .22 |
| August | 345 | 12 | 84.0 | .165 | .19 |
| September | 580 | 30 | 105.0 | .324 | .36 |
| The year | 6,900 | .0 | 223 | .437 | 5.94 |

### CROOKED CREEK AT RIPLEY, ILL.

LOCATION.—In sec. 33, T. 1 N., R. 2 W., at highway bridge one-fourth mile east of Ripley, Brown County.

DRAINAGE AREA.—1,310 square miles (measured on United States Geological Survey map of Illinois; scale, 1:500,000).

RECORDS AVAILABLE.—March 12, 1921, to September 30, 1923.

GAGE.—Chain gage attached to downstream side of bridge; read by Mrs. John Hess.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of soft mud and clay; control not well defined, likely to shift. Banks high; subject to overflow only at extreme high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.0 feet March 13 (discharge, 5,050 second-feet); minimum stage, 2.00 feet October 19 (discharge, 10 second-feet).

1921–1923: Maximum stage recorded, 18.2 feet April 11, 1922 (discharge, 6,370 second-feet); minimum discharge, 9 second-feet September 8 and 9, 1922.

Old high-water mark, date unknown, is at a stage of about 26.0 feet on gage.

ACCURACY.—Stage-discharge relation permanent during year; affected by ice for a short period. Rating curve fairly well defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for medium stages; fair for very low and for high stages; poor for ice periods.

*Discharge measurements of Crooked Creek at Ripley, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet.* | *Sec.-ft.* |
| Apr. 27 | 3.32 | 140 |
| June 2 | 3.38 | 176 |

*Daily discharge, in second-feet, of Crooked Creek at Ripley, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 23 | 60 | 79 | | 168 | 85 | 650 | 152 | 285 | 168 | 45 | 152 |
| 2 | 21 | 68 | 79 | | 152 | 79 | 625 | 145 | 175 | 62 | 38 | 160 |
| 3 | 22 | 85 | 73 | | 138 | 79 | 625 | 145 | 225 | 115 | 23 | 168 |
| 4 | 23 | 79 | 68 | | | 85 | 500 | 142 | 205 | 820 | 11 | 175 |
| 5 | 23 | 73 | 60 | | | 115 | 345 | 138 | 205 | 1,720 | 19 | 175 |
| 6 | 23 | 58 | 58 | | | 122 | 325 | 130 | 190 | 1,060 | 115 | 168 |
| 7 | 51 | 54 | 57 | 45 | | 138 | 325 | 122 | 175 | 1,090 | 730 | 160 |
| 8 | 225 | 51 | 57 | | | 145 | 325 | 115 | 160 | 1,030 | 790 | 145 |
| 9 | 245 | 47 | 56 | | | 152 | 285 | 62 | 145 | 880 | 2,600 | 115 |
| 10 | 79 | 39 | 56 | | | 152 | 265 | 60 | 68 | 760 | 1,720 | 38 |
| 11 | 56 | 34 | 56 | | | 152 | 245 | 57 | 62 | 475 | 1,330 | 31 |
| 12 | 35 | 700 | 55 | | | 4,570 | 245 | 2,730 | 60 | 225 | 450 | 27 |
| 13 | 35 | 1,270 | 54 | 53 | | 5,050 | 205 | 2,680 | 55 | 190 | 55 | 22 |
| 14 | 35 | 1,360 | | 55 | | 2,860 | 205 | 2,550 | 50 | 175 | 115 | 18 |
| 15 | 29 | 1,270 | | 58 | | 2,820 | 205 | 2,120 | 45 | 168 | 115 | 18 |
| 16 | 20 | 760 | | 108 | 75 | 2,640 | 190 | 1,060 | 40 | 175 | 122 | 20 |
| 17 | 17 | 285 | | 205 | | 3,090 | 175 | 305 | 42 | 79 | 130 | 25 |
| 18 | 14 | 245 | | 145 | | 3,040 | 168 | 190 | 44 | 43 | 138 | 108 |
| 19 | 10 | 205 | | 108 | | 3,040 | 138 | 880 | 44 | 43 | 100 | 79 |
| 20 | 14 | 190 | | 92 | | 2,780 | 130 | 500 | 42 | 46 | 73 | 68 |
| 21 | 23 | 175 | | 51 | | 2,820 | 122 | 500 | 40 | 44 | 68 | 59 |
| 22 | 30 | 168 | 45 | 47 | | 2,120 | 138 | 175 | 36 | 35 | 60 | 56 |
| 23 | 23 | 160 | | 46 | | 730 | 145 | 245 | 33 | 22 | 56 | 21 |
| 24 | 19 | 92 | | 40 | | 700 | 152 | 115 | 33 | 23 | 32 | 19 |
| 25 | 17 | 100 | | 38 | | 650 | 168 | 85 | 38 | 29 | 12 | 19 |
| 26 | 14 | 92 | | 36 | | 600 | 168 | 79 | 40 | 37 | 115 | 345 |
| 27 | 16 | 92 | | 79 | | 600 | 175 | 108 | 62 | 39 | 122 | 1,960 |
| 28 | 20 | 92 | | 100 | | 600 | 175 | 115 | 1,060 | 42 | 122 | 3,970 |
| 29 | 22 | 85 | | 108 | ------- | 575 | 168 | 175 | 760 | 47 | 138 | 2,780 |
| 30 | 23 | 85 | | 168 | ------- | 575 | 160 | 285 | 500 | 50 | 145 | 940 |
| 31 | 26 | ------- | | 168 | ------- | 550 | ------- | 365 | ------- | 52 | 152 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Jan. 12 and Feb. 4–28; discharge estimated from gage-height record, observers notes, records on Spoon River at Seville, and weather records.

*Monthly discharge of Crooked Creek at Ripley, Ill., for the year ending September 30, 1923*

[Drainage area, 1,310 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 245 | 10 | 39.8 | 0.030 | 0.03 |
| November | 1,360 | 34 | 269 | .205 | .23 |
| December | ---------- | ---------- | 52.2 | .040 | .05 |
| January | 205 | ---------- | 72.4 | .055 | .06 |
| February | ---------- | ---------- | 83.3 | .064 | .07 |
| March | 5,050 | 79 | 1,350 | 1.03 | 1.19 |
| April | 650 | 122 | 258 | .197 | .22 |
| May | 2,730 | 57 | 533 | .407 | .47 |
| June | 1,060 | 33 | 164 | .125 | .14 |
| July | 1,720 | 22 | 314 | .240 | .28 |
| August | 2,600 | 11 | 314 | .240 | .28 |
| September | 3,970 | 18 | 401 | .306 | .34 |
| The year | 5,050 | 10 | 323 | .247 | 3.36 |

### MACOUPIN CREEK NEAR KANE, ILL.

LOCATION.—In sec. 7, T. 9 N., R. 11 W., at Chicago & Alton Railway bridge 3 miles northwest of Kane, Greene County.

DRAINAGE AREA.—865 square miles (measured on United States Geological Survey map; scale, 1:500,000).

RECORDS AVAILABLE.—March 11, 1921, to September 30, 1923.

GAGE.—Vertical staff; lower section on old piling between piers, intermediate section on left pier, high-water section on transmission line pole on left bank 20 feet above bridge until July, 1923, on left abutment after July, 1923; read by Claude Linn.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading; during high water also at bridges over flood channels one-fourth mile south and one-eighth mile north of main channel.

CHANNEL AND CONTROL.—Control is clay and heavy mud, somewhat shifting. At high stages creek overflows above gage into two high-water channels.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.75 feet March 18 (discharge, 4,400 second-feet); minimum stage, 0.5 foot October 3, 5, and 15 (discharge, 1 second-foot).

1921–1923: Maximum stage recorded, 21.6 feet March 15, 1922 (discharge, 15,000 second-feet); minimum stage, 0.5 foot September 29, October 3, 5, and 15, 1922 (discharge, 1 second-foot).

High water of 1915 reached a stage of 26.5 feet on present gage.

ACCURACY.—During 1923 Macoupin Creek was improved by dredging a new channel across bends, decreasing length and increasing slope of stream. Dredging began at mouth of creek in spring and reached gage about August 1. Channel not changed for 150 feet below gage and low-water control apparently unchanged. No high water occurred after channel had been changed in vicinity of gage. From about May 26 to July 31, stage-discharge relation was affected by cofferdams placed for dredging operations. Rating curve used October 1 to May 25 fairly well defined, rating curve used May 26 to July 31 poorly defined, rating curve used after July 31 fairly well defined. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as explained in footnote to table of daily discharge. Records fair for period October 1 to May 25; poor for remainder of year.

*Discharge measurements of Macoupin Creek near Kane, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| June 3 | 3.07 | 137 |
| Sept. 21 | 4.02 | 382 |

*Daily discharge, in second-feet, of Macoupin Creek near Kane, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 5 | 2.5 | 80 | 6 | 33 | 85 | 70 | 100 | 21 | 5 | 177 |
| 2 | 1.5 | 6.5 | 2 | 39 | 12 | 27 | 80 | 66 | 73 | 28 | 5 | 53 |
| 3 | 1 | 6.5 | 1.5 | 22 | 14 | 22 | 80 | 53 | 184 | 17 | 61 | 235 |
| 4 | 1.5 | 4 | 3 | 12 | 4 | 27 | 90 | 50 | 243 | 13 | 12 | 280 |
| 5 | 1 | 5 | 8 | 12 | 4 | 39 | 136 | 46 | 115 | 7 | 61 | 510 |
| 6 | 2 | 6.5 | 5 | 12 | 4 | 61 | 130 | 42 | 69 | 8 | 280 | 510 |
| 7 | 2.5 | 10 | 446 | 20 | 4 | 100 | 100 | 39 | 26 | 7 | 235 | 355 |
| 8 | 2.5 | 8 | 526 | 61 | 4 | 177 | 80 | 39 | 73 | 1,520 | 111 | 280 |
| 9 | 2.5 | 10 | 220 | 177 | 4 | 100 | 100 | 39 | 26 | 1,300 | 80 | 205 |
| 10 | 2.5 | 8 | 177 | 12 | 3 | 100 | 80 | 36 | 17 | 366 | 177 | 205 |
| 11 | 2 | 6.5 | 136 | 8 | 4 | 61 | 75 | 33 | 19 | 100 | 136 | 33 |
| 12 | 2.5 | 8 | 27 | 39 | 6 | 2,440 | 70 | 39 | 526 | 57 | 80 | 53 |
| 13 | 2 | 6.5 | 12 | 12 | 574 | 3,360 | 111 | 57 | 17 | 100 | 61 | 39 |
| 14 | 2.5 | 53 | 17 | 12 | 760 | 2,320 | 622 | 53 | 131 | 198 | 39 | 46 |
| 15 | 1 | 46 | 12 | 22 | 430 | 542 | 850 | 123 | 90 | 81 | 33 | 39 |
| 16 | 2.5 | 12 | 6 | 20 | 235 | 3,300 | 590 | 136 | 81 | 73 | 39 | 33 |
| 17 | 2.5 | 10 | 6 | 22 | 206 | 4,100 | 340 | 1,190 | 21 | 57 | 12 | 27 |
| 18 | 2 | 8 | 4 | 12 | 177 | 4,400 | 235 | 542 | 56 | 184 | 53 | 39 |
| 19 | 3 | 10 | 2 | 8 | 106 | 1,510 | 177 | 355 | 90 | 273 | 12 | 850 |
| 20 | 2 | 6.5 | 2 | 10 | 36 | 526 | 149 | 235 | 73 | 198 | 5 | 510 |
| 21 | 2.5 | 8 | 2 | 10 | 24 | 385 | 136 | 205 | 13 | 43 | 12 | 370 |
| 22 | 2.5 | 6.5 | 2 | 5 | 12 | 325 | 142 | 191 | 7 | 37 | 5 | 220 |
| 23 | 3 | 5 | 2 | 8 | 12 | 280 | 235 | 130 | 5 | 31 | 8 | 136 |
| 24 | 3 | 4 | 3 | 12 | 12 | 235 | 355 | 90 | 5 | 43 | 2 | 80 |
| 25 | 3 | 3 | 3 | 5 | 8 | 220 | 205 | 36 | 3 | 50 | 2 | 46 |
| 26 | 2.5 | 3 | 3 | 5 | 22 | 177 | 149 | 184 | 2 | 43 | 3 | 42 |
| 27 | 3 | 3 | 5 | 5 | 27 | 163 | 106 | 110 | 303 | 26 | 280 | 80 |
| 28 | 3 | 2.5 | 220 | 5 | 39 | 136 | 100 | 170 | 350 | 100 | 46 | 136 |
| 29 | 3 | 3 | 177 | 5 | ------- | 123 | 95 | 184 | 90 | 17 | 33 | 220 |
| 30 | 4 | 2 | 136 | 5 | ------- | 106 | 80 | 131 | 43 | 7 | 12 | 295 |
| 31 | 4 | ------- | 80 | 4 | ------- | 100 | ------- | 110 | ------- | 31 | 220 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 16–23, Feb. 3–11, and 16–21; discharge estimated from observer's notes and gage-height and weather records. Gage not read Aug. 6, 7, 27, Sept. 3–8, 19, and 20; discharge estimated from records of flow of near-by streams and rainfall records.

*Monthly discharge of Macoupin Creek near Kane, Ill., for the year ending September 30, 1923*

[Drainage area, 865 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 4 | 1 | 2.40 | 0.003 | 0.003 |
| November | 53 | 2 | 9.20 | .011 | .01 |
| December | 526 | 1.5 | 72.5 | .084 | .10 |
| January | 177 | 4 | 22.0 | .025 | .03 |
| February | 760 | 3 | 98.2 | .113 | .12 |
| March | 4,400 | 22 | 822 | .950 | 1.10 |
| April | 850 | 70 | 193 | .223 | .25 |
| May | 1,190 | 33 | 154 | .178 | .21 |
| June | 526 | 2 | 95.0 | .110 | .12 |
| July | 1,520 | 7 | 162 | .187 | .22 |
| August | 280 | 2 | 68.4 | .079 | .09 |
| September | 850 | 27 | 203 | .235 | .26 |
| The year | 4,400 | 1 | 160 | .185 | 2.51 |

### KASKASKIA RIVER AT VANDALIA, ILL.

LOCATION.—In sec. 16, T. 6 N., R. 1 E. third principal meridian, at highway bridge at east end of Main Street, Vandalia, Fayette County, 3½ miles above Hickory Creek.

DRAINAGE AREA.—1,980 square miles.

RECORDS AVAILABLE.—February 26, 1908, to December 31, 1912; August 11, 1914, to September 30, 1923.

GAGE.—Chain gage attached to bridge; read by Wilson Haley.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Measuring section is at a pool; control likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 21.6 feet March 17 (discharge, 13,700 second-feet); minimum stage, 0.65 foot October 5 and 6 (discharge, 18 second-feet).

1908–1912; 1914–1923: Maximum discharge recorded, 18,800 second-feet April 18, 1922; minimum discharge, 3.5 second-feet August 22, 1911.

ACCURACY.—Stage-discharge relation changed slightly March 21; affected by ice for a few days in December and February. Both rating curves well defined between 30 and 11,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

*Discharge measurements of Kaskaskia River at Vandalia, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Mar. 16 | 18.45 | 8,480 |
| May 23 | 5.21 | 882 |
| Sept. 17 | 1.50 | 96.0 |

*Daily discharge, in second-feet, of Kaskaskia River at Vandalia, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19 | 28 | 116 | 750 | 2,560 | 415 | 1,470 | 690 | 630 | 190 | 237 | 81 |
| 2 | 19 | 29 | 109 | 500 | 1,260 | 395 | 1,400 | 630 | 720 | 182 | 182 | 1,750 |
| 3 | 19 | 28 | 102 | 395 | 690 | 395 | 1,300 | 630 | 630 | 175 | 146 | 1,890 |
| 4 | 19 | 28 | 90 | 355 | 630 | 1,750 | 1,260 | 575 | 575 | 168 | 182 | 750 |
| 5 | 18 | 26 | 275 | 315 | 525 | 1,820 | 1,330 | 525 | 780 | 205 | 205 | 475 |
| 6 | 18 | 28 | 475 | 295 | 475 | 2,360 | 1,680 | 500 | 455 | 339 | 237 | 500 |
| 7 | 395 | 26 | 1,470 | 145 | 435 | 3,490 | 1,680 | 475 | 415 | 339 | 455 | 630 |
| 8 | 1,610 | 28 | 3,290 | 355 | 395 | 2,520 | 1,820 | 455 | 375 | 900 | 321 | 475 |
| 9 | 435 | 27 | 3,000 | 198 | 435 | 1,960 | 1,750 | 435 | 339 | 720 | 375 | 269 |
| 10 | 255 | 26 | 1,470 | 138 | 375 | 1,720 | 1,720 | 415 | 339 | 435 | 600 | 205 |
| 11 | 123 | 27 | 690 | 109 | 395 | 1,400 | 1,750 | 415 | 2,200 | 286 | 435 | 175 |
| 12 | 116 | 28 | 435 | 90 | 455 | 5,490 | 1,680 | 415 | 2,040 | 253 | 253 | 435 |
| 13 | 84 | 30 | 335 | 84 | 2,880 | 6,880 | 3,200 | 415 | 750 | 253 | 375 | 190 |
| 14 | 78 | 42 | 275 | 67 | 1,860 | 7,560 | 4,240 | 415 | 500 | 205 | 455 | 139 |
| 15 | 72 | 90 | 415 | 550 | 1,050 | 8,320 | 5,770 | 750 | 415 | 205 | 475 | 119 |
| 16 | 67 | 84 | 190 | 455 | 930 | 10,100 | 3,290 | 1,920 | 395 | 182 | 435 | 107 |
| 17 | 42 | 78 | 160 | 395 | 660 | 13,700 | 2,640 | 1,890 | 357 | 160 | 357 | 96 |
| 18 | 42 | 78 | 116 | 395 | 630 | 9,820 | 1,820 | 1,680 | 286 | 139 | 286 | 102 |
| 19 | 36 | 72 | 116 | 395 | 630 | 9,030 | 1,640 | 1,540 | 286 | 132 | 237 | 1,330 |
| 20 | 36 | 67 | 116 | 435 | 600 | 8,060 | 1,540 | 1,330 | 253 | 126 | 190 | 1,440 |
| 21 | 35 | 62 | 116 | 435 | 575 | 7,100 | 1,400 | 990 | 237 | 119 | 168 | 900 |
| 22 | 34 | 53 | 109 | 415 | 525 | 6,270 | 1,300 | 930 | 221 | 113 | 146 | 435 |
| 23 | 32 | 49 | 109 | 375 | 475 | 5,560 | 1,260 | 870 | 205 | 102 | 119 | 375 |
| 24 | 31 | 46 | 109 | 355 | 455 | 4,830 | 1,120 | 870 | 196 | 102 | 113 | 308 |
| 25 | 31 | 42 | 109 | 315 | 435 | 4,410 | 1,080 | 750 | 182 | 91 | 107 | 253 |
| 26 | 30 | 42 | 109 | 295 | 415 | 4,140 | 990 | 630 | 160 | 86 | 96 | 237 |
| 27 | 30 | 46 | 138 | 315 | 415 | 3,290 | 900 | 575 | 357 | 81 | 91 | 205 |
| 28 | 29 | 49 | 275 | 315 | 435 | 2,560 | 870 | 575 | 660 | 81 | 107 | 190 |
| 29 | 28 | 46 | 600 | 335 | ------- | 2,240 | 840 | 550 | 321 | 76 | 119 | 435 |
| 30 | 28 | 46 | 930 | 335 | ------- | 2,000 | 810 | 660 | 237 | 76 | 96 | 295 |
| 31 | 28 | ------- | 990 | 315 | ------- | 1,750 | ------- | 575 | ------- | 76 | 91 | ------- |

NOTE.—Stage-discharge relation affected by ice Dec. 17–25 and Feb. 15–22; discharge estimated from gage-height record, observer's notes, and weather records.

*Monthly discharge of Kaskaskia River at Vandalia, Ill., for the year ending September 30, 1923*

[Drainage area, 1,980 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 1,610 | 18 | 124 | 0.063 | 0.07 |
| November | 90 | 26 | 45.0 | .023 | .03 |
| December | 3,290 | 90 | 543 | .274 | .32 |
| January | 750 | 67 | 330 | .167 | .19 |
| February | 2,880 | 375 | 771 | .389 | .40 |
| March | 13,700 | 395 | 4,560 | 2.30 | 2.65 |
| April | 5,770 | 810 | 1,780 | .899 | 1.00 |
| May | 1,920 | 415 | 777 | .392 | .45 |
| June | 2,200 | 160 | 517 | .261 | .29 |
| July | 900 | 76 | 213 | .108 | .12 |
| August | 600 | 91 | 248 | .125 | .14 |
| September | 1,890 | 81 | 493 | .249 | .28 |
| The year | 13,700 | 18 | 870 | .439 | 5.94 |

### BIG MUDDY RIVER AT PLUMFIELD, ILL.

LOCATION.—In W. ½ sec. 20, T. 7 S., R. 2 E., at highway bridge in Plumfield, Franklin County, 6 miles west of West Frankfort, 1½ miles below mouth of Middle Fork, and 2 miles below station formerly maintained at Chicago, Burlington & Quincy Railroad bridge.

DRAINAGE AREA.—753 square miles.

RECORDS AVAILABLE.—August 18, 1914, to September 30, 1923; June 16, 1908, to December 31, 1912, records were obtained at Chicago, Burlington & Quincy Railroad bridge.

GAGE.—Chain gage attached to bridge; read by Louis Robertson.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Practically permanent at low stages. Banks wooded above medium stage. Right bank is overflowed at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 23.0 feet, March 19 (discharge, 9,000 second-feet); minimum stage, 0.70 foot October 1 and 2 (discharge, 0.5 second-foot).

1914–1923: Maximum stage recorded, 30.2 feet February 1, 1916 (discharge, 16,300 second-feet); minimum discharge, no flow, August 18–26, 1914.

ACCURACY.—Stage-discharge relation practically permanent during year except as affected by vegetation at high stages; not affected by ice during winter. Rating curve well defined below and fairly well defined above 300 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for low and medium stages; fair for high stages.

*Discharge measurements of Big Muddy River at Plumfield, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Mar. 15 | 15.62 | 3,100 |
| May 23 | 17.27 | 2,920 |

*Daily discharge, in second-feet, of Big Muddy River at Plumfield, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.5 | 2.6 | 7 | 2,850 | 1,740 | 1,450 | 90 | 191 | 746 | 36 | 6 | 42 |
| 2 | .5 | 1.6 | 7 | 2,750 | 2,650 | 1,180 | 77 | 141 | 555 | 29 | 6 | 121 |
| 3 | .6 | 1.8 | 7 | 2,480 | 3,840 | 912 | 73 | 103 | 270 | 22 | 6 | 322 |
| 4 | .7 | 2.6 | 25 | 2,080 | 5,060 | 682 | 73 | 406 | 141 | 18 | 9 | 378 |
| 5 | .6 | 2.8 | 69 | 1,300 | 5,140 | 844 | 336 | 555 | 90 | 15 | 650 | 495 |
| 6 | .7 | 3.0 | 108 | 602 | 4,620 | 1,230 | 586 | 322 | 66 | 13 | 1,230 | 420 |
| 7 | 1.8 | 3.0 | 181 | 213 | 3,780 | 1,620 | 794 | 161 | 52 | 11 | 1,650 | 929 |
| 8 | 3.4 | 2.8 | 258 | 126 | 2,750 | 1,840 | 827 | 94 | 42 | 10 | 1,880 | 1,120 |
| 9 | 4.2 | 2.7 | 666 | 103 | 1,590 | 2,120 | 698 | 62 | 42 | 9 | 2,060 | 1,080 |
| 10 | 94 | 2.8 | 634 | 90 | 895 | 2,080 | 510 | 45 | 42 | 8 | 2,060 | 1,050 |
| 11 | 62 | 3.0 | 296 | 85 | 435 | 1,680 | 336 | 116 | 66 | 8 | 1,670 | 450 |
| 12 | 31 | 3.0 | 151 | 77 | 270 | 2,120 | 202 | 181 | 682 | 10 | 1,060 | 141 |
| 13 | 19 | 3.2 | 69 | 66 | 997 | 2,360 | 714 | 90 | 1,170 | 131 | 435 | 112 |
| 14 | 14 | 5.8 | 42 | 77 | 1,380 | 2,900 | 1,380 | 52 | 1,450 | 85 | 131 | 103 |
| 15 | 12 | 7.0 | 31 | 151 | 1,650 | 3,400 | 1,840 | 2,240 | 1,590 | 48 | 66 | 85 |
| 16 | 12 | 8.0 | 25 | 480 | 1,770 | 4,980 | 2,280 | 3,230 | 1,430 | 94 | 48 | 62 |
| 17 | 11 | 8.8 | 21 | 570 | 1,590 | 7,230 | 2,560 | 4,650 | 666 | 108 | 698 | 42 |
| 18 | 5.8 | 9.8 | 19 | 309 | 895 | 8,900 | 2,600 | 5,210 | 270 | 141 | 1,290 | 34 |
| 19 | 12 | 9.5 | 14 | 151 | 336 | 9,000 | 2,050 | 5,590 | 121 | 108 | 1,470 | 270 |
| 20 | 12 | 9.0 | 12 | 98 | 191 | 8,100 | 1,500 | 5,280 | 77 | 77 | 1,510 | 465 |
| 21 | 12 | 8.8 | 10 | 213 | 126 | 6,780 | 666 | 4,650 | 55 | 48 | 1,190 | 480 |
| 22 | 8.8 | 7.0 | 10 | 682 | 103 | 5,620 | 378 | 3,810 | 121 | 29 | 827 | 570 |
| 23 | 8.0 | 6.0 | 9 | 946 | 90 | 4,480 | 270 | 2,940 | 131 | 22 | 1,130 | 336 |
| 24 | 6.8 | 5.0 | 8 | 1,010 | 81 | 3,600 | 171 | 2,120 | 66 | 17 | 1,310 | 161 |
| 25 | 6.2 | 5.0 | 8 | 730 | 77 | 3,000 | 112 | 1,390 | 39 | 14 | 1,370 | 94 |
| 26 | 5.0 | 5.5 | 7 | 246 | 336 | 2,200 | 85 | 844 | 27 | 11 | 1,100 | 62 |
| 27 | 4.6 | 6.2 | 1,150 | 666 | 963 | 1,210 | 77 | 322 | 23 | 10 | 364 | 42 |
| 28 | 3.2 | 7.2 | 1,840 | 1,150 | 1,280 | 698 | 103 | 246 | 19 | 9 | 126 | 34 |
| 29 | 3.0 | 7.5 | 2,000 | 1,400 | ------- | 296 | 171 | 282 | 17 | 8 | 69 | 29 |
| 30 | 3.2 | 7.8 | 2,400 | 1,480 | ------- | 151 | 202 | 322 | 15 | 7 | 48 | 27 |
| 31 | 2.2 | ------- | 2,800 | 1,250 | ------- | 116 | ------- | 450 | ------- | 7 | 39 | ------- |

NOTE.—Gage not read Mar. 2, Apr. 19, and Sept. 9; discharge interpolated.

*Monthly discharge of Big Muddy River at Plumfield, Ill., for the year ending September 30, 1923*

[Drainage area, 753 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 94.0 | 0.5 | 11.6 | 0.015 | 0.02 |
| November | 9.8 | 1.6 | 5.29 | .007 | .008 |
| December | 2,800 | 7 | 416 | .552 | .64 |
| January | 2,850 | 66 | 788 | 1.05 | 1.21 |
| February | 5,140 | 77 | 1,590 | 2.11 | 2.20 |
| March | 9,000 | 116 | 2,990 | 3.97 | 4.58 |
| April | 2,600 | 73 | 725 | .963 | 1.07 |
| May | 5,590 | 45 | 1,490 | 1.98 | 2.28 |
| June | 1,590 | 15 | 336 | .446 | .50 |
| July | 141 | 7 | 37.5 | .050 | .06 |
| August | 2,060 | 6 | 850 | 1.13 | 1.30 |
| September | 1,120 | 27 | 319 | .424 | .47 |
| The year | 9,000 | .5 | 790 | 1.05 | 14.34 |

### BIG MUDDY RIVER AT MURPHYSBORO, ILL.

LOCATION.—In SW. ¼ sec. 8, T. 9 S., R. 2 W., at lower highway bridge on South Twentieth Street, Murphysboro, Jackson County, a quarter of a mile below mouth of Louis Creek and Mobile & Ohio Railway bridge.

DRAINAGE AREA.—2,170 square miles (measured on map of United States Geological Survey; scale, 1:500,000).

RECORDS AVAILABLE.—December 6, 1916, to September 30, 1923.

GAGE.—Chain gage attached to bridge; read by Clarence Jacobs.

CHANNEL AND CONTROL.—Bed composed of heavy clay; likely to shift.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 31.83 feet March 22 (discharge not determined because of backwater from Mississippi River); minimum stage, 1.70 feet October 1 and 2 (discharge, 4.0 second-feet).

1917–1923: Maximum discharge recorded, 15,600 second-feet January 10, 1917; minimum discharge, 1.0 second-foot August 1, 1921.

The highest known stage of this river occurred about February 2, 1916, when a stage of 39.6 feet on the present gage was reached (discharge, ascertained from extension of rating curve, 28,000 second-feet).

ACCURACY.—Stage-discharge relation changed during high water of March; affected by backwater from Mississippi River whenever height on United States Weather Bureau gage at Chester, Ill., is above about 10 feet; not affected by ice. Rating curve used October 1 to March 12 well defined between 10 and 600 second-feet, fairly well defined beyond these limits; curve used July 28 to September 30 poorly defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table; not determined for periods of backwater. Records fair.

*Discharge measurements of Big Muddy River at Murphysboro, Ill., during the year ending September 30, 1923*

[Made by H. E. Grosbach]

| Date | Gage height | Discharge |
|---|---|---|
| | *Feet* | *Sec.-ft.* |
| Oct. 27 | 2.23 | 17.5 |
| Mar. 15 | [a] 23.60 | 8,270 |
| Sept. 20 | [b] 6.71 | 1,250 |

[a] Stage-discharge relation affected by backwater from Mississippi River.
[b] Rapidly rising stage.

*Daily gage height, in feet, of Big Muddy River at Murphysboro, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.70 | 2.16 | 2.12 | 18.67 | 24.54 | 11.27 | 6.64 | 5.69 | 9.34 | 5.04 | 2.33 | 4.78 |
| 2 | 1.70 | 2.26 | 2.16 | 18.97 | 24.74 | 10.12 | 6.24 | 5.69 | 9.09 | 5.44 | 2.35 | 5.53 |
| 2 | 1.72 | 2.36 | 2.18 | 17.17 | 24.99 | 11.17 | 5.99 | 5.34 | 8.34 | 6.24 | 2.13 | 6.43 |
| 4 | 1.74 | 2.31 | 2.16 | 16.47 | 25.79 | 11.11 | 5.54 | 7.84 | 6.44 | 6.44 | 2.93 | 5.88 |
| 5 | 1.72 | 2.16 | 2.76 | 13.17 | 26.49 | 12.22 | 8.49 | 10.16 | 6.04 | 6.74 | 4.23 | 5.93 |
| 6 | 1.74 | 2.16 | 3.66 | 12.47 | 27.44 | 13.17 | 8.19 | 10.56 | 5.59 | 7.69 | 9.53 | 6.73 |
| 7 | 2.01 | 2.10 | 4.06 | 11.27 | 26.74 | 14.27 | 7.44 | 9.84 | 5.19 | 8.74 | 13.40 | 7.58 |
| 8 | 2.16 | 2.10 | 5.66 | 9.15 | 24.59 | 16.47 | 6.14 | 4.84 | 4.24 | 8.44 | 13.95 | 7.53 |
| 9 | 2.94 | 2.10 | 6.96 | 8.45 | 23.49 | 16.02 | 6.54 | 5.64 | 4.19 | 8.39 | 14.65 | 8.78 |
| 10 | 3.71 | 2.10 | 7.71 | 8.00 | 20.79 | 15.42 | 6.94 | 5.09 | 3.99 | 8.34 | 15.45 | 9.58 |
| 11 | 3.56 | 2.06 | 7.96 | 6.85 | 17.77 | 16.52 | 8.14 | 4.69 | 3.84 | 8.34 | 16.20 | 8.53 |
| 12 | 3.46 | 1.86 | 6.46 | 5.55 | 14.42 | 19.42 | 8.58 | 4.54 | 6.44 | 7.94 | 16.50 | 7.53 |
| 13 | 3.41 | 2.26 | 5.41 | 4.45 | 14.22 | 20.81 | 11.71 | 4.64 | 8.94 | 5.34 | 14.85 | 5.43 |
| 14 | 3.16 | 2.46 | 4.96 | 4.05 | 14.07 | ------- | 15.26 | 4.79 | 12.26 | 4.74 | 10.65 | 4.33 |
| 15 | 3.01 | 2.40 | 3.76 | 3.45 | 15.07 | 24.29 | 17.66 | 22.34 | 12.36 | 4.14 | 7.53 | 3.78 |
| 16 | 2.96 | 2.44 | 3.46 | 5.70 | 12.92 | 28.59 | 17.71 | 24.38 | 12.30 | 3.93 | 8.23 | 3.63 |
| 17 | 2.90 | 2.40 | 3.26 | 5.85 | 11.55 | 28.69 | 19.66 | 25.68 | 12.20 | 5.78 | 10.31 | 3.53 |
| 18 | 2.86 | 2.86 | 3.08 | 5.45 | 10.97 | 29.94 | 18.66 | 26.88 | 12.56 | 4.93 | 13.21 | 3.63 |
| 19 | 2.76 | 2.82 | 2.96 | 5.25 | 9.20 | 29.99 | 16.91 | 29.03 | 12.26 | 4.33 | 16.85 | 3.68 |
| 20 | 2.76 | 2.78 | 2.84 | 5.40 | 8.45 | 30.45 | 15.96 | 28.58 | 11.31 | 4.28 | 16.90 | 7.68 |
| 21 | 2.71 | 2.78 | 3.69 | 6.30 | 6.70 | 31.77 | 14.26 | 29.48 | 8.74 | 4.18 | 16.75 | 10.95 |
| 22 | 2.66 | 2.76 | 2.53 | 10.37 | 5.10 | 31.83 | 12.20 | 28.58 | 8.44 | 3.93 | 14.55 | 10.65 |
| 23 | 2.46 | 2.74 | 2.55 | 10.52 | 4.95 | 28.44 | 8.94 | 30.03 | 7.24 | 3.53 | 12.35 | 8.88 |
| 24 | 2.36 | 2.60 | 2.53 | 10.57 | 4.15 | 28.69 | 7.34 | 28.48 | 7.54 | 3.33 | 10.31 | 6.33 |
| 25 | 2.36 | 2.48 | 3.00 | 10.72 | 4.05 | 27.64 | 6.74 | 23.12 | 8.04 | 3.13 | 10.10 | 5.08 |
| 26 | 2.30 | 2.38 | 5.45 | 10.97 | 5.35 | 25.69 | 6.34 | 20.18 | 7.39 | 2.83 | 9.38 | 4.23 |
| 27 | 2.26 | 2.34 | 6.15 | 11.37 | 8.35 | 22.63 | 6.19 | 18.46 | 6.14 | 2.63 | 8.68 | 3.73 |
| 28 | 2.21 | 2.26 | 9.95 | 15.57 | 12.07 | 20.69 | 5.74 | 14.36 | 5.04 | 2.53 | 7.38 | 3.53 |
| 29 | 2.01 | 2.18 | 12.37 | 18.72 | ------- | 16.52 | 5.54 | 11.36 | 4.34 | 2.43 | 5.38 | 3.33 |
| 30 | 1.96 | 2.14 | 16.37 | 20.79 | ------- | 12.67 | 5.64 | 12.01 | 4.74 | 2.38 | 4.53 | 3.13 |
| 31 | 2.01 | ------- | 18.47 | 23.89 | ------- | 9.15 | ------- | 10.16 | ------- | 2.23 | 3.73 | ------- |

NOTE.—Gage not read Mar. 14.

*Daily discharge, in second-feet, of Big Muddy River at Murphysboro, Ill., for the year ending September 30, 1923*

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 4 | 16 | 15 | 5,800 | 9,000 | 2,320 | ------- | 52 | 490 |
| 2 | 4 | 19 | 16 | 5,950 | 9,120 | 1,940 | ------- | 54 | 670 |
| 3 | 4 | 22 | 16 | 5,050 | 9,300 | 2,320 | ------- | 36 | 940 |
| 4 | 5 | 20 | 16 | 4,700 | 9,780 | 2,280 | ------- | 118 | 790 |
| 5 | 4 | 16 | 42 | 3,090 | 10,200 | 2,680 | ------- | 350 | 790 |
| 6 | 5 | 16 | 160 | 2,800 | 10,700 | 3,090 | ------- | 1,880 | 1,030 |
| 7 | 11 | 14 | 240 | 2,360 | 10,300 | 3,600 | ------- | 3,340 | 1,300 |
| 8 | 16 | 14 | 640 | 1,660 | 9,060 | 4,700 | ------- | ------- | 1,270 |
| 9 | 56 | 14 | 1,000 | 1,420 | 8,410 | 4,450 | ------- | ------- | 1,660 |
| 10 | 170 | 14 | 1,210 | 1,300 | 6,940 | 4,150 | ------- | ------- | 1,910 |
| 11 | 140 | 13 | 1,300 | 940 | 5,350 | 4,700 | ------- | ------- | 1,570 |
| 12 | 121 | 7 | 850 | 615 | 3,650 | 6,170 | ------- | ------- | 1,270 |
| 13 | 112 | 19 | 565 | 315 | 3,550 | ------- | ------- | ------- | 640 |
| 14 | 76 | 26 | 465 | 240 | 3,500 | ------- | ------- | ------- | 370 |
| 15 | 60 | 24 | 180 | 121 | 4,000 | ------- | ------- | ------- | 270 |
| 16 | 56 | 26 | 121 | 640 | 2,960 | ------- | ------- | ------- | 230 |
| 17 | 52 | 24 | 89 | 665 | 2,460 | ------- | ------- | ------- | 220 |
| 18 | 48 | 48 | 70 | 565 | 2,250 | ------- | ------- | ------- | 230 |
| 19 | 42 | 45 | 56 | 515 | 1,660 | ------- | ------- | ------- | 250 |
| 20 | 42 | 45 | 48 | 565 | 1,420 | ------- | ------- | ------- | 1,330 |
| 21 | 39 | 45 | 170 | 790 | 910 | ------- | ------- | ------- | 2,400 |
| 22 | 36 | 42 | 30 | 2,040 | 490 | ------- | ------- | ------- | 2,260 |
| 23 | 26 | 42 | 30 | 2,080 | 465 | ------- | ------- | ------- | 1,690 |
| 24 | 22 | 33 | 30 | 2,110 | 270 | ------- | ------- | ------- | 910 |
| 25 | 22 | 27 | 60 | 2,140 | 240 | ------- | ------- | 2,080 | 540 |
| 26 | 20 | 23 | 565 | 2,250 | 565 | ------- | ------- | 1,840 | 350 |
| 27 | 19 | 22 | 765 | 2,390 | 1,420 | ------- | ------- | 1,630 | 250 |
| 28 | 17 | 19 | 1,900 | 4,250 | 2,640 | ------- | 73 | 1,240 | 220 |
| 29 | 11 | 16 | 2,760 | 5,800 | ------- | ------- | 61 | 640 | 182 |
| 30 | 10 | 15 | 4,650 | 6,940 | ------- | ------- | 56 | 415 | 148 |
| 31 | 11 | ------- | 5,700 | 8,640 | ------- | ------- | 43 | 250 | ------- |

NOTE.—Stage-discharge relation affected by backwater from Mississippi River Mar. 13 to July 27 and August 8–24; discharge not determined.

*Monthly discharge of Big Muddy River at Murphysboro, Ill., for the year ending September 30, 1923*

[Drainage area, 2,170 square miles]

| Month | Discharge in second-feet | | | | Run-off in inches |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | Per square mile | |
| October | 170 | 4 | 40.7 | 0.019 | 0.02 |
| November | 48 | 7 | 24.2 | .011 | .01 |
| December | 5,700 | 15 | 766 | .353 | .41 |
| January | 8,640 | 121 | 2,540 | 1.17 | 1.35 |
| February | 10,700 | 240 | 4,660 | 2.15 | 2.23 |
| September | 2,400 | 148 | 873 | .402 | .45 |

## MISCELLANEOUS MEASUREMENTS

The following discharge measurement was made at the old gaging station on Kinnikinnic River near River Falls, Wis.:

Oct. 10, 1922: Gage-height, 3.93 feet; discharge, 84 second-feet.

# STREAM-GAGING STATIONS AND PUBLICATIONS RELATING TO WATER RESOURCES

## INTRODUCTION

Investigation of water resources by the United States Geological Survey has consisted in large part of measurements of the volume of flow of streams and studies of the conditions affecting that flow, but it has comprised also investigation of such closely allied subjects as irrigation, water storage, water powers, underground waters, and quality of waters. Most of the results of these investigations have been published in the series of water-supply papers, but some have appeared in the bulletins, monographs, professional papers, and annual reports.

The results of stream-flow measurements are now published annually in 12 parts, each part covering an area whose boundaries coincide with natural drainage features as indicated below:

Part I. North Atlantic slope basins (St. John River to York River).
II. South Atlantic slope and eastern Gulf of Mexico basins (James River to the Mississippi).
III. Ohio River basin.
IV. St. Lawrence River basin.
V. Upper Mississippi River and Hudson Bay basins.
VI. Missouri River basin.
VII. Lower Mississippi River basin.
VIII. Western Gulf of Mexico basins.
IX. Colorado River basin.
X. Great basin.
XI. Pacific Slope basins in California.
XII. North Pacific slope basins, published in three volumes:
A, Pacific slope basins in Washington and upper Columbia River basin.
B, Snake River basin.
C, Lower Columbia River basin and Pacific slope basins in Oregon.

## HOW GOVERNMENT REPORTS MAY BE OBTAINED OR CONSULTED

Water-supply papers and other publications of the United States Geological Survey containing data in regard to the water resources of the United States may be obtained or consulted as indicated below:

1. Copies may be purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will, on application, furnish lists giving prices.

2. Sets of the reports may be consulted in the libraries of the principal cities of the United States.

3. Complete sets are available for consultation in the local offices of the water-resources branch of the Geological Survey, as follows:

Boston, Mass., 2500 Customhouse.
Albany, N. Y., 704 Journal Building.
Trenton, N. J., Statehouse.
Charlottesville, Va., University of Virginia.
Asheville, N. C., 316 Jackson Building.
Chattanooga, Tenn., 37 Municipal Building.
Columbus, Ohio, Engineering Experiment Station, Ohio State University.
Chicago, Ill., 950 Transportation Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Ames, Iowa, State Highway Commission Building.
Rolla, Mo., Rolla Building, School of Mines and Metallurgy.
Topeka, Kans., 23 Federal Building.
Helena, Mont., 45–46 Federal Building.
Denver, Colo., 403 Post Office Building.
Salt Lake City, Utah, 313 Federal Building.
Idaho Falls, Idaho, 228 Federal Building.
Boise, Idaho, Federal Building.
Tacoma, Wash., 404 Federal Building.
Portland, Oreg., 606 Post Office Building.
San Francisco, Calif., 303 Customhouse.
Los Angeles, Calif., 600 Federal Building.
Tucson, Ariz., Room 106, College of Law Building, University of Arizona.
Austin, Tex., State Captol.
Honolulu, Hawaii, 25 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director, United States Geological Survey, Washington, D. C.

## STREAM-FLOW REPORTS

Stream-flow records have been obtained at about 5,600 points in the United States, and the data obtained have been published in the reports tabulated on page 184.

*Stream-flow data in reports of the United States Geological Survey*

[A=Annual Report; B=Bulletin; W=Water-Supply Paper]

| Report | Character of data | Year |
|---|---|---|
| 10th A, pt. 2 | Descriptive information only | |
| 11th A, pt. 2 | Monthly discharge and descriptive information | 1884 to September, 1890. |
| 12th A, pt. 2 | do | 1884 to June 30, 1891. |
| 13th A, pt. 3 | Mean discharge in second-feet | 1884 to Dec. 31, 1892. |
| 14th A, pt. 2 | Monthly discharge (long-time records, 1871 to 1893) | 1888 to Dec. 31, 1893. |
| B 131 | Descriptions, measurements, gage heights, and ratings | 1893 and 1894. |
| 16th A, pt. 4 | Descriptive information only | |
| B 140 | Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years). | 1895. |
| W 11 | Gage heights (also gage heights for earlier years) | 1896. |
| 18th A, pt. 4 | Descriptions, measurements, ratings, and monthly discharge (also similar data for some earlier years). | 1895 and 1896. |
| W 15 | Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas. | 1897. |

*Stream-flow data in reports of the United States Geological Survey*—Continued

| Report | Character of data | Year |
|---|---|---|
| W 16 | Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States. | 1897. |
| 19th A, pt. 4 | Descriptions, measurements, ratings, and monthly discharge (also some long-time records). | 1897. |
| W 27 | Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River. | 1898. |
| W 28 | Measurements, ratings and gage heights, Arkansas River and western United States. | 1898. |
| 20th A, pt. 4 | Monthly discharge (also for many earlier years) | 1898. |
| W 35 to 39 | Descriptions, measurements, gage heights, and ratings | 1899. |
| 21st A, pt. 4 | Monthly discharge | 1899. |
| W 47 to 52 | Descriptions, measurements, gage heights, and ratings | 1900. |
| 22d A, pt. 4 | Monthly discharge | 1900. |
| W 65, 66 | Descriptions, measurements, gage heights, and ratings | 1901. |
| W 75 | Monthly discharge | 1901. |
| W 82 to 85 | Complete data | 1902. |
| W 97 to 100 | do | 1903. |
| W 124 to 135 | do | 1904. |
| W 165 to 178 | do | 1905. |
| W 201 to 214 | do | 1906. |
| W 241 to 252 | do | 1907–8. |
| W 261 to 272 | do | 1909. |
| W 281 to 292 | do | 1910. |
| W 301 to 312 | do | 1911. |
| W 321 to 332 | do | 1912. |
| W 351 to 362 | do | 1913. |
| W 381 to 394 | do | 1914. |
| W 401 to 414 | do | 1915. |
| W 431 to 444 | do | 1916. |
| W 451 to 464 | do | 1917. |
| W 471 to 484 | do | 1918. |
| W 501 to 514 | do | 1919–20. |
| W 521 to 534 | do | 1921. |
| W 541 to 554 | do | 1922. |
| W 561 to 574 | do | 1923. |

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years, and miscellaneous measurements at many points other than regular gaging stations have been made each year. An index of the reports containing records obtained prior to 1904 has been published in Water-Supply Paper 119.

The following table gives, by years and drainage basins, the numbers of the papers on surface-water supply published from 1899 to 1923. The data for any particular station will, as a rule, be found in the reports covering the years during which the station was maintained. For example, data for Machias River at Whitneyville, Maine, 1903 to 1921, are published in Water-Supply Papers, 97, 124, 165, 201, 241, 261, 281, 301, 321, 351, 381, 401, 431, 451, 471, 501, and 521, which contain records for the New England streams from 1903 to 1921. Results of miscellaneous measurements are published by drainage basins.

## Numbers of water-supply papers containing results of stream measurements, 1899-1923

[For basins included, see p. 177]

| Year | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | A | B | C |
| 1899 [a] | 35 | [b] 35, 36 | 36 | 36 | 36 | [c] 36, 37 | 37 | 37 | [d] 37, 39 | 38, [e] 39 | 38, [f] 39 | 38 | 38 | 38 |
| 1900 [g] | 47, [h] 48 | 48 | 48, [i] 49 | 49 | 49 | 49, [j] 50 | 50 | 50 | 50 | 51 | 51 | 51 | 51 | 51 |
| 1901 | 65, 75 | 65, 75 | 65, 75 | 65, 75 | [k] 65, 66, 75 | 66, 75 | [k] 65, 66, 75 | 66, 75 | 66, 75 | 66, 75 | 66, 75 | 66, 75 | 66, 75 | 66, 75 |
| 1902 | 82 | [b] 82, 83 | 83 | [l] 82, 83 | [k] 83, 85 | 84 | [k] 83, 84 | 84 | 85 | 85 | 85 | 85 | 85 | 85 |
| 1903 | 97 | [b] 97, 98 | 98 | 97 | [k] 98, 99, [m] 100 | 99 | [k] 98, 99 | 99 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1904 | [n] 124, [o] 125, [p] 126 | [p] 126, 127 | 128 | 129 | [k] 128, 130 | 130, [q] 131 | [k] 128, 131 | 132 | 133 | 133, [r] 134 | 134 | 135 | 135 | 135 |
| 1905 | [n] 165, [o] 166, [p] 167 | [p] 167, 168 | 169 | 170 | 171 | 172 | [k] 169, 173 | 174 | 175, [s] 177 | 176, [r] 177 | 177 | 178 | 178 | [t] 177, 178 |
| 1906 | [n] 201, [o] 202, [p] 203 | [p] 203, 204 | 205 | 206 | 207 | 208 | [k] 205, 209 | 210 | 211 | 212, [r] 213 | 213 | 214 | 214 | 214 |
| 1907–8 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250, [r] 251 | 251 | 252 | 252 | 252 |
| 1909 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270, [r] 271 | 271 | 272 | 272 | 272 |
| 1910 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 292 | 292 |
| 1911 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 312 | 312 |
| 1912 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332A | 332B | 332C |
| 1913 | 351 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362A | 362B | 362C |
| 1914 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 |
| 1915 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 |
| 1916 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 |
| 1917 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 | 464 |
| 1918 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 | 481 | 482 | 483 | 484 |
| 1919–20 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 |
| 1921 | 521 | 522 | 523 | 524 | 525 | 526 | 527 | 528 | 529 | 530 | 531 | 532 | 533 | 534 |
| 1922 | 541 | 542 | 543 | 544 | 545 | 546 | 547 | 548 | 549 | 550 | 551 | 552 | 553 | 554 |
| 1923 | 561 | 562 | 563 | 564 | 565 | 566 | 567 | 568 | 569 | 570 | 571 | 572 | 573 | 574 |

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39. Monthly discharge for 1899 in Twenty-first Annual Report, Part IV.
[b] James River only.
[c] Gallatin River.
[d] Green and Gunnison Rivers and Grand River above junction with Gunnison.
[e] Mohave River only.
[f] Kings and Kern Rivers and south Pacific slope basins.
[g] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52. Monthly discharge for 1900 in Twenty-second Annual Report, Part IV.
[h] Wissahickon and Schuylkill Rivers to James River.
[i] Scioto River.
[j] Loup and Platte Rivers near Columbus, Nebr., and all tributaries below junction with Platte.
[k] Tributaries of Mississippi from east.
[l] Lake Ontario and tributaries to St. Lawrence River proper.
[m] Hudson Bay only.
[n] New England rivers only.
[o] Hudson River to Delaware River, inclusive.
[p] Susquehanna River to Yadkin River, inclusive.
[q] Platte and Kansas Rivers.
[r] Great Basin in California except Truckee and Carson River basins.
[s] Below junction with Gila.
[t] Rogue, Umpqua, and Siletz Rivers only.

In these papers and in the following lists the stations are arranged in downstream order. The main stem of any river is determined by measuring or estimating its drainage area—that is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. All stations from the source to the mouth of the main stem of the river are presented first, and the tributaries in regular order from source to mouth follow, the streams in each tributary basin being listed before those of the next basin below.

In exception to this rule, the records for Mississippi River are given in four parts, as indicated on page 177, and the records for large lakes are taken up in order of streams around the rim of the lake.

## PRINCIPAL STREAMS

The Hudson Bay and upper Mississippi River basins include streams whose waters reach Hudson Bay and the Mississippi above its junction with the Ohio (except the Missouri). The principal streams flowing into Hudson Bay from the United States are St. Mary River, Red River, and Rainy River. The principal tributaries of the upper Mississippi are Crow Wing, Sauk, Crow, Rum, Minnesota, St. Croix, Chippewa, Zumbro, Black, Root, Wisconsin, Wapsipinicon, Rock, Iowa, Des Moines, Illinois, and Kaskaskia Rivers. These streams drain wholly or in part the States of Illinois, Indiana, Iowa, Minnesota, Missouri, Montana, North Dakota, South Dakota, and Wisconsin.

In addition to the list of gaging stations and the annotated list of publications relating specifically to the section, these pages contain a similar list of reports that are of general interest in many sections and cover a wide range of hydrologic subjects, and also brief references to reports published by State and other organizations. (See pp. 191–192.)

## GAGING STATIONS

NOTE.—Dash after a date indicates that station was being maintained September 30, 1923. Period after a date indicates discontinuance.

### HUDSON BAY DRAINAGE BASIN

St. Mary River near Babb (formerly dam site), Mont., 1902–
St. Mary River below Swiftcurrent Creek, at Babb, Mont., 1901–2; 1910–1915.
St. Mary River near Kimball, Alberta, 1902–
St. Mary Canal at intake, near Babb, Mont., 1918–
St. Mary Canal at St. Mary crossing, near Babb, Mont., 1918–
St. Mary Canal at Hudson Bay Divide, near Browning, Mont., 1917–
Swiftcurrent Creek at Many Glacier, Mont., 1912–
Swiftcurrent Creek at Sherburne, Mont., 1912–
Swiftcurrent Creek near Babb (formerly Wetzel), Mont., 1902–1910.
Canyon Creek near Many Glacier, Mont., 1918–
Kennedy Creek near Babb (formerly Wetzel), Mont., 1903–1907.

Ottertail River (head of Red River) at German Church, near Fergus Falls, Minn., 1913–1917.
Ottertail River near Fergus Falls, Minn., 1904–1913.
Red River near Fergus Falls, Minn., 1909–10.
Red River at Fargo, N. Dak., 1901–
Red River at Grand Forks, N. Dak., 1901–
Red River at Pembina, N. Dak., 1901.
Red River at Emerson, Manitoba, 1900–1902.
Pelican River near Fergus Falls, Minn., 1909–1912.
Bois des Sioux River near Tenney, Minn., 1919–
Mustinka River above Wheaton, Minn., 1917; 1919–
Mustinka River near Wheaton, Minn., 1916.
Wild Rice River near Wild Rice, N. Dak., 1919.
Sheyenne River at Valley City, N. Dak., 1919.
Sheyenne River at Haggart, N. Dak., 1902–1907; 1919.
Wild Rice River at Twin Valley, Minn., 1909–1917.
Devils Lake near Devils Lake, N. Dak., 1901–1920.
Red Lake River at Thief River Falls, Minn., 1909–1918; 1920–
Red Lake River at Crookston, Minn., 1901–
Thief River near Thief River Falls, Minn., 1909–1917; 1920–1921; 1922–
Clearwater River at Red Lake Falls, Minn., 1909–1917.
South Branch of Two Rivers at Hallock, Minn., 1911–1914.
Pembina River at Neche, N. Dak., 1903–1915; 1919–
Roseau River at Caribou, Minn., 1917; 1920–
Roseau River at Dominion City, Canada, 1912.
West Branch of Roseau River near Malung, Minn., 1911–1914.
Mouse River near Foxholm, N. Dak., 1904–1906.
Mouse River at Minot, N. Dak., 1903–
Des Lacs River at Foxholm, N. Dak., 1904–1906.
Rainy Lake at Rainier, Minn., 1910–1917.
Rainy River at International Falls, Minn., 1907–1917.
Kawishiwi River near Winton, Minn., 1905–1907; 1912–1919.
Vermilion River below Lake Vermilion, near Tower, Minn., 1911–1917.
Little Fork at Little Fork, Minn., 1909–1917.
Big Fork at Big Falls, Minn., 1909–1912.
Big Fork at Laurel, Minn., 1909.
Black River near Loman, Minn., 1909.

UPPER MISSISSIPPI RIVER BASIN

Mississippi River above Sandy River, Minn., 1895–1915.
Mississippi River near Fort Ripley, Minn., 1909–10.
Mississippi River near Sauk Rapids, Minn., 1903–1906.
Mississippi River at Elk River, Minn., 1915–
Mississippi River at Anoka, Minn., 1905–1914.
Mississippi River at St. Paul, Minn., 1873–
Sandy River below Sandy Lake reservoir, Minn., 1893–1916.
Pine River below Pine River reservoir, Minn., 1886–1916.
Prairie River near Grand Rapids, Minn., 1909.
Crow Wing River at Nimrod, Minn., 1910–1914.
Crow Wing River at Motley, Minn., 1909; 1913–1917.
Crow Wing River at Pillager, Minn., 1903; 1909–1913.
Long Prairie River near Motley, Minn., 1909–1917.
Sauk River near St. Cloud, Minn., 1909–1913.
Elk River near Big Lake, Minn., 1911–1917.

Mississippi River tributaries—Continued.
Crow River at Rockford, Minn., 1909–1917.
Crow River near Dayton, Minn., 1906.
North Fork of Crow River near Rockford, Minn., 1909–10.
South Fork of Crow River near Rockford, Minn., 1909–1912.
Rum River at Onamia, Minn., 1909–1912.
Rum River at Cambridge, Minn., 1909–1914.
Rum River at St. Francis, Minn., 1903
Rum River near Anoka, Minn., 1905–6; 1909.
Minnesota River near Odessa, Minn., 1909–1913.
Minnesota River near Montevideo, Minn., 1909–
Minnesota River near Mankato Minn., 1903–
Whetstone River near Big Stone, S. Dak., 1910–1912.
Lac qui Parle River at Lac qui Parle, Minn., 1910–1914.
Chippewa River near Watson, Minn., 1909–1917.
Redwood River near Redwood Falls, Minn., 1909–1914.
Cottonwood River near New Ulm, Minn., 1909–1913.
Blue Earth River at Rapidan Mills, Minn., 1909–10.
St. Croix River at Swiss, Wis., 1914–
St. Croix River near St. Croix Falls, Wis., 1910–
Namakagon River at Trego, Wis., 1914–
Yellow River at Webster, Wis., 1914.
Kettle River near Sandstone, Minn., 1908–1917.
Snake River at Mora, Minn., 1909–1913.
Snake River near Pine City, Minn., 1913–1917.
Apple River near Somerset, Wis., 1901–
Kinnikinnic River near River Falls, Wis., 1916–1921.
Cannon River at Welch, Minn., 1909–1914.
Chippewa River at Bishops Bridge, near Winter, Wis., 1912–
Chippewa River near Bruce, Wis., 1914–
Chippewa River at Chippewa Falls, Wis., 1888–
Chippewa River near Eau Claire, Wis., 1902–1909.
West Fork of Chippewa River near Winter, Wis., 1911–1916.
Flambeau River near Butternut, Wis., 1914–
Flambeau River near Ladysmith, Wis., 1914–
Flambeau River at Ladysmith, Wis., 1903–1906.
Jump River at Sheldon, Wis., 1915–
Eau Claire River near Augusta, Wis., 1914–
Eau Claire River near Eau Claire, Wis., 1913–14.
Red Cedar River near Colfax, Wis., 1914–
Red Cedar River at Cedar Falls, Wis., 1909–
Red Cedar River at Menominee, Wis., 1907–8; 1913–
Zumbro River at Zumbro Falls, Minn., 1909–1917.
South Branch of Zumbro River near Zumbro Falls, Minn., 1911–1917.
Trempealeau River at Dodge, Wis., 1913–1919.
Black River at Neillsville, Wis., 1905–1909; 1913–
Black River at Melrose, Wis., 1902–3.
La Crosse River near West Salem, Wis., 1913–
Root River near Houston, Minn., 1909–1917.
North Branch of Root River near Lanesboro, Minn., 1910–1917.
Upper Iowa River near Decorah, Iowa, 1913–14; 1919–
Wisconsin River near Rhinelander, Wis., 1905–1915.
Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., 1915–

Mississippi River tributaries—Continued.
Wisconsin River at Merrill, Wis., 1902–
Wisconsin River at Knowlton, Wis., 1921–
Wisconsin River near Nekoosa, Wis., 1914–
Wisconsin River near Neceda, Wis., 1902–1914.
Wisconsin River at Muscoda, Wis., 1902–3; 1913–
Tomahawk River near Bradley, Wis., 1914–
Prairie River near Merrill, Wis., 1914–
Little Rib River near Wausau, Wis., 1914–1916.
Eau Claire River at Kelly, Wis., 1914–
Big Eau Pleine River near Stratford, Wis., 1914–
Plover River near Stevens Point, Wis., 1914–1919.
Baraboo River near Baraboo, Wis., 1913–1922.
Kickapoo River at Gays Mills, Wis., 1913–
Turkey River at Garber, Iowa, 1913–1916; 1919–
Maquoketa River above mouth of North Fork, near Maquoketa, Iowa, 1913–14.
Maquoketa River at Manchester, Iowa, 1903.
Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, 1913–
Wapsipinicon River at Stone City, Iowa, 1903–1914.
Rock River at Watertown, Wis., 1914.
Rock River at Afton, Wis., 1914–
Rock River above mouth of Pecatonica River, at Rockton, Ill., 1903.
Rock River below mouth of Pecatonica River, at Rockton, Ill., 1903–1909.
Rock River at Rockford, Ill., 1914–1919.
Rock River near Nelson, Ill., 1906.
Rock River at Sterling, Ill., 1905–6.
Rock River at Lyndon, Ill., 1914–
Catfish River at Madison, Wis., 1902–3.
Lake Mendota at Madison, Wis., 1902–3.
Yahara River near Edgerton, Wis., 1916–17.
Pecatonica River at Dill, Wis., 1914–1919.
Pecatonica River at Freeport, Ill., 1914–
Sugar River near Brodhead, Wis., 1914–
Iowa River near Iowa Falls, Iowa, 1911–1914.
Iowa River at Marshalltown, Iowa, 1903; 1915–
Iowa River at Iowa City, Iowa, 1903–1906; 1913–
Iowa River at Wapello, Iowa, 1915–
Cedar River near Austin, Minn., 1909–1914.
Cedar River at Janesville, Iowa, 1905–6; 1915–
Cedar River at Cedar Rapids, Iowa, 1903–
Shellrock River near Clarksville, Iowa, 1915–
Skunk River near Ames, Iowa, 1920–
Skunk River at Coppock, Iowa, 1913–
Skunk River at Augusta, Iowa, 1913; 1915–
Squaw Creek at Ames, Iowa, 1919–
Des Moines River at Jackson, Minn., 1909–1913.
Des Moines River at Fort Dodge, Iowa, 1905–6; 1911–1913.
Des Moines River at Kalo, Iowa, 1913–
Des Moines River near Boone, Iowa, 1920–
Des Moines River at Des Moines, Iowa, 1902–3; 1905–6; 1914–
Des Moines River near Tracy, Iowa, 1920–
Des Moines River at Ottumwa, Iowa, 1917–

Mississippi River tributaries—Continued.
Des Moines River at Keosauqua, Iowa, 1903–1906; 1910–
Raccoon River at Van Meter, Iowa, 1915–
Raccoon River near Des Moines, Iowa, 1902–3.
Sugar Creek near Keokuk, Iowa, 1922–
Fox River near Wayland, Mo., 1922–
Wyaconda River near Canton, Mo., 1922–
North Fabius River (head of Fabius River) at Monticello, Mo., 1922–
Salt River near New London, Mo., 1922–
Cuivre River near Troy, Mo., 1922–
Des Plaines River (head of Illinois River) at Riverside, Ill., 1896–1898.
Des Plaines River at Lemont, Ill., 1914–
Des Plaines River at Romeo, Ill., 1914.
Des Plaines River at Joliet, Ill., 1914–
Des Plaines River above mouth of Jackson Creek, near Channahon, Ill., 1903–1906.
Des Plaines River above Kankakee River, near Channahon, Ill., 1902–3.
Illinois River near Minooka, Ill., 1903–4.
Illinois River at Morris, Ill., 1919–
Illinois River near Seneca, Ill., 1902–3.
Illinois River near Ottawa, Ill., 1902–1904.
Illinois River near La Salle, Ill., 1902–3.
Illinois River at Peoria, Ill., 1910–
Illinois River near Peoria, Ill., 1903–1906.
Illinois River at Havana, Ill., 1921–
Illinois River at Beardstown, Ill., 1920–
Kankakee River at Davis, Ind., 1905–6.
Kankakee River at Momence, Ill., 1905–6; 1914–
Kankakee River at Custer Park, Ill., 1914–
Yellow River at Knox, Ind., 1905–6.
Iroquois River near Chebanse, Ill., 1923–
Fox River at Algonquin, Ill., 1915–
Fox River at South Elgin, Ill., 1914–15.
Fox River at Aurora, Ill., 1914.
Fox River at Sheridan, Ill., 1905–6.
Fox River at Wedron, Ill., 1914–
Fox River at Ottawa, Ill., 1903.
Vermilion River near Streator, Ill., 1914–
Mackinaw River near Green Valley, Ill., 1921–
Spoon River at Seville, Ill., 1914–
Sangamon River at Monticello, Ill., 1908–1912; 1914–
Sangamon River at Decatur, Ill., 1905.
Sangamon River at Riverton, Ill., 1908–1912; 1914–
Sangamon River at Springfield, Ill., 1903.
Sangamon River near Oakford, Ill., 1909–1912; 1914–1919; 1921–22.
Sangamon River near Chandlerville, Ill., 1908–9.
South Fork of Sangamon River near Taylorville, Ill., 1908–1912; 1914–1917.
South Fork of Sangamon River at power plant, near Taylorville, Ill., 1917–
Salt Creek near Kenny, Ill., 1908–1912.
Crooked Creek at Ripley, Ill., 1921–
Macoupin Creek near Kane, Ill., 1921–

Mississippi River tributaries—Continued.
Cahokia Creek at Poag, Ill., 1909–1912.
Kaskaskia River near Arcola, Ill., 1908–1912.
Kaskaskia River at Shelbyville, Ill., 1908–1912; 1914.
Kaskaskia River at Vandalia, Ill., 1908–1912; 1914–
Kaskaskia River at Carlyle, Ill., 1908–1912; 1914–15.
Kaskaskia River at New Athens, Ill., 1907–1912; 1914–1921.
Shoal Creek near Breese, Ill., 1909–1912; 1914.
Silver Creek near Lebanon, Ill., 1908–1912; 1914.
Big Muddy River near Cambon, Ill., 1908–1912.
Big Muddy River at Plumfield, Ill., 1914–
Big Muddy River at Murphysboro, Ill., 1916–
Beaucoup Creek at Pinckneyville, Ill., 1908–1912; 1914.

## REPORTS ON WATER RESOURCES OF THE HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS

### PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY

#### WATER-SUPPLY PAPERS

Water-supply papers may be purchased (at price quoted below) from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. An asterisk (*) indicates that the report is out of print. Water-supply papers are of octavo size.

*21. Wells of northern Indiana, by Frank Leverett. 1899. 82 pp., 2 pls.
Discusses, by counties, glacial deposits and sources of well waters; many well sections.

*44. Profiles of rivers in the United States, by Henry Gannett. 1901. 100 pp., 11 pls.
Gives elevations and distances along Red River (of the North), and Minnesota, Skunk, Iowa, Des Moines, Illinois, and Rock Rivers; also brief descriptions.

*57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp.

*61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp.
A revised edition of Nos. 57 and 61; was published in 1905 as Water-Supply Paper 149 (q. v.)

96. Destructive floods in the United States in 1903, by E. C. Murphy. 1904. 81 pp., 13 pls. 15c.
Contains notes on early floods in Mississippi Valley.

*102. Contributions to the hydrology of eastern United States, 1903; M. L. Fuller, geologist in charge. 1904. 522 pp.
Contains brief reports on wells and springs of Minnesota and Missouri.
The reports comprise tabulated well records, giving information as to location, owner, depth, yield, head, etc., supplemented by notes as to elevation above sea, material penetrated, temperature, use, and quality; many miscellaneous analyses.

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp.
Cites statutory restrictions of water pollution in Iowa, Illinois, North Dakota, South Dakota, and Wisconsin. Superseded by 152.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls.
Contains brief reports as follows: Missouri, by E. M. Shepard; Iowa, by W. H. Norton; Minnesota, by C. W. Hall; Wisconsin district, by Alfred R. Schultz; Illinois, by Frank Leverett; Indiana, by Frank Leverett; each of these reports describes briefly the topography of the area, the relation of the geology to the water supplies, and gives list of pertinent publications; lists also principal mineral springs.

117. The lignite of North Dakota and its relation to irrigation, by F. A. Wilder. 1905. 59 pp., 8 pls. 10c.
Describes the thickness, extent, variations, and fuel value of the lignite and its use for pumping water, the area, soils, and lignite of the river flats, and the status of irrigation in the State.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp.
Cites legislative acts affecting underground waters in South Dakota and Wisconsin.

*145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls.

Contains two reports relating to areas draining to Hudson Bay or upper Mississippi River.

Water resources of Mineral Point quadrangle, Wisconsin, by U. S. Grant. Describes springs, streams, and shallow and deep wells.

Water supplies at Waterloo, Iowa, by W. H. Norton. Summarizes results of investigations to determine availability of artesian water to replace the surface supply from Cedar River; discusses necessity of test wells, supplementary supplies, artesian head, and permanency of flow.

149. Preliminary list of deep borings in the United States, second edition, with additions, by N. H. Darton. 1905. 175 pp. 10c.

Gives by States (and within the States by counties), the location, depth, diameter, yield, height of water, and other features of wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 and 61; mentions also principal publications relating to deep borings.

*152. A review of the laws forbidding pollution of the inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp.

Cities statutory restrictions of water pollution in Iowa, Illinois, North Dakota, South Dakota, and Wisconsin.

*156. Water powers of northern Wisconsin, by L. S. Smith. 1906. 145 pp., 5 pls.

Describes by river systems the drainage, geology, topography, rainfall and run-off, water powers, and dams.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index of flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls.

Contains accounts of floods in southeastern Minnesota, on Devils Creek, Iowa, and in Des Moines County, Iowa; gives estimates of flood discharge and frequency on Illinois River and on Mississippi River at St. Paul.

193. The quality of surface waters in Minnesota, by R. B. Dole and F. F. Westbrook. 1907. 171 pp., 7 pls. 25c.

Describes by river basins the topography, geology, and soils, the individual and municipal pollution of the streams, and gives notes on the municipalities; contains many analyses.

*194. Pollution of Illinois and Mississippi Rivers by Chicago sewage (a digest of the testimony taken in the case of the State of Missouri *v.* the State of Illinois and the Sanitary District of Chicago), by M. O. Leighton. 1907. 369 pp., 2 pls.

Scope indicated by amplification of title.

195. Underground waters of Missouri, their geology and utilization, by E. M. Shepard. 1907. 224 pp., 6 pls. 30c.

Describes the topography and geology of the State, the waters of the various formations, and discusses the water supplies by districts and counties, gives statistics of city water supplies, analyses of waters, and many well records.

*227. Geology and underground waters of South Dakota, by. N. H. Darton. 1909. 156 pp., 15 pls.

Describes physical features, geologic formations, water horizons, and, by counties, deep wells and well prospects; gives notes on construction and management of artesian wells.

*236. The quality of surface waters in the United States: Part I, Analyses of waters east of the one hundredth meridian, by R. B. Dole. 1909. 123 pp.

Describes collection of samples, methods of examination, preparation of solutions, accuracy of estimates and expression of analytical results; gives results of analyses of waters of Mississippi, Minnesota, Chippewa, Wisconsin, Rock, Iowa, Cedar, Des Moines, Illinois, Kankakee, Fox, Sangamon, Kaskaskia, and Big Muddy Rivers.

239. The quality of the surface waters of Illinois, by W. D. Collins. 1910. 94 pp., 3 pls. 10c.

Discusses the natural and economic features that determine the character of the streams. describes the larger drainage basins and the methods of collecting and analyzing the samples of water, and discusses each river in detail with reference to its source and course and the quality of water; includes short chapters on municipal supplies and industrial uses.

254. The underground waters of north-central Indiana, by S. R. Capps, with a chapter on the chemical character of the waters, by R. B. Dole. 1910. 279 pp., 7 pls. 40c.

Describes relief, drainage, vegetation, soils, and crops, industrial development, geologic formations; sources, movements, occurrence, and volume of ground water; methods of well construction and lifting devices; discusses, in detail for each county, surface features and drainage, geology and ground water, city, village, and rural supplies, and gives records of wells and analyses of waters. Discusses also, under chemical character, methods of analyses and expression of results, mineral constituents, effect of the constituents on waters for domestic, industrial, and medicinal uses, methods of purification, chemical composition; many analyses and field assays.

256. Geology and underground waters of southern Minnesota, by C. W. Hall, O. E. Meinzer, and M. L. Fuller. 1911. 406 pp., 18 pls. 60c.

Discusses the physiography of the State, geologic formations and their water-bearing capacity, artesian conditions, the mineral quality of the underground waters, types of wells, finishing wells in sand, drilling in quartzite, fluctuation in yield and head, "blowing" and "breathing" wells, freezing of wells, drainage by wells, hydraulic rams, and scientific prospecting for water, municipal supplies, power, storage and distribution, consumption of water, prices, sanitation. Gives by counties details concerning surface features; rocks, yield, head, and quality of water, and summaries and analyses.

293. Underground water resources of Iowa, by W. H. Norton, W. S. Hendrixson, H. E. Simpson, O. E. Meinzer, and others. 1912. 994 pp., 18 pls. 70c.

Describes the relief, drainage, temperature, and precipitation of the State and the geologic formations; discusses the geologic occurrence of ground waters, artesian phenomena and yield of artesian wells, the chemical composition of ground waters, municipal, domestic, and industrial water supplies, and mineral waters; gives details concerning topography, geology, ground waters, and city and village supplies by districts and counties.

345. Contributions to the hydrology of the United States, 1914. N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c. Contains:

(i) Gazetteer of surface waters of Iowa, by W. G. Hoyt and H. J. Ryan, pp. 169–221. 5c.

364. Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp. 5c.

Contains analyses of spring and well waters from Nashville and Macomb, Ill., and Story City, Iowa.

417. Profile surveys of rivers in Wisconsin, prepared under the direction of W. H. Herron, acting chief geographer. 1917. 16 pp., 32 pls. 45c.

Contains brief description of general features of drainage of Wisconsin and of the rivers surveyed, but consists chiefly of maps showing "not only the outlines of the river banks, the islands, the position of rapids, falls, shoals, and existing dams, and the crossings of all ferries and roads but the contours of banks to an elevation high enough to indicate the possibilities of using the stream" for the development of power by low or medium heads.

### ANNUAL REPORTS

Each of the papers contained in the annual reports was also issued in separate form.

Annual reports may be purchased (at price quoted below) from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. An asterisk (*) indicated that the report is out of print.

*Sixteenth Annual Report of the United States Geological Survey, 1894–95. 4 parts. Pt. II. Papers of an economic character, XIX 598 pp., 43 pls. $1.25. Contains:

The public lands and their water supply, by F. H. Newell, pp. 457–533, pls. 35 to 39. Describes general character of the public lands, the lands disposed of (railroad, grant, and swamp lands and private miscellaneous entries), lands reserved (Indian, forest, and military reservations) the vacant lands, and the rate of disposal of vacant lands; discusses the streams, wells and reservoirs as sources of water supply; gives details for each State.

Seventeenth Annual Report of the United States Geological Survey, 1895–96, Charles D. Walcott, Director, 1896; 3 parts in 4 vols. *Pt. II. Economic geology and hydrography, XXV, 864 pp., 113 pls. Contains:

Preliminary report on artesian waters of a portion of the Dakotas, by N. H. Darton, pp. 603–694, pls. 69 to 107. Gives an outline of the geologic relations; describes the water horizons and the extent of the artesian water, and gives details concerning wells and prospects by counties; discusses the origin, amount, pressure, head, and composition of the artesian waters, the use of artesian water for power, and gives details concerning artesian irrigation by counties; contains also remarks on the construction and management of artesian wells.

*The water resources of Illinois, by Frank Leverett, pp. 695–849, pls. 108 to 113. Describes the physical features of the State, and the drainage basins, including Illinois, Des Plaines, Kankakee, Fox, Illinois-Vermilion, Spoon, Mackinaw, and Sangamon Rivers, Macoupin Creek, Rock River, tributaries of the Mississippi in western Illinois, Kaskaskia, Big Muddy, and tributaries of the Wabash; discusses the rainfall and run-off, navigable waters and water powers, the wells supplying waters for rural districts, and artesian wells; contains tabulated artesian well data and water analyses.

*Eighteenth Annual Report of the United States Geological Survey, 1896–97, 5 parts in 6 vols. Pt. IV, Hydrography, x, 756 pp., 102 pls. $1.75. Contains:

*The water resources of Indiana and Ohio, by Frank Leverett, pp. 419–560, pls. 33 to 37. Describes the Wabash, Whitewater, Great Miami, Little Miami, Scioto, Hocking, Muskingum, and Beaver Rivers, and lesser tributaries of the Ohio in Indiana and Ohio, the streams discharging into Lake Erie and Lake Michigan, and streams flowing to the upper Mississippi through the Illinois; discusses shallow and drift wells, the flowing wells, from the drift and deeper artesian wells, and gives records of wells at many of the cities; describes the mineral springs, and gives analyses of the waters; contains also tabulated lists of cities using surface waters for water works, and of cities and villages using shallow and deep-well waters; discusses the source and quality of the city and village supplies, and gives precipitation tables for various points.

**MONOGRAPHS**

Monographs may be purchased (at price quoted below) from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. An asterisk (*) indicates that the report is out of print. Monographs are of quarto size.

*25. The glacial Lake Agassiz, by Warren Upham. 1896. 658 pp., 38 pls.

Contains a chapter (pp. 523–582) on "Artesian and common wells of the Red River Valley," which discusses the sources of artesian water, the fresh waters in the drift sheets, the saline and alkaline waters in the Dakota sandstone, and the use of artesian water for irrigation; contains analyses of waters from wells, streams, and lakes in Red River Valley and the adjoining region; and gives notes on wells in Clay, Kittson, Marshall, Norman, Polk, Traverse, and Wilkin Counties, in Minnesota; in Cass, Grand Forks, Pembina, Richland, Traill, and Walsh Counties, in North Dakota; and in a part of the area covered by Lake Agassiz, in Manitoba. The monograph includes numerous maps relating to the Pleistocene geology of the region and a map (Pl. XXXVII) showing the distribution and depths of artesian wells in glacial drift and bedrock.

*38. The Illinois glacial lobe, by Frank Leverett. 1899. 817 pp., 24 pls.

Includes a chapter (pp. 550–788) on "Wells of Illinois," which contains a general discussion of artesian and other wells, a table of municipal water supplies derived from underground sources, and a detailed description of wells and ground-water conditions in practically every county in the State. The monograph includes maps showing the geology, the distribution of wells, the intake areas of "Potsdam" and St. Peter sandstones, and the relation of glacial drift to ground-water supplies.

**PROFESSIONAL PAPERS**

Professional papers may be purchased (at prices quoted below) from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. An asterisk (*) indicates that the report is out of print. Professional papers are of quarto size.

*32. Preliminary report on the geology and underground-water resources of the central Great Plains, by N. H. Darton. 1905. 433 pp., 72 pls.

Covers South Dakota, Nebraska, central and western Kansas, eastern Colorado, and eastern Wyoming. Describes the geography, geology, and water horizons; gives deep-well data and well prospects by counties; also describes other mineral resources. Includes maps showing the geology, location of deep wells, structure of the Dakota sandstone, depths to this sandstone head of artesian water, and areas of artesian flow.

*135. The composition of the river and lake waters of the United States, by F. W. Clarke. 1924. iv, 199 pp.

Contains analyses of waters of principal streams in this region.

BULLETINS

Bulletins may be purchased (at price quoted below) from the Superintendent of Documents, Washington, D. C. An asterisk (*) indicates that the report is out of print. Bulletins are of octavo size.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp.

Discusses the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general methods of work; gives tabulated records of wells in Illinois and Iowa, and detailed records of wells in Boone, Dupage, Henry, and La Salle Counties, Ill., and Des Moines and Scott Counties, Iowa. These wells were selected because they give definite stratigraphic information.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp.

Gives an account of progress in the collection of well records and samples; contains tabulated records of wells in Illinois, Indiana, Iowa, Minnesota, Missouri, North Dakota, South Dakota, and Wisconsin; and detailed records of wells in Brown, Hancock, La Salle, Pike, and Schuyler Counties, Ill.; Blackhawk, Floyd, Louisa, Mahaska, Scott, and Wapello Counties, Iowa; and Hennepin, Ottertail, and Pine Counties, Minn. The wells of which detailed sections are given were selected because they afford valuable stratigraphic information.

GEOLOGIC FOLIOS

Under the plan adopted for the preparation of a geologic map of the United States the entire area is divided into small quadrangles bounded by certain meridians and parallels, and these quadrangles, which number several thousand, are separately surveyed and mapped.[1] The unit of survey is also the unit of publication, and the maps and description of each quadrangle are issued in the form of a folio. When all the folios are completed they will constitute the Geologic Atlas of the United States.

A folio is designated by the name of the principal town or of a prominent natural feature within the quadrangle. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped and several pages of descriptive text. The text explains the maps and describes the topographic and geologic features of the country and its mineral products. The topographic map shows roads, railroads, waterways, and, by contour lines, the shapes of hills and valleys and the height above sea level of all points in the quadrangle. The areal-geology map shows the distribution of the various rocks at the surface. The structural-geology map shows relations of the rocks to one another underground. The economic-geology map indicates the location of mineral deposits that are commercially valuable. The artesian-water map shows the depth to underground-water horizons. Economic-geology and artesian-water maps are included in folios if the conditions in the areas mapped warrant their publication. The folios are of special interest to students of geography and geology and are valuable as guides in the development and utilization of mineral resources.

The folios numbered from 1 to 163, inclusive, are published in only one form (18 by 22 inches), called the library edition. Some of the folios that bear numbers higher than 163 are published also in an octavo edition (6 by 9 inches). Owing to a fire in the Geological Survey building May 18, 1913, the stock of geologic folios was more or less damaged by fire and water, but 80 or 90 per cent of the folios are usable. They will be sold at the uniform price of 5 cents each,

[1] Index maps showing areas in the Hudson Bay and upper Mississippi River basins covered by topographic maps and by geologic folios will be mailed on receipt of request addressed to the Director, U. S. Geological Survey, Washington, D. C.

with no reduction for wholesale orders. This rate applies to folios in stock from 1 to 184, inclusive (except reprints), also to the library edition of folio 186. The library edition of folios 185, 187, and higher numbers sells for 25 cents a copy, except that some folios which contain an unusually large amount of matter sell at higher prices. The octavo edition of folio 185 and higher numbers sells for 50 cents a copy. A discount of 40 per cent is allowed on an order for folios or for folios together with topographic maps amounting to $5 at the retail rate.

All the folios contain descriptions of the drainage of the quadrangles. The folios in the following list contain also a brief discussion of the underground waters in connection with the economic resources of the areas and more or less information concerning the utilization of the water resources.

An asterisk (*) indicates that the stock of the folio is exhausted.

*117. Casselton-Fargo, North Dakota-Minnesota.

Gives a somewhat detailed account of the water supply, including descriptions and logs of principal wells and tabulated well records; contains artesian-water maps showing areas which will probably yield flowing wells.

*145. Lancaster-Mineral Point, Wisconsin-Iowa-Illinois.

Discusses the springs, shallow and deep wells, streams, and water power; gives analyses of artesian water from well at Dubuque, Iowa.

*168. Jamestown-Tower (Jamestown, Eckelson, and Tower quadrangles), North Dakota.

Discusses shallow, deep, and artesian wells and head, pressure, power, volume, and character of the water. Gives a tabulated list of representative wells and contains an artesian-water map showing areas in which flowing wells may probably be obtained.

185. Murphysboro-Herrin, Illinois.[2] Library edition, 25c., octavo edition, 50c.

188. Tallula-Springfield, Illinois.[2] Library edition, 25c., octavo edition, 50c.

Discusses wells and the wholesomeness of the water; gives analyses of water from wells in the city of Springfield.

195. Belleville-Breese, Illinois, 25c.

Discusses wells and gives analyses of water from springs and wells.

200. Galena-Elizabeth, Illinois-Iowa, 25c.

201. Minneapolis-St. Paul, Minnesota.[2] Library edition, 25c., octavo edition, 50c

208. Colchester-Macomb, Illinois, 25c.

210. Herman-Morris, Minnesota, 25c.

213. New Athens-Okawville, Illinois, 25c.

216. Carlyle-Centralia, Illinois, 25c.

## MISCELLANEOUS REPORTS

Other Federal bureaus and the State and other organizations have from time to time published reports relating to the water resources of the various sections of the country. Notable among those pertaining to the Hudson Bay and upper Mississippi River basins are the reports of the State surveys of Illinois and North Dakota, the Wisconsin Geological and Natural History Survey and the Railroad Commission of Wisconsin, the Illinois Water-Supply Commission, and the Rivers and Lakes Commissions of Illinois, and the water-power report of the Tenth Census (vol. 17). The following reports deserve special mention:

Contribution to the physical geography of the United States, Part I. On the physical geography of the Mississippi Valley, with suggestions for the improve-

[2] Issued in two editions; specify which edition is wanted.

ment of navigation of the Ohio and other rivers, by Charles Ellet, jr.; Smithsonian Pub. 13, Washington, 1850.

The Mississippi and Ohio Rivers, by Charles H. Ellet. 1853.

Report upon the physics and hydraulics of Mississippi River, by A. A. Humphreys and H. L. Abbott.

The mineral content of Illinois waters, by Edward Barstow, J. A. Udden, S. W. Parr, and George T. Palmer: Illinois State Geol. Survey Bull. 10, 1909.

Water resources of the East St. Louis district, by Isaiah Bowman: Illinois State Geol. Survey Bull. 5, 1907.

Chemical and biological survey of waters of Illinois, by Edward Barstow: Univ. Illinois Pub. 3, 6, 7, 1906–1909.

Chemical survey of the waters of Illinois, report for the years 1897–1902, by A. W. Palmer, with report on geology of Illinois as related to its water supply, by Charles W. Rolfe: Univ. Illinois Pub.

Report and plans for the reclamation of lands subject to overflow in the Kaskaskia River Valley, Illinois; begun under the direction of the Internal Improvement Commission; completed and published under the direction of the Rivers and Lakes Commission of Illinois, by Jacob A. Harman. 1912.

Diversion of the waters of the Great Lakes by way of the sanitary and ship canal of Chicago: A brief of the facts and issues, by Lyman E. Cooley, Chicago. 1913.

The State of Missouri *vs.* the State of Illinois and the sanitary district of Chicago, before Frank S. Bright, Commissioner of the Supreme Court of the United States. 1904.

The mineral waters of Indiana, their location, origin, and character, by W. S. Blatchley: Indiana Dept. Geology and Nat. Res. Twenty-sixth Ann. Rept., 1901.

Report of the water-resources investigation of Minnesota by the State drainage commission, 1910.

Report of the commission on conservation [Montana] on bills relating to the public lands, water rights, and the protection and preservation of the forests, 1911.

Governor's message relating to conservation [in Montana] on bills relating to public lands, water rights, and the protection and preservation of the forests.

Water resources of the Devils Lake region, North Dakota, by E. J. Babcock: North Dakota Geol. Survey, Second Bienn. Rept., 1903.

The water powers of Wisconsin, by Leonard S. Smith: Wisconsin Geol. and Nat. Hist. Survey Bull. 20. Madison, Wis., 1908.

Report of the Railroad Commission of Wisconsin to the legislature on water powers. Madison, Wis., 1915.

Second report of the Railroad Commission of Wisconsin on water powers, 1914–1923. Madison, Wis., 1924.

Many of these reports can be obtained by applying to the several organizations, and most of them can be consulted in the public libraries of the larger cities.

# AREAS AND PUBLICATIONS COVERED

[A=Annual Reports; M=Monograph; B=Bulletin; P=Professional Paper; W=Water-Supply Paper; G F =Geologic folio]



[3] Many analyses of river, spring, and well waters are scattered through publications, as noted in abstract.

# STREAMS ON WHICH GAGING STATIONS HAVE BEEN MAINTAINED

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