DEPARTMENT OF THE INTERIOR
ALBERT B. FALL, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

Water-Supply Paper 475

SURFACE WATER SUPPLY OF THE UNITED STATES

1918

PART V. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS

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Prepared in cooperation with the States of
MINNESOTA, WISCONSIN, IOWA, and ILLINOIS

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SURFACE WATER SUPPLY OF HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS, 1918.

AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 14 reports presenting records of measurements of flow made on streams in the United States during the year ending September 30, 1918.

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 sundry civil bills passed by Congress have carried the following item and appropriations:

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, 1895–1919.

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911 to 1917, inclusive	150,000
1918	175,000
1919	148,244.10

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 9.

Measurements of stream flow have been made at about 4,500 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1918, 1,180 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 depth 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, run-off in inches, acre-feet, and millions of cubic 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 average 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 (depth 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 storage for irrigation.

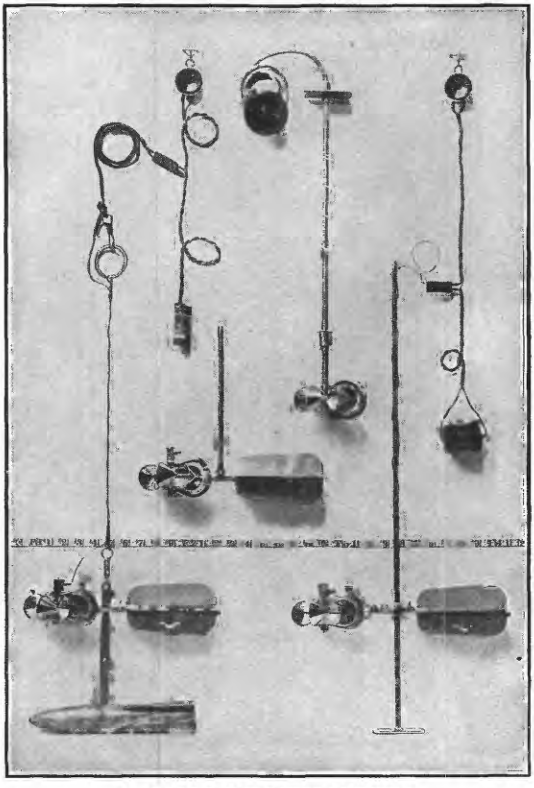
"Millions of cubic feet" is applied to quantities of water stored in reservoirs, most frequently in connection with studies of flood control.

The following terms not in common use are here defined:

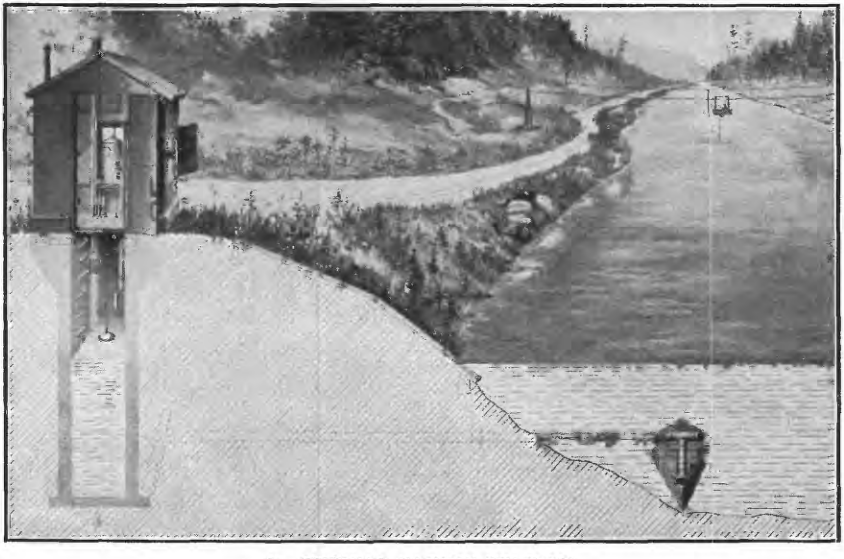
"Stage-discharge relation," an abbreviation for the term "relation of gage height to discharge."

"Control," a term used to designate the section or sections of the stream channel 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.

The "point of zero flow" for a gaging station is that point on the gage—the gage height—to which the surface of the river falls when the discharge is reduced to zero.



A. PRICE CURRENT METERS.



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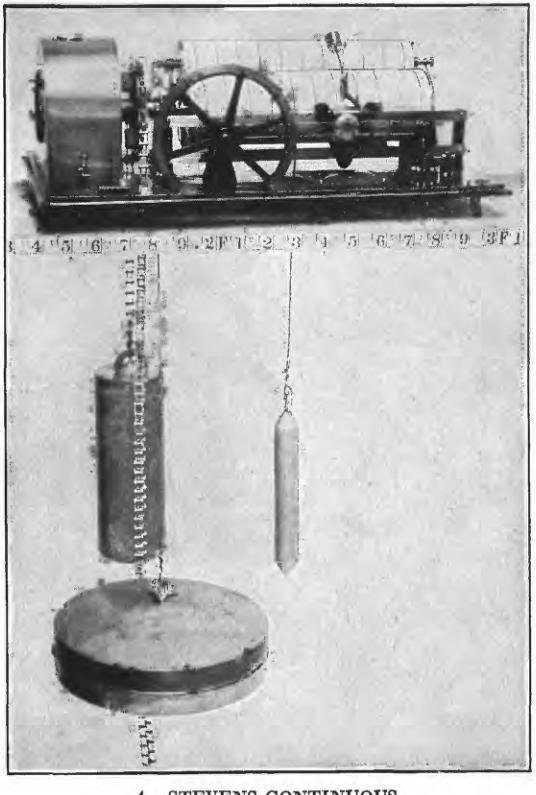

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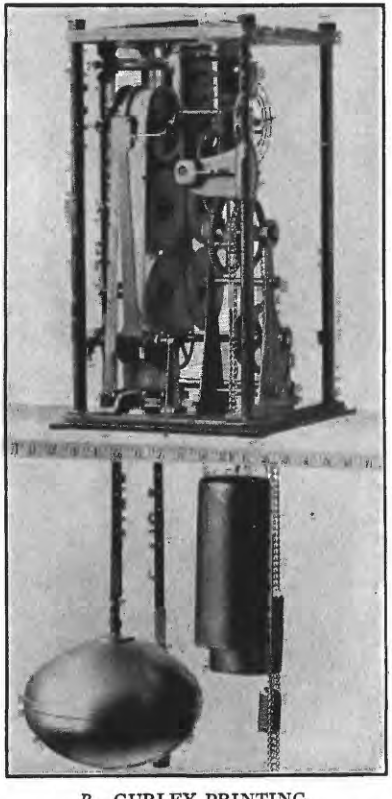

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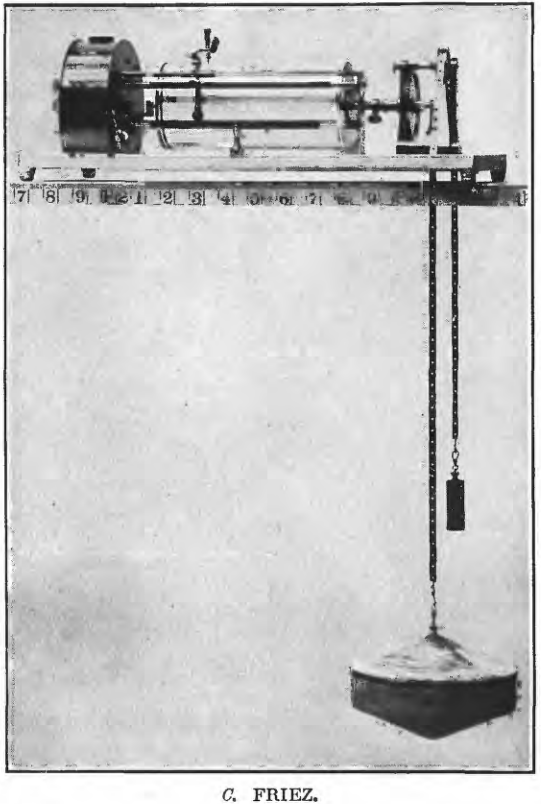

C. FRIEZ.

WATER-STAGE RECORDERS.

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1917, and ending September 30, 1918. 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, II.) 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, and these rating tables, when applied to the gage heights, give the discharge from which the daily, monthly, and yearly means of discharge are determined.

The data presented for each gaging station in the area covered by this report comprise a description of the station, a table giving records 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 height and records 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 permanence 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 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 avarage flow in cubic feet per second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 6, are based.

The deficiency table presented for some of the gaging stations shows the number of days in each year on which the mean daily discharge was less than the discharge given in the table. By subtraction the table gives the number of days each year that the mean daily discharge was between the discharges given in the table and, also by subtraction, the number of days that the mean daily discharge was equal to or greater than the discharge given. If one discharge rating table was used throughout the period covered by the deficiency table, gage heights that correspond to the discharges are also given.

ACCURACY OF FIELD DATA AND COMPUTED RECORDS.

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

[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.

showing discharge per square mile and depth of run-off in inches may be subject to gross errors caused by the inclusion of large non-contributing 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 flow of the river above the station. "Second-feet per square mile" and "Run-off (depth 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 (depth in inches)" previously published by the Survey should be used with caution because of possible inherent sources of error not known to the Survey.

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.

In Montana the work was done in cooperation with the United States Reclamation Service. The station on St. Mary River at Kimball, Alberta, was maintained in cooperation with the Canadian Department of Interior.

In Minnesota the work was carried on in cooperation with the State Drainage Commission, E. V. Willard, acting State drainage engineer, under terms of an act of the legislature of 1909 as embodied in joint resolution 19, which reads as follows:

> Whereas the water supplies, water powers, navigation of our rivers, drainage of our lands, and the sanitary condition of our streams and their watersheds generally form one great asset and present one great problem, therefore:
>
> *Be it resolved by the house of representatives, the senate concurring*, That the State drainage commission be, and is hereby, directed to investigate progress in other States toward the solution of said problem in such States, to investigate and determine the nature of said problems in this State.

The International Joint Commission maintained the water-stage recorder and paid the salary of the observer at the station on Kawishiwi River near Winton, and the United States Engineer Corps paid the salaries of the observers at the stations on Minnesota River near Montevideo and Mississippi River at Elk River.

The United States Weather Bureau furnished daily gage readings for the stations on Mississippi River at St. Paul and Minnesota River near Mankato.

In Wisconsin the work was carried on in cooperation with the Railroad Commission of Wisconsin, C. M. Larson, chief engineer, and at certain stations with the Wisconsin-Minnesota Light & Power Co. (Chippewa River at Chippewa Falls, Red Cedar River near Colfax, Red Cedar River at Cedar Falls, Red Cedar River at Menomonie) and Chippewa & Flambeau Improvement Co. (Chippewa River at Bishops Bridge, near Winter).

In Iowa the work was carried on in cooperation with the Iowa Geological Survey, George F. Kay, director; the Mississippi River Power Co., of Keokuk, Iowa, R. H. Bolster, hydraulic engineer; and the Iowa Highway Commission, Thomas H. MacDonald, chief engineer.

In Illinois work was carried on in cooperation with the Division of Waterways of Public Works and Buildings afterward, and at single stations with the United States Army Engineer Corps (Illinois River at Peoria) and the Central Illinois Public Service Co. (South Fork of Sangamon River at power plant near Taylorville).

DIVISION OF WORK.

The data for stations in the Hudson Bay basin, except in Minnesota, were collected and prepared for publication under the direction of W. A. Lamb, district engineer, Helena, Mont., assisted by E. F. Chandler.

The data for stations in the Hudson Bay and Mississippi River basins in Minnesota were collected and prepared for publication under the direction of W. G. Hoyt, district engineer, assisted by S. B. Soulé and E. F. Chandler, assisted by T. G. Bedford, R. B. Kilgore, and H. A. Noble.

For stations in the Mississippi River basin in Wisconsin the data were collected for publication under the direction of W. G. Hoyt, assisted by R. B. Kilgore, T. G. Bedford, J. B. Entringer, L. L. Smith, and F. W. Huels.

For stations in the Mississippi River basin in Iowa the data were collected under the direction of W. G. Hoyt, assisted by R. H. Bolster and R. W. Clyde, assisted by C. Herlofson, A. Davis, P. F. Gregg, and H. C. Hodge.

The data for stations in the Mississippi River basin in Illinois were collected under the direction of W. G. Hoyt, assisted by H. C. Beckman, assisted by A. M. Wohl and H. S. Wohl.

GAGING-STATION RECORDS.

HUDSON BAY DRAINAGE BASIN.

ST. MARY RIVER NEAR BABB, MONT.

[Including diversion from Swiftcurrent Creek.]

LOCATION.—In sec. 27, T. 36 N., R. 14 W., 1,040 feet above headworks of St. Mary canal and 2 miles south of Babb, on Blackfeet Indian Reservation, in Teton County.

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

RECORDS AVAILABLE.—April 9, 1902, to September 30, 1918.

GAGE.—Stevens water-stage recorder on left bank; installed June 15, 1918. Prior to that date chain gage on right bank was used; read by Andrew Chevirer from October 1 to August 24 and thereafter by William Olson. During the winter months of 1917 a temporary low-water gage was read, located at site of present automatic gage.

DISCHARGE MEASUREMENTS.—Made from a cable 560 feet below the gage. In September, 1909, the cable was moved from a point about 300 feet downstream. Low-water measurements are made by wading 800 feet below the gage.

CHANNEL AND CONTROL.—Bed of stream composed of gravel and cobblestones. Banks are high and will not be overflowed. The concrete diversion dam for the St. Mary canal, located 1,040 feet below the gage, forms the control. The dam is provided with flashboard sluice gates near the canal head gates. Stage-discharge relation is permanent when the flashboards in the sluice gates remain at the level of the crest of the dam and canal head gates are closed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.15 feet June 14 (discharge, 5,200 second-feet); minimum stage 1.02 feet December 10, 11, and 12 (discharge, 66 second-feet).

1902–1918: Maximum stage estimated at 9.4 feet June 5, 1908 (discharge, 7,980 second-feet); minimum stage recorded, 1.0 foot April 3–7, 1904 (discharge, 20 second-feet).

ICE.—Stage-discharge relation affected very little, if any, by ice.

DIVERSIONS.—None.

REGULATION.—Flow is regulated by Sherburne Lake reservoir and natural storage in St. Mary Lakes.

ACCURACY.—Stage-discharge relation affected by placing or removing flashboards on dam and operation of gates. Rating curve used October 1, 1917 to May 31, 1918, and September 8–30 based on measurements made with gates closed and flashboards in place and is well defined between 60 and 5,700 second-feet; curve used June 1 to July 28 based on measurements made with flashboards removed and is well defined between 110 and 5,720 second-feet; indirect method used July 29 to September 8. Gage read daily to half-tenths October 1 to June 15 and to hundredths June 16 to September 30; after June 15 records taken from Stevens continuous water-stage recorder. Daily discharge ascertained by applying daily gage height to rating table. Records good.

The diversion dam below the gaging station was constructed by the United States Reclamation Service for the purpose of diverting water from St. Mary River into St. Mary canal, which carries the water across the divide into North Fork of Milk River. The water then flows in the natural channel of Milk River through Canada, and is finally used for irrigation in the Milk River Valley in Montana. The present capacity of the diversion canal is about 425 second-feet. A storage reservoir is being provided on Swiftcurrent Creek by constructing a dam at the outlet of Sherburne Lake. By means of a diversion channel connecting Swiftcurrent Creek and Lower St. Mary Lake, the run-off from Swiftcurrent Creek is made available for diversion through St. Mary canal.

Discharge measurements of St. Mary River near Babb, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 9	Jones and Lamb	1.50	247	June 18	W. A. Lamb	5.40	4,140
Jan. 24	W. A. Lamb	1.56	290	July 7	do	2.64	1,140
May 25	R. F. Edwards	2.67	1,110	Aug. 12	do	2.11	784
June 15	W. A. Lamb	6.13	5,190	Sept. 6	do	1.70	451

Daily discharge, in second-feet, of St. Mary River near Babb, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	328	222	120	246	120	104	272	758	1,250	1,570	740	572
2	328	246	120	299	104	104	272	798	1,490	1,450	740	541
3	328	246	120	568	88	120	272	958	1,580	1,380	745	524
4	328	246	120	1,120	138	120	272	1,120	1,490	1,320	761	515
5	358	257	120	1,480	199	120	272	2,210	1,440	1,240	778	463
6	358	272	120	1,680	199	120	272	2,880	1,420	1,210	800	448
7	358	257	120	1,630	199	120	272	3,240	1,490	1,150	800	452
8	371	246	120	1,560	191	120	288	3,300	1,880	1,120	788	452
9	371	246	88	1,390	178	120	299	3,120	2,430	1,090	788	458
10	371	246	66	1,210	178	120	328	2,770	3,240	1,080	783	444
11	371	246	66	958	178	120	358	2,320	4,000	1,090	783	390
12	358	246	66	718	165	120	423	1,880	4,700	1,090	805	390
13	358	246	74	643	157	120	568	1,680	4,980	1,070	788	410
14	328	208	88	583	157	127	718	1,600	5,200	1,060	794	423
15	299	208	104	553	157	138	798	1,780	5,120	1,040	788	423
16	299	199	104	458	157	138	798	1,990	4,940	1,030	805	410
17	299	178	104	437	157	199	758	2,100	4,530	1,020	810	390
18	299	178	120	423	157	199	718	2,040	4,210	1,000	783	358
19	299	178	120	390	157	199	643	1,940	3,950	986	772	358
20	299	178	127	358	157	208	643	1,780	3,800	968	761	378
21	288	165	127	346	157	208	643	1,680	3,610	950	735	378
22	272	157	138	328	157	237	703	1,530	3,340	920	725	378
23	272	150	138	311	157	237	758	1,390	3,000	908	720	378
24	246	138	138	288	138	237	838	1,300	2,990	872	695	378
25	222	138	138	272	120	246	838	1,210	2,880	866	690	378
26	222	138	138	257	104	246	838	1,110	2,680	832	665	410
27	199	138	138	237	104	246	838	1,040	2,440	794	680	378
28	199	138	138	208	104	246	758	958	2,220	772	685	371
29	199	127	150	178	.....	246	758	958	1,920	735	650	346
30	199	127	157	150	.....	257	734	822	1,780	730	625	346
31	199	.....	157	120	.....	257	.....	862	.....	735	605	.....

Monthly discharge of St. Mary River near Babb, Mont., for the year ending Sept. 30, 1918.

[Drainage area, 278 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches.	Acre-feet.
October	371	199	298	1.07	1.23	18,300
November	272	127	199	.715	.80	11,800
December	157	66	118	.424	.49	7,260
January	1,680	120	626	2.25	2.59	38,500
February	199	88	151	.543	.57	8,390
March	257	104	174	.626	.72	10,700
April	838	272	565	2.03	2.27	33,600
May	3,300	758	1,710	6.15	7.09	105,000
June	5,200	1,250	3,000	10.79	12.04	179,000
July	1,570	730	1,040	3.74	4.31	64,000
August	810	605	745	2.68	3.09	45,800
September	572	346	418	1.50	1.67	24,900
The year	5,200	66	755	2.72	36.87	547,000

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 from 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 1918. From September 4, 1902, to December 31, 1912, records were obtained at a point one-quarter of a mile below the boundary line. Records were also obtained by the Irrigation Branch (now the Reclamation Service), Department of the Interior, Canada, at a point half a mile below the present station, from 1905 to 1912. The discharge at the three points is practically the same.

GAGE.—Stevens water-stage recorder with a concrete well and shelter on the right bank used during the open-water season. During the winter months a chain gage, located on the highway bridge 3 miles below the station is used. A staff gage located at cable from which measurements were made was used from October 1, 1917, to November 8, 1917.

DISCHARGE MEASUREMENTS.—Made from a cable 1,200 feet above the gage; low-water measurements made by wading near the gage.

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

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 6.35 feet at 11 a. m. June 14 (discharge, 4,970 second-feet); minimum stage, December 13–15 and March 1; flow computed from hydrographic study of winter flow as stage-discharge relation was affected by ice.

1902–1918: 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, 70 second-feet,[2] February 5, 1914.

ICE.—Stage-discharge relation seriously affected by ice December 1 to March 29.

DIVERSIONS.—The St. Mary canal, constructed by the United States Reclamation Service, diverts water from St. Mary River near Babb, Mont., to North Fork of Milk River. During 1918 approximately 58,030 acre-feet were diverted, measurement being made at St. Mary crossing. Seepage from the canal above this point returns directly to the river and is measured at the international boundary. Seepage from the canal between St. Mary crossing and Hudson Bay divide goes into Rolph Creek, which enters St. Mary River below the gaging station at international boundary. The Alberta Railway & Irrigation Co. canal diverts from St. Mary River about 2 miles below the station.

REGULATION.—The flow of Swiftcurrent Creek will be regulated by the Sherburne Lake reservoir, under construction by the United States Reclamation Service.

ACCURACY.—Stage-discharge relation permanent during year except for period affected by ice December 1 to March 29. Rating curve well defined. Daily gage heights obtained from Stevens water-stage recorder records by straight-line method for periods October 1 to December 10, 1917, and March 28 to September 30, 1918. Daily gage heights from December 12 to March 28 from observer's reading to hundredths on chain gage at highway bridge 3 miles below gage. Daily discharge October 1 to November 30 and March 29 to September 30 ascertained by applying mean daily gage height to rating table. Records for this period are good as curve is well defined between 200 and 5,000 second-feet. Daily discharge December 1 to March 28 from winter hydrograph, based upon observer's gage heights and notes on ice, temperature records, and discharge measurements. Records fair.

COOPERATION.—Station maintained jointly with the Reclamation Service, Department of the Interior, Canada.

[2] Only estimates of mean monthly flow are available for the winter periods from 1902 to 1912, inclusive, and a lower minimum discharge may have occurred during that time.

Discharge measurements of St. Mary River near Kimball, Alberta, during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 16	A. W. P. Lowrie [a]	2.80	376	June 2	C. H. Ellacott [a]	4.45	1,600
Nov. 6	....do	2.65	301	15	....do	6.19	4,501
10	B. E. Jones and W. A. Lamb	2.59	276	17	W. A. Lamb	5.92	4,230
19	S. H. Frame [a]	2.33	222	18	V. A. Newhall [a] and D. G. Chadsey [a]	5.83	3,760
Dec. 4	D. G. Chadsey [a]	[b] 3.86	144	July 3	C. H. Ellacott [a]	3.93	1,154
Jan. 1	S. H. Frame	5.46	497	6	B. E. Jones	3.72	859
4	....do	5.34	1,341	11	W. A. Lamb	3.55	851
28	....do	4.04	224	23	C. H. Ellacott [a]	3.42	740
Feb. 21	A. W. P. Lowrie	4.65	143	Aug. 4	B. E. Jones and R. J. Burley [a]	3.11	[c] 518
Mar. 12	....do	4.60	136	7	C. H. Ellacott [a]	3.18	581
29	C. M. O'Neil [a]	2.65	287	10	W. A. Lamb	3.09	512
Apr. 3	....do	2.70	306	15	C. H. Ellacott [a]	3.13	541
22	....do	3.55	806	31	....do	2.90	413
26	....do	3.67	928	Sept. 6	B. E. Jones and R. J. Burley [a]	2.85	391
May 10	B. Russell [a]	5.32	2,845	21	C. H. Ellacott [a]	2.94	445
24	W. A. Lamb	4.26	1,360	28	....do	2.90	408
28	C. H. Ellacott [a]	3.88	1,110				

[a] Engineer, Department of Interior, Canada.
[b] Stage-discharge relation affected by ice; gage height from staff gage at regular station.
[c] Measurement made below Alberta Railway & Irrigation Co.'s dam, flow of canal included in results.

NOTE.—Stage-discharge relation affected by ice Dec. 12 to Mar. 27. Measurements during this period referred to chain gage on highway bridge 3 miles below gage.

Daily discharge, in second-feet, of St. Mary River near Kimball, Alberta, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	415	284	190	500	200	115	315	846	1,370	1,340	464	503
2	415	315	180	700	200	120	315	972	1,550	1,190	464	498
3	415	315	165	1,000	200	120	315	1,160	1,570	1,120	486	470
4	410	340	145	1,340	200	125	304	1,500	1,510	1,070	520	432
5	410	315	140	1,650	205	125	340	2,280	1,430	995	567	415
6	443	298	140	1,870	205	130	390	2,990	1,460	942	591	395
7	437	294	135	1,850	210	130	375	3,300	1,570	882	573	452
8	448	290	130	1,700	210	130	375	3,380	1,970	860	549	510
9	459	284	130	1,500	215	130	420	3,210	2,720	832	537	567
10	426	277	125	1,300	215	130	476	2,970	3,540	825	520	555
11	400	274	120	1,050	220	130	514	2,520	4,200	825	525	531
12	405	268	120	770	220	135	585	2,120	4,600	818	592	508
13	400	256	115	690	220	135	671	1,890	4,930	811	573	498
14	395	239	115	630	220	140	776	1,820	4,970	797	537	481
15	380	237	115	600	215	145	846	1,980	4,730	790	549	470
16	360	236	120	510	210	150	853	2,160	4,420	790	624	464
17	340	226	125	490	200	160	846	2,340	4,040	762	561	448
18	355	225	130	470	190	170	818	2,200	3,800	762	531	443
19	355	224	140	440	170	180	783	2,080	3,560	755	520	443
20	375	221	150	410	155	190	769	1,990	3,420	727	486	426
21	426	217	155	395	145	205	790	1,780	3,170	727	486	437
22	443	212	160	370	140	220	839	1,710	2,950	713	464	432
23	410	208	170	345	135	230	860	1,570	2,670	727	464	426
24	390	204	180	320	130	240	882	1,450	2,570	713	470	437
25	365	201	190	295	130	255	898	1,370	2,450	664	464	448
26	325	197	200	280	130	270	912	1,260	2,260	650	470	443
27	290	197	215	255	125	275	935	1,170	2,030	592	443	426
28	256	197	230	225	120	280	898	1,100	1,850	503	498	415
29	253	197	250	220	.....	285	898	1,070	1,670	459	437	415
30	262	197	320	210	.....	290	832	972	1,450	464	415	415
31	268	.....	400	205	.....	298	.....	980	.....	464	410	.....

Monthly discharge of St. Mary River near Kimball, Alberta, for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	459	253	378	23,200
November	340	197	248	14,800
December	400	115	168	10,300
January	1,870	205	729	44,800
February	220	120	183	10,200
March	298	115	182	11,200
April	935	304	661	39,300
May	3,380	846	1,880	116,000
June	4,970	1,370	2,810	167,000
July	1,340	459	793	48,800
August	624	410	509	31,300
September	567	395	460	27,400
The year	4,970	115	739	544,000

Combined daily discharge, in second-feet, of St. Mary River near Kimball, Alberta, and St. Mary canal at St. Mary crossing, near Babb, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	415	284	190	500	200	115	315	846	1,370	1,340	726	635
2	415	315	180	700	200	120	315	972	1,550	1,190	724	630
3	415	315	165	1,000	200	120	315	1,160	1,570	1,120	745	603
4	410	340	145	1,340	200	125	304	1,500	1,510	1,070	760	567
5	410	315	140	1,650	205	125	340	2,280	1,430	995	806	542
6	443	298	140	1,870	205	130	390	2,990	1,460	1,330	833	516
7	437	294	135	1,850	210	130	375	3,300	1,570	1,270	817	542
8	448	290	130	1,700	210	130	375	3,380	1,970	1,250	814	512
9	459	284	130	1,500	215	130	420	3,210	2,720	1,220	793	567
10	426	277	125	1,300	215	130	476	2,970	3,540	1,220	776	555
11	400	274	120	1,050	220	130	514	2,520	4,200	1,220	764	531
12	405	268	120	770	220	135	585	2,120	4,600	1,210	840	508
13	400	256	115	690	220	135	671	1,890	4,930	1,210	845	498
14	395	239	115	630	220	140	776	1,820	4,970	1,200	830	481
15	380	237	115	600	215	145	846	1,980	4,730	1,190	851	470
16	360	236	120	510	210	150	853	2,160	4,420	1,190	945	464
17	340	226	125	490	200	160	846	2,340	4,040	1,160	897	448
18	355	225	130	470	190	170	818	2,200	3,800	1,160	897	443
19	355	224	140	440	170	180	783	2,080	3,560	1,160	886	443
20	375	221	150	410	155	190	769	1,990	3,420	1,130	841	426
21	426	217	155	395	145	205	790	1,780	3,170	1,130	804	437
22	443	212	160	370	140	220	839	1,710	2,950	1,120	768	432
23	410	208	170	345	135	230	860	1,570	2,670	1,130	725	426
24	390	204	180	320	130	240	882	1,450	2,570	1,120	697	437
25	365	201	190	295	130	255	898	1,370	3,450	1,070	669	448
26	325	197	200	280	130	270	912	1,260	2,260	1,060	661	443
27	290	197	215	255	125	275	935	1,170	2,030	998	618	426
28	256	197	230	225	120	280	898	1,100	1,850	903	624	415
29	253	197	250	220	.....	285	898	1,070	1,670	843	569	415
30	262	197	320	210	.....	290	832	972	1,450	786	562	415
31	268	.....	400	205	.....	298	.....	980	.....	745	551	.....

NOTE.—For table of daily discharge of St. Mary canal at St. Mary crossing, see p. 18.

Combined monthly discharge of St. Mary River near Kimball, Alberta, and St. Mary canal at St. Mary crossing, near Babb, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	459	253	378	23,200
November	340	197	248	14,800
December	400	115	168	10,300
January	1,870	205	729	44,800
February	220	120	183	10,200
March	298	115	182	11,200
April	935	304	661	39,300
May	3,380	846	1,880	116,000
June	4,970	1,370	2,810	167,000
July	1,340	745	1,120	68,900
August	945	551	763	46,900
September	635	415	489	29,100
The year	4,970	115	803	581,700

NOTE.—For table of monthly discharge at St. Mary canal at St. Mary crossing, see p. 18.

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

LOCATION.—In SE. ¼ sec. 27, T. 36 N., R. 14 W., 300 feet below headworks of canal and 2 miles south of Babb, on Blackfeet Indian Reservation.

RECORDS AVAILABLE.—June 1 to September 7, 1918.

GAGE.—Staff gage nailed to downstream side of pier of footbridge, 300 feet below headworks of canal. Gage read by United States Reclamation Service employees.

DISCHARGE MEASUREMENTS.—Made from footbridge at gage.

CHANNEL AND CONTROL.—Bed composed of gravel. Repairs to canal may cause slight changes in cross section below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.3 feet June 27 and 28 (discharge, 626 second-feet).

ICE.—Canal is not operated during winter months.

REGULATION.—Discharge is regulated by the head gates.

ACCURACY.—Stage-discharge relation fairly permanent, but current-meter measurements only fair, due to eddies from bridge piers. Rating curve fairly well defined. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

COOPERATION.—Station maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

Discharge measurements of St. Mary canal at intake, near Babb, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 15	W. A. Lamb	5.90	565	Aug. 12	C. H. Ellacott	4.50	319
July 7	do	6.25	613	Sept. 6	W. A. Lamb	3.14	185
Aug. 9	do	4.67	335				

Daily discharge, in second-feet, of St. Mary canal at intake, near Babb, Mont., for the year ending Sept. 30, 1918.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept
1	208	616	350	187	16	550	615	421	.....
2	208	616	350	187	17	550	616	512	.....
3	208	616	350	186	18	550	615	522	.....
4	238	616	321	188	19	550	615	522	.....
5	258	616	321	187	20	550	615	522	.....
6	264	616	288	185	21	550	611	421	.....
7	270	616	321	69	22	550	611	388	.....
8	270	616	357	.....	23	550	611	301	.....
9	288	616	366	.....	24	569	611	294	.....
10	342	616	342	.....	25	588	615	253	.....
11	388	616	314	.....	26	588	611	230	.....
12	421	616	314	.....	27	626	607	230	.....
13	457	620	351	.....	28	626	607	208	.....
14	493	616	388	.....	29	623	550	197	.....
15	540	613	388	.....	30	619	430	197	.....
					31	.....	380	186	.....

NOTE.—Canal gates closed at 9 a. m. Sept. 7.

Monthly discharge of St. Mary canal at intake, near Babb, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June	626	208	450	26,800
July	620	380	599	36,800
August	522	186	340	20,900
September 1–7	188	69	170	2,360
The period	626	69	442	86,860

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

LOCATION.—In sec. 19, T. 37 N., R. 13 W., at entrance to flume, 600 feet below outlet of siphon by which canal crosses St. Mary River, 9 miles below headworks, and 6 miles northeast of Babb, on Blackfeet Indian Reservation.

RECORDS AVAILABLE.—July 6 to September 8, 1918.

GAGE.—Stevens water-stage recorder, located on concrete entrance to flume just below outlet to siphon crossing St. Mary River. A staff gage on outside of gage house is also read.

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

CHANNEL AND CONTROL.—Control is the steel flume several hundred feet long heading at the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.40 feet July 26 (discharge, 408 second-feet).

ICE.—Canal not operated during winter months.

REGULATION.—Flow is regulated by head gates about 9 miles above.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 180 and 400 second-feet. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

COOPERATION.—Station maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

Discharge measurements of St. Mary canal at St. Mary crossing, near Babb, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
July 11	W. A. Lamb	6.34	400	Aug. 9	W. A. Lamb	5.06	253
Aug. 5	Jones and Burley	4.90	242	Sept. 5	Jones and Burley	3.55	126

Daily discharge, in second-feet, of St. Mary canal at St. Mary crossing, near Babb, Mont., for the year ending Sept. 30, 1918.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1		262	132	11	398	239		21	403	318	
2		260	132	12	395	248		22	404	304	
3		259	133	13	400	272		23	403	261	
4		240	135	14	398	293		24	406	227	
5		239	127	15	403	302		25	406	205	
6	391	242	121	16	403	321		26	408	191	
7	392	244	90	17	403	336		27	406	175	
8	394	265	2	18	403	366		28	400	126	
9	390	256		19	403	366		29	384	132	
10	398	256		20	402	355		30	322	147	
								31	281	141	

NOTE.—Discharge for Sept. 7 and 8 computed by hourly method. Canal gates closed Sept. 8.

Monthly discharge of St. Mary canal at St. Mary crossing, near Babb, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
July 6-31	408	281	392	20,200
August	366	126	253	15,600
September 1-8	135	2	109	1,730
The period	408	2	291	37,530

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

LOCATION.—At Douglas bridge on Hudson Bay divide, 3 miles above outlet of canal and 30 miles directly north of Browning, in Blackfeet Indian Reservation.

RECORDS AVAILABLE.—July 3, 1917, to September 30, 1918.

GAGE.—A vertical staff, graduated to tenths, nailed to upstream side of left pier of bridge; read once a day by United States Reclamation Service ditch rider.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge at gage.

CHANNEL AND CONTROL.—Channel uniform, but slope varies with the stage. Control is a V-shaped concrete drop located 1 mile below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 5.4 feet July 25–29 (discharge, 405 second-feet).

1917–1918: Maximum stage recorded, 5.4 feet July 25–29, 1918 (discharge, 405 second-feet).

REGULATION.—The flow is regulated at the head gates 26 miles above. A small reservoir at Spider Lake eliminates sudden changes at the head gates.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 120 and 400 second-feet. Daily discharge ascertained by applying daily gage height to rating table. Records fair.

COOPERATION.—Station maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

Discharge measurements of St. Mary canal at Hudson Bay divide, near Browning, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 18[a]	B. E. Jones	4.96	317	July 9[a]	W. A. Lamb	5.30	403
18[b]	do	4.95	327	Aug. 10[a]	do	4.25	264
29[b]	do	5.16	363	Sept. 7[a]	do	3.02	138

[a] Made at Douglas Bridge. [b] Made at bridge below first drop.

Daily discharge, in second-feet, of St. Mary canal at Hudson Bay divide, near Browning, Mont., for the year ending Sept. 30, 1918.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1	.....	373	243	138	16	315	394	289	.....
2	.....	383	254	138	17	329	394	302	.....
3	114	383	248	138	18	337	394	315	.....
4	114	383	248	122	19	329	394	345	.....
5	146	383	233	122	20	329	394	363	.....
6	183	394	238	122	21	329	394	308	.....
7	183	394	238	122	22	329	394	289	.....
8	188	394	238	122	23	329	394	265	.....
9	193	394	248	72	24	329	394	214	.....
10	213	394	243	.....	25	337	405	203	.....
11	218	394	238	.....	26	337	405	183	.....
12	265	405	238	.....	27	337	405	173	.....
13	296	383	243	.....	28	354	405	173	.....
14	302	394	248	.....	29	363	405	114	.....
15	302	394	265	.....	30	368	363	138	.....
					31	.....	302	138	.....

NOTE.—Canal gates closed Sept. 9. Discharge for Sept. 9 computed by hourly method.

Monthly discharge of St. Mary canal at Hudson Bay divide, near Browning, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
June 3–30	368	114	277	15,400
July	405	302	390	24,000
August	363	114	241	14,800
September 1–9	138	72	122	2,180
The period	405	72	287	56,400

SWIFTCURRENT CREEK AT MANY GLACIER, MONT.

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

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

RECORDS AVAILABLE.—June 6, 1912, to September 30, 1918.

GAGE.—Stevens water-stage recorder installed June 15, 1918, in shelter built by park officials and Great Northern Railway, and referred to two staff gages, one inside well and one outside. Prior to May 23, 1916, a staff gage on left bank opposite present gage was read. May 23, 1916, to June 15, 1918, a vertical staff at same location as present gage. Gage read by E. Peterson and others twice daily to hundredths.

DISCHARGE MEASUREMENTS.—Made by wading at outlet of lake or below falls. High-water measurements made from highway bridge above power house; measuring section at bridge is very poor.

CHANNEL AND CONTROL.—Control is a limestone outcrop at outlet of the lake; just below is a fall and a cataract.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.25 feet June 10 (discharge, 1,250 second-feet); minimum stage, 1.48 feet February 25–28 and January 1 and 2 (discharge, 41 second-feet).

1912–1918: Maximum stage recorded, 4.75 feet June 17, 1916 (discharge, 1,550 second-feet); minimum discharge, 10.8 second-feet March 19, 1912, measured by current meter, prior to installation of gage.

ICE.—Stage-discharge affected very little, if any, by ice. Open channel conditions assumed throughout year.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation apparently changed during high water of June, but remained constant during remainder of year. Two rating tables used; one applicable October 1 to June 10, the other June 11 to September 30. The former is well defined between 44 and 825 second-feet; the latter between 60 and 300 second-feet. Gage heights October 1 to June 14 are mean of two readings daily to nearest hundredth; June 15 to September 30 determined by graphic method from Stevens water-stage recorder. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

The following discharge measurements were made by W. A. Lamb:

July 8, 1918: Gage height, 2.32 feet; discharge, 209 second-feet (subject to some error caused by wave action due to strong wind); September 6, 1918: Gage height, 1.81 feet; discharge, 67 second-feet.

Daily discharge, in second-feet, of Swiftcurrent Creek at Many Glacier, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	94	56	54	147	48	42	53	440	367	211	192	119
2	94	54	54	455	48	42	54	570	372	242	222	112
3	94	55	54	525	48	44	56	715	367	242	215	89
4	103	56	55	500	46	46	59	740	372	203	188	76
5	128	56	54	460	44	46	59	886	420	188	174	73
6	133	58	53	430	44	48	62	924	590	182	164	71
7	128	59	53	405	46	46	64	935	565	188	155	80
8	118	60	53	353	46	46	65	372	742	207	161	87
9	114	62	53	306	44	46	82	287	1,020	238	158	91
10	94	59	52	278	44	46	144	343	1,250	280	149	91
11	88	59	53	256	44	46	165	324	1,160	293	168	89
12	86	59	53	224	44	46	172	310	1,070	263	242	97
13	86	58	52	88	44	46	189	324	980	226	246	95
14	78	55	53	71	44	46	185	560	860	222	222	95
15	76	52	53	65	44	50	165	666	860	226	199	85
16	74	54	53	65	44	53	155	704	563	226	192	80
17	73	53	53	64	44	53	133	682	563	226	188	75
18	70	54	68	65	44	58	144	732	618	238	168	76
19	67	54	125	65	44	55	162	710	640	246	149	82
20	65	54	125	65	44	53	155	655	618	234	134	85
21	62	54	92	63	44	53	201	555	520	207	129	85
22	60	54	78	60	44	53	224	152	473	182	129	89
23	62	54	63	54	44	53	238	138	484	178	126	89
24	59	54	55	53	44	43	269	130	443	164	129	89
25	59	55	55	53	42	54	287	123	458	137	146	91
26	59	55	55	53	42	58	256	123	389	122	146	84
27	56	55	55	53	42	55	212	121	324	126	143	78
28	63	54	84	51	42	56	204	123	276	134	122	76
29	62	54	136	51	.....	65	224	141	234	143	105	75
30	56	54	147	51	.....	63	324	287	199	161	101	73
31	56	.....	138	48	.....	59	.....	357	.....	178	99	.....

Monthly discharge of Swiftcurrent Creek at Many Glacier, Mont., for the year ending Sept. 30, 1918.

[Drainage area, 31.4 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches.	Acre-feet.
October	133	56	81.2	2.59	2.99	4,990
November	62	52	55.7	1.77	1.98	3,310
December	147	52	70.4	2.24	2.58	4,330
January	525	48	177	5.63	6.49	10,900
February	48	42	44.3	1.41	1.47	2,460
March	65	42	50.6	1.61	1.86	3,110
April	324	53	159	5.09	5.68	9,460
May	935	121	456	14.5	16.7	28,000
June	1,250	199	593	18.9	21.1	35,200
July	293	122	204	6.50	7.49	12,500
August	246	99	163	5.19	5.98	10,000
September	119	71	85.9	2.74	3.06	5,110
The year	1,250	42	179	5.70	77.38	129,000

SWIFTCURRENT CREEK AT SHERBURNE, MONT.

LOCATION.—In sec. 35, T. 36 N., R. 15 W., near outlet of Lower Sherburne Lake, in Teton County.

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

RECORDS AVAILABLE.—July 1, 1912, to September 30, 1918.

GAGE.—Staff gage on left bank about 300 feet below the spillway of Sherburne Lake dam, read by employees of the United States Reclamation Service. From July 1, 1912, to November 9, 1914, a vertical staff gage was maintained on left bank near outlet of lake, and at a different datum from present gage.

DISCHARGE MEASUREMENTS.—Made by wading or from cable 50 feet below gage.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.20 feet May 5, June 14–15 (discharge, 1,140 second-feet); minimum stage, gates closed January 11 to March 13; flow only the leakage through gates and small inflow between dam and gage.

1912–1918: Maximum stage recorded, 7.85 feet June 17, 1916 (discharge, 2,280 second-feet); minimum stage, gates closed January 11 to March 13, 1918; flow only the leakage through gates and small inflow between dam and gage.

ICE.—Not seriously affected by ice; gates closed during most of winter season.

DIVERSIONS.—None.

REGULATION.—The natural flow of the stream was affected by placing and removing flashboards on temporary dam built at outlet of the lake for construction purposes in connection with Sherburne Lake storage dam. See footnote to table of daily discharge. Flow partly regulated by gate operation.

ACCURACY.—Stage-discharge relation not permanent during year; affected by changes in control due to landslide. After May 5 control practically permanent. Two rating curves used during year; one from October 1 to January 10 and the other from May 5 to September 30; the former is well defined between 40 and 1,000 second-feet, and the latter between 60 and 1,200 second-feet. Daily gage heights are mean of two readings daily to nearest hundredth. Daily discharge ascertained by applying daily gage heights to rating table, except for period March 14 to April 27, when they were obtained by indirect method for shifting control. Records good.

Discharge measurements of Swiftcurrent Creek at Sherburne, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 16	W. A. Lamb	2.50	148	July 8	W. A. Lamb	3.50	278
May 25	do	3.36	245	Aug. 12	do	3.00	180
June 17	do	6.02	1,070	Sept. 6	do	2.48	110

Daily discharge, in second-feet, of Swiftcurrent Creek at Sherburne, Mont., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	108	246	54	5	.....	151	.....	663	296	137	110
2	113	193	56	4	.....	148	.....	636	278	138	110
3	117	202	56	695	.....	148	.....	458	278	164	110
4	114	180	56	970	.....	148	1,100	348	280	180	110
5	123	142	57	873	.....	146	1,140	348	278	194	110
6	170	176	56	800	.....	145	1,110	350	278	201	110
7	187	180	56	695	.....	145	1,050	496	276	200	110
8	170	148	55	630	.....	145	1,000	816	269	198	110
9	134	134	54	94	.....	153	801	906	252	188	110
10	105	124	55	92	.....	213	448	1,000	238	180	110
11	108	118	55	.....	.....	282	296	1,080	243	180	110
12	104	92	56	.....	.....	415	214	1,110	243	180	110
13	105	82	56	.....	.....	560	234	1,130	245	183	110
14	99	76	56	.....	198	282	324	1,140	245	183	110
15	65	70	32	.....	167	339	673	1,140	245	194	110
16	49	57	10	.....	149	412	649	1,120	247	247	110
17	54	54	42	.....	151	293	554	1,050	247	291	110
18	71	49	93	.....	151	231	422	997	247	278	110
19	60	38	93	.....	148	210	367	967	249	230	109
20	83	46	95	.....	148	202	360	887	260	185	109
21	55	43	98	.....	148	216	302	794	282	164	109
22	59	44	.....	.....	146	282	276	524	287	143	109
23	57	38	.....	.....	153	304	267	502	287	143	108
24	59	40	.....	.....	159	274	256	710	282	143	108
25	58	43	.....	.....	159	276	193	609	265	124	108
26	57	48	.....	.....	158	265	151	513	220	108	108
27	57	51	.....	.....	159	240	148	464	176	108	99
28	58	55	.....	.....	159	.....	148	353	157	108	90
29	55	62	1	.....	159	.....	145	314	144	109	76
30	130	53	1	.....	151	.....	145	317	143	109	60
31	194	.....	3	.....	151	.....	355	.....	137	109	.....

NOTE.—Entire flow of river held back at Sherburne Lake from Dec. 22-28, Jan. 11 to Mar. 13, and Apr. 28 to May 3.

Monthly discharge of Swiftcurrent Creek at Sherburne, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	194	49	96.1	5,910
November	246	38	96.1	5,720
December	98	1	40.2	2,470
May	1,140	145	425	26,100
June	1,140	314	725	43,100
July	296	137	244	15,000
August	291	108	171	10,500
September	110	60	106	6,310

NOTE.—Stream partly controlled beginning with 1915, therefore valves for discharge in second-feet per square mile and for run-off, depth in inches, are not computed. June 1-30, 1915, a total of 1,560 acre-feet of water was stored in Sherburne Lake by a temporary construction dam; 134 acre-feet was stored Aug. 25 to Sept. 18, 1915; the latter amount was released Sept. 18-20, 1915.

CANYON CREEK NEAR MANY GLACIER, MONT.

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

DRAINAGE AREA.—7.0 square miles (measured on topographic map).

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

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

DISCHARGE MEASUREMENTS.—Made from footbridge at gage.

CHANNEL AND CONTROL.—Bed of stream covered with heavy boulders and cobblestones. Control is riffle about 20 feet below gage; may shift at high stage. Both banks high and can not be overflowed.

EXTREMES OF DISCHARGE.—Maximum discharge recorded, 74 second-feet by current-meter measurement, June 16; minimum stage, 0.83 foot September 29 and 30 (discharge, 10 second-feet).

ICE.—Station not operated during winter on account of severe ice effect on stage-discharge relation.

DIVERSIONS.—None.

REGULATIONS.—Some natural storage in small lake at head of creek; no artificial regulations.

ACCURACY.—Stage-discharge relation practically permanent except for severe ice effect. Rating curve well defined between 15 and 40 second-feet. Daily gage heights obtained from Stevens water-stage recorder graph by the straight-line method, except for period August 4–11 when clock stopped. Daily discharge ascertained by applying mean daily gage height to rating table except for period noted above, for which discharge was interpolated. Records good.

Discharge measurements of Canyon Creek near Many Glacier, Mont., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 16	W. A. Lamb	(a)	74	Aug. 11	W. A. Lamb	1.12	23.0
27	B. E. Jones	1.35	36	Sept. 6	Jones and Burley [b]	.99	15.0
July 12	W. A. Lamb	1.27	31.0				

[a] Measurement referred to nail in crack in rock.
[b] Engineer, Department of the Interior, Canada.

Daily discharge, in second-feet, of Canyon Creek near Many Glacier, Mont., for the year ending Sept. 30, 1918.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1		26	17	11		24	18	21	24	16	14
2		24	16	12	31	32	17	22	24	15	14
3		21	14	13	29	30	17	23	22	17	14
4		21	15	14	29	27	16	24	20	18	13
5		22	16	15	29	26	15	25	20	18	12
6		22	17	16	30	24	13	26	20	18	11
7		23	17	17	30	23	12	27	20	17	11
8		23	18	18	30	21	13	28	20	14	10
9		23	20	19	29	18	13	29	22	13	10
10		24	19	20	26	17	13	30	23	13	10
								31	24	14	

Monthly discharge of Canyon Creek near Many Glacier, Mont., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
July 12-31	31	20	25.1	996
August	32	13	20.8	1,280
September	20	10	14.5	863

RED RIVER AT FARGO, N. DAK.

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

DRAINAGE AREA.—6,020 square miles.

RECORDS AVAILABLE.—May 27, 1901, to September 30, 1918.

GAGE.—Vertical staff attached to tree on left bank about six rods above the dam; vertical staff for use at low stages attached to upper end of fishway at left end of dam; read by F. L. Anders. Prior to September 1, 1914, gage readings were obtained from a vertical staff attached to the breakwater for the center pier of Front Street bridge; this gage is still maintained and used by the Weather Bureau, but can not be read accurately without a field glass and has less permanent control than gage now used. At the same stage, readings on Front Street gage are numerically about 10.4 feet greater than readings on gage now used.

DISCHARGE MEASUREMENTS.—Made from footbridge at gage.

CHANNEL AND CONTROL.—Bed consists of clay and silt, nearly permanent. Control is timber crib dam, rock filled, below gage; has settled slightly during 1918.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.1 feet March 30 and 31 and May 25 (discharge, 750 second-feet); minimum stage, 1.0 foot February 11 (discharge not computed).

1901–1918: Maximum stage recorded, 19.9 feet April 6, 1916 (stage-discharge relation affected by ice); open channel maximum stage 17.34 feet at 3.30 p. m. July 11, 1916 (discharge, 7,740 second-feet); minimum stage recorded, 1.0 foot February 11, 1918 (discharge not computed).

ICE.—Stage-discharge relation affected by ice December 18 to March 31.

DIVERSIONS.—None.

REGULATION.—No power plants or storage above station within 60 miles; storage not great enough to noticeably affect the discharge at station.

ACCURACY.—Stage-discharge relation affected by settling of dam, and by ice December 18 to March 31. The rating curves used for 1918, one applicable October 1 to December 17 and the other April 1 to September 30; the former is well defined between 150 and 4,000 second-feet, and the latter between 59 and 4,400 second-feet. Gage heights are read to hundredths once daily except during winter when one reading a week is made. Daily discharge ascertained by applying daily gage height to rating tables for days when gage was read; discharges interpolated for intervening days. Open-water records good.

Discharge measurements of Red River at Fargo, N. Dak., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 3	E. F. Chandler	1.52	108	July 2	Alf. Hulteng	2.03	321
Apr. 4	Alf. Hulteng	2.33	451	Aug. 27	E. F. Chandler	1.58	134
20	do	2.03	357	Sept. 25	do	1.25	61
May 10	E. F. Chandler	2.17	378	25	do	1.26	75

Daily discharge, in second-feet, of Red River at Fargo, N. Dak., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	156	98	104	700	414	452	342	218	140
2	142	92	129	550	452	491	324	204	140
3	142	92	156	490	452	530	306	204	140
4	129	131	129	433	452	452	306	208	143
5	116	170	104	378	452	530	306	211	140
6	92	170	88	378	452	490	299	204	140
7	124	142	104	378	452	490	292	198	143
8	156	92	116	378	414	570	248	204	130
9	142	116	116	378	414	570	386	204	116
10	116	142	116	378	378	570	272	238	140
11	70	136	104	378	342	570	245	221	134
12	92	129	97	342	342	550	265	204	116
13	92	185	97	306	342	530	275	172	96
14	86	170	90	342	414	490	277	143	110
15	81	142	83	342	356	471	279	162	124
16	70	129	76	351	299	462	245	166	137
17	81	116	70	360	272	452	258	143	125
18	70	122	.....	396	272	414	221	160	116
19	92	129	.....	378	289	414	224	178	110
20	92	142	.....	360	306	414	218	178	83
21	98	142	.....	360	433	396	220	166	105
22	104	185	.....	342	610	378	221	265	96
23	104	142	.....	342	655	342	162	231	134
24	116	142	.....	324	700	324	191	172	110
25	92	142	.....	306	750	306	198	172	78
26	116	142	.....	299	660	272	153	172	86
27	116	129	.....	306	570	324	231	166	87
28	116	70	.....	315	490	306	238	169	87
29	116	97	.....	324	452	318	245	166	87
30	110	124	.....	378	452	330	241	134	88
31	104	.....	.....	.....	452	.....	207	140	.....

NOTE.—Discharge interpolated for lack of gage readings on following days: Oct. 7, 14, 21, 28, 30, 31; Nov 1, 4, 11, 18, 24, 25, 29; Apr. 7, 16, 28; May 5. 6, 12, 15, 19, 23, 26, 30; June 2, 9, 16, 21, 29, 31; July 4, 14, 21, 28; Aug. 4, 11, 18, 25; Sept. 1, 8, 15, 27–29. Gage read Dec. 29, Jan. 13 and 24; Feb. 11, 22, 28; Mar. 1, 11; 15 to 31; discharge not computed on account of ice.

Monthly discharge of Red River at Fargo, N. Dak., for the year ending ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	156	70	108	6,640
November	185	70	132	7,860
December 1–17	156	70	105	3,540
April	700	299	376	22,400
May	750	272	445	27,400
June	570	272	440	26,200
July	342	153	251	15,400
August	265	134	186	11,400
September	143	78	116	6,900

RED RIVER AT GRAND FORKS, N. DAK.

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

DRAINAGE AREA.—25,000 square miles.

RECORDS AVAILABLE.—May 26, 1901, to September 30, 1918; gage-height records have been kept by the United States Engineer Corps since 1882 and a few discharge measurements were made by them in early years.

GAGE.—Chain gage attached to Northern Pacific Railway bridge and vertical staff gages attached to ice breaker below center pier of same bridge; read by H. L. Hayes. The staff gages as used by the United States Engineer Corps and the United States Weather Bureau are on the bridge breakwater at the same place as the staff gage used by the United States Geological Survey and at a datum 5 feet higher.

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

CHANNEL AND CONTROL.—Clay and silt; shifts very slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.3 feet March 28 (discharge 4, 480 second-feet); minimum stage, open channel, 3.5 feet September 22–25 and 26–30 (discharge ,440 second-feet); minimum discharge February 21, 186 second-feet (stage discharge relation affected by ice).

1882–1918: Maximum stage recorded; 50.2 feet April 10, 1897 (discharge, 43,000 second-feet); minimum stage, 2.6 feet February 10, 1912 (discharge, 100 second-feeet).

ICE.—Stage-discharge relation affected by ice. The ice cover is usually complete and smooth from late in November until about the beginning of April and the flow steady with few fluctuations; in determining flow during spring break-up, however, corrections amounting to several feet must be applied to gage heights before applying them to open-water rating table, owing to backwater from ice jams.

DIVERSIONS.—None.

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

ACCURACY.—Stage-discharge relation affected by ice and by shifting control. Two rating curves used during the year; October 1 to March 26 (open-water season only) well defined between 600 and 16,000 second-feet, and fairly well defined to 26,000 second-feet; March 27 to September 30 well defined between 655 and 16,300 second-feet and fairly well above 16,300. Gage read to quarter-tenths twice daily during open season and three times weekly to tenths during frozen period. Daily discharge ascertained by applying gage height to rating tables, except during ice period when discharge was ascertained by the use of Stout method, temperature records, discharge measurements, and observer's notes Open-water records good; winter records poor.

Discharge measurements of Red River at Grand Forks, N. Dak., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 16	Chandler and Noble....	3.81	501	May 4	H. A. Noble.....	6.71	1,796
Dec. 15	.....do.....	4.75	469	June 21	Chandler and Hulteng.	6.58	1,690
Feb. 23	H. A. Noble.....	4.01	186	July 22	E. F. Chandler.....	4.25	702
Mar. 30	Chandler and Noble....	10.48	4,167				

Daily discharge, in second-feet, of Red River at Grand Forks, N. Dak., or the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	560	622	654	310	200	272	3,520	1,490	2,800	1,160	689	950
2	560	687	654	315	195	297	3,340	1,540	2,740	1,160	689	871
3	560	720	591	320	190	321	3,040	1,590	2,680	1,120	689	833
4	560	687	560	326	186	346	3,160	1,640	2,620	1,070	689	760
5	591	687	530	312	195	371	2,860	1,690	2,560	1,030	689	724
6	622	687	530	298	205	396	2,620	1,740	2,500	990	655	689
7	638	687	530	285	215	420	2,260	1,800	2,440	950	655	655
8	654	754	530	280	211	436	1,910	1,910	2,380	950	622	655
9	622	824	530	275	207	452	1,740	1,910	2,320	950	622	622
10	591	860	530	270	204	468	1,690	1,850	2,260	960	655	622
11	560	897	516	266	200	484	1,640	1,800	2,260	910	655	590
12	560	897	501	260	200	501	1,640	1,690	2,200	871	689	590
13	591	934	492	254	200	516	1,590	1,640	2,140	871	689	558
14	622	934	482	248	200	530	1,590	1,590	2,080	871	724	527
15	591	972	473	248	197	695	1,540	1,540	2,020	833	724	527
16	560	972	420	248	194	860	1,540	1,490	1,970	796	689	497
17	501	934	446	248	192	860	1,490	1,440	1,910	760	655	497
18	530	897	421	262	189	860	1,490	1,440	1,800	760	622	468
19	560	860	396	276	186	934	1,490	1,440	1,760	724	655	468
20	560	824	371	290	186	1,170	1,490	1,490	1,720	724	689	468
21	591	789	360	305	186	1,260	1,390	1,490	1,690	724	724	468
22	560	789	348	286	186	1,720	1,340	1,540	1,590	689	760	440
23	530	789	360	267	186	2,070	1,300	1,590	1,490	689	724	440
24	501	824	371	248	195	2,500	1,250	1,800	1,440	655	724	440
25	560	824	356	240	205	3,120	1,200	2,140	1,340	655	689	440
26	622	789	341	232	125	3,720	1,160	2,380	1,300	689	724	468
27	687	754	326	224	232	4,300	1,160	2,620	1,300	724	760	440
28	720	720	315	215	248	4,480	1,200	2,680	1,250	724	796	440
29	687	654	305	211	.....	4,000	1,300	2,740	1,200	724	871	440
30	622	654	305	208	.....	4,060	1,390	2,800	1,200	724	1,120	440
31	560	.....	305	204	.....	3,760	.....	2,860	.....	689	1,070	.....

NOTE.—Discharge interpolated for lack of gage readings Oct. 7; Dec. 11, 13, 14, 18, 19, 21, 23, 25, 26, 28, 30; Jan. 1-3, 5-6, 8-10, 12-13, 15-16, 18-20, 22-23, 25-27, 29-31; Feb. 2, 3, 5, 6, 8-10, 12-13, 15-18, 20, 22, 24, 25, 27; Mar. 1-4, 6, 8-11, 13, 15; June 19, 20, 22.

Correction for Stout method used Dec. 3 to Mar. 26 determined from observer's notes, temperature records, and discharge measurements. After applying the Stout correction to gage heights, the discharge was ascertained by applying corrected gage heights to rating table.

Monthly discharge of Red River at Grand Forks, N. Dak., for the year ending Sept. 30, 1918.

[Drainage area, 25,000 square miles.]

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	720	501	588	36,200
November	972	622	797	47,400
December	654	305	447	27,500
January	326	204	266	16,400
February	248	186	200	11,100
March	4,480	272	1,490	91,600
April	3,520	1,160	1,811	108,000
May	2,860	1,440	1,850	114,000
June	2,800	1,200	1,970	117,000
July	1,160	655	843	51,800
August	1,120	622	723	44,500
September	950	440	568	33,800
The year	4,480	186	965	699,000

DEVILS LAKE NEAR DEVILS LAKE, N. DAK.

LOCATION.—At biologic station of University of North Dakota, near Devils Lake, in Ramsey County, 6 miles southwest of city of Devils Lake.

DRAINAGE AREA.—The theoretical drainage area of the lake is about 3,700 square miles. In years of ordinary rainfall water reaches the lake from only a small part of this area, most of which drains into local depressions and small lakelets, where the water remains until it is lost by evaporation. In 1880 the length of Devils Lake was 35 miles and its area about 120 square miles, but its present area is probably not more than 50 square miles.

RECORDS AVAILABLE.—June 8, 1901, to September 30, 1916 (fragmentary).

GAGE.—Staff gage on pier at the biologic station. Zero of gage, 1416.2 feet above sea level. Previous to 1916 staff gages were placed at convenient points on piers, but it has been necessary to renew them occasionally, sometimes every year, owing to damage caused by ice during the spring break-up. These gages have been reset as near to the correct datum as possible, often by the use of a carpenter's level. Occasionally errors of 0.1 foot in the records have been discovered when accurate checks were made, but no larger errors are likely to occur. The gage is read occasionally by employees of the biologic station.

REGULATION.—The lake has no outlet. The stage of the lake shows the relation between evaporation from the lake surface and the inflow from the surrounding country and gives an indication whether the run-off has been affected by the settlement of the drainage area and cultivation of the land surface.

COOPERATION.—Records furnished by North Dakota Biological Survey.

Gage height of Devils Lake near Devils Lake, N. Dak., during the year ending Sept. 30, 1918.

Date.	Gage height.	Date.	Gage height.	Date.	Gage height.
	Feet.		*Feet.*		*Feet.*
Nov. 10	5.55	May 18	5.45	Oct. 7	4.75
April	5.52	June 8	5.70	Nov. 22[a]	4.70
May 7	5.70	July 30	5.33		

[a] About Nov. 22.

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, which comes in from the right.

DRAINAGE AREA.—3,430 square miles.

RECORDS AVAILABLE.—July 2, 1909, to Sept. 30, 1918.

GAGE.—Inclined staff gage located on left bank; read by Dodrick Knutson.

DISCHARGE MEASUREMENTS.—Made from cable near gage.

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

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded 5.9 feet March 26 (discharge, 995 second-feet); minimum open-water stage about 3.0 feet August 31 (discharge, about 19 second-feet).

1909–1918: Maximum open-water stage recorded 15.0 feet, April 16, 1916 (discharge, 8,000 second-feet); minimum discharge recorded, no flow, July 17 and August 27, 1911.

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

REGULATION.—A short distance above station is a dam owned by Hansen & Barzen Milling Co. and the city lighting plant. The variation in load on the turbines due to the operation of the lighting plant (at night) and of the mill (chiefly during the day) caused fluctuations in stage at the gage.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well defined between 19 and 5,500 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage heights to rating table, except for periods when stage-discharge relation was affected by ice and when gage was not read, for which it was obtained by comparison with flow of Red Lake River at Crookston and to some extent by weather records. Open-water records good except for extremely low stages, when they are fair; winter records and records for period when gage was not read only roughly approximate.

Discharge measurements of Red Lake River at Thief River Falls, Minn., during the year ending Sept. 30, 1918.

[Made by E. F. Chandler.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Apr. 13	4.59	413
July 11	4.46	339

Daily discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1							472	452	582	19	156	183
2							306	538	605	156	183	54
3							266	431	672	242	131	180
4							227	393	650	340	183	306
5							306	431	628	306	212	290
						70						
6							340	515	650	274	156	183
7							306	560	605	274	212	31
8							375	494	582	306	227	306
9							375	538	582	306	227	290
10							340	472	605	274	227	274
11							357	472	582	274	227	31
12							340	431	560	290	143	19
13							357	412	560	274	119	19
14							375	375	538	306	197	131
15						40	340	340	494	290	169	27
	215	240	120	80		300						
16							340	375	538	274	131	54
17							375	375	494	242	119	88
18							357	393	494	242	143	19
19							306	340	515	212	156	19
20							340	340	494	212	227	19
21						650	306	417	375	183	227	19
22						650	274	494	375	212	274	88
23						650	340	605	274	156	227	41
24						695	393	605	306	212	227	31
25						840	375	538	393	183	227	41
26						995	375	582	306	212	227	54
27						605	375	560	274	274	227	31
28						605	424	538	306	242	242	70
29					.....	616	472	560	242	212	242	88
30					.....	628	538	538	202	198	306	131
31		.....			.....	605	.....	560	.....	183	19	.....

NOTE.—Daily discharges from Oct. 7 to Mar. 20 computed by comparison with other streams, and the mean for the month obtained by averaging those values.

Monthly discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for the year ending Sept. 30, 1918.

[Drainage area, 3,430 square miles.]

Month.	Maximum.	Minimum.	Mean.
October			215
November			240
December			120
January			80
February			40
March	995		363
April	538	227	356
May	605	340	473
June	672	202	483
July	340	19	238
August	306	19	193
September	306	19	104
The year	995		243

NOTE.—Mean discharge values for the months of October, November, December, January, February, and March obtained from comparison of Red Lake River flow with the flow of adjacent streams.

RED LAKE RIVER AT CROOKSTON, MINN.

LOCATION.—In sec. 31, T. 150 N., R. 46 W., at new Sampson's Addition highway bridge in Crookston, Polk County, a quarter of a mile below dam and power house of Crookston Waterworks Power & Light Co.'s plant. No tributaries enter for several miles.

DRAINAGE AREA.—5,320 square miles.

RECORDS AVAILABLE.—May 19, 1901, to September 30, 1918.

GAGE.—Barret & Lawrence water-stage recorder, on right abutment of bridge; installed in September, 1911, replacing chain gage attached to bridge July 1, 1909. Both gages at same datum. Prior to July 1, 1909, gage was on old Sampson's Addition bridge, about 300 feet farther upstream; this gage read the same as the present one at ordinary stages. Gage attended to by S. V. Holder.

DISCHARGE MEASUREMENTS.—Made from steel highway bridge at gage section.

CHANNEL AND CONTROL.—One channel at all stages. Bed composed of silt, gravel and small boulders; slightly shifting. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum mean daily stage during year from water-stage recorder, 6.2 feet April 2 (discharge, 1,760 second-feet); minimum mean daily stage from water-stage recorder 2.3 feet Sept. 20 (discharge, 50 second-feet).

1901–1918: Maximum mean daily stage recorded during period 21.5 feet April 17, 1916 (discharge, 14,400 second-feet). A minimum discharge of 10 second-feet was recorded by discharge measurement made January 27, 1912. The flow is controlled to such an extent that the minimum recorded discharge has no bearing on the minimum natural flow.

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

REGULATION.—Considerable diurnal fluctuation at the gage is caused by operation of power plant immediately above station. The plant has little storage, so that the mean monthly flow should represent nearly the natural flow.

ACCURACY.—Stage-discharge relation fairly permanent and changes are small. Two rating curves used during the year; October 1 to March 28 well defined 100 to 10,000 second-feet; March 23 to September 30 well defined 218 to 10,000 second-feet, only fairly well defined below 218 second-feet. Operation of water-stage recorder fairly satisfactory throughout year. Daily discharge ascertained by applying to rating table mean daily gage height obtained by planimeter from the gage-height graph, except during period when stage-discharge relation was affected by ice, for which it was ascertained by applying to the rating table mean daily

gage heights corrected for ice effect by means of discharge measurements, observer's notes, and weather records. During open-water periods of the year when gage was not in operation discharge was estimated and interpolated on the basis of flow at Thief River Falls and Grand Forks, N. Dak. Open-water records excellent when gage was in operation, fair for the remainder of period; winter records subject to error.

Discharge measurements of Red Lake River at Crookston, Minn., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 18	E. F. Chandler	3.20	310	Apr. 13	E. F. Chandler	4.19	673
Nov. 17	H. A. Noble	3.20	381	July 12	do	3.60	440
Dec. 22[a]	do	3.43	98	Sept. 26	do	3.33	283
Feb. 18[a]	do	3.56	62				

[a] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Red Lake River at Crookston, Minn., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	242	275	280	150	100	150	1,760	475	895	397	400	320
2	242	272	280	150	100	200	1,760	495	805	397	436	358
3	245	286	280	150	100	250	1,090	475	895	436	416	320
4	245	275	280	150	100	310	990	675	940	380	358	300
5	249	255	280	150	100	275	940	675	990	320	378	290
6	249	255	250	140	90	210	595	715	1,040	320	397	280
7	249	249	250	140	90	275	358	760	940	284	358	270
8	252	265	250	140	90	346	218	715	940	302	339	260
9	252	249	250	140	90	210	358	675	940	302	339	250
10	255	245	250	140	90	242	440	715	895	284	397	240
11	255	245	200	130	90	383	520	715	805	267	378	220
12	250	252	200	130	90	310	600	715	760	250	416	200
13	250	252	200	130	90	210	675	715	760	300	436	140
14	250	252	200	130	90	242	660	760	715	320	400	68
15	250	328	200	130	90	310	640	715	715	340	360	88
16	250	342	170	120	80	310	630	675	635	340	320	68
17	260	335	170	120	80	500	610	715	675	340	284	99
18	310	324	170	120	80	620	595	715	715	340	267	68
19	310	306	170	120	80	1,100	555	715	675	340	284	88
20	306	310	170	120	80	910	535	715	635	340	284	50
21	303	317	150	120	90	1,260	515	675	575	310	320	68
22	303	314	150	120	90	1,500	495	715	555	310	358	88
23	300	321	150	120	90	1,320	475	760	456	310	397	78
24	296	303	150	120	90	1,320	456	760	535	310	397	140
25	292	328	150	120	90	1,140	475	850	535	310	302	200
26	289	303	140	110	100	1,200	475	805	475	350	320	267
27	289	303	140	110	100	940	475	850	495	350	358	284
28	286	292	140	110	110	1,040	475	895	495	350	339	284
29	282	290	140	110	.....	1,140	475	895	456	350	302	284
30	278	290	140	110	.....	1,140	475	850	416	350	302	234
31	275	.....	140	110	.....	1,380	.....	895	.....	380	320	.....

NOTE.—Gage not read Oct. 4, Oct. 7 to Mar. 20, discharge estimated. Gage not read Mar. 22, 23, 29, Apr. 3, 15, 26, 28, May 21, July 30, Aug. 3, 10, 24, discharge interpolated. On July 1, Aug. 31, Sept. 2, 3, 7, 11–16, 18–21, 23–25, water was below gage and discharge has been based on estimate of stage made by observer and other notes regarding flow of river.

Monthly discharge, in second-feet, of Red Lake River at Crookston, Minn., for the year ending Sept. 30, 1918.

[Drainage area, 5,320 square miles.]

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October		242	270	May	895	475	725
November	342	245	288	June	1,040	416	712
December			196	July	436		332
January			128	August		267	354
February			91.4	September		50	197
March	1,500	150	669				
April	1,760	218	644	The year	1,760	50	385

MOUSE RIVER AT MINOT, N. DAK.

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

DRAINAGE AREA.—8,400 square miles.

RECORDS AVAILABLE.—May 5, 1903, to September 30, 1918.

GAGE.—Vertical staff attached to pier nearest left end of Anne Street footbridge; read by Ephraim Cox. From 1903 to December, 1909, a vertical staff on old footbridge 20 rods above present site was used. Both gages at 1,534.26 elevation sea level datum.

DISCHARGE MEASUREMENTS.—Made from Anne Street bridge or by wading a few rods below dam at the Soo Railway water tank.

CHANNEL AND CONTROL.—Bed composed of clay and silt; nearly permanent. Dam of the Minneapolis, St. Paul & Sault Ste. Marie Railway Co. forms the low-water control. At higher stages dam is submerged, causing a reversal in rating curve. The crest of dam was slightly changed when repairs were made in spring of 1918.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year 8.5 feet March 30 (discharge, 790 second-feet); minimum stage, 3.0 feet October 6 (discharge, 0.3 second-foot).

1903–1918: Maximum stage recorded, 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 affected by ice.

REGULATION.—A dam 4 feet high at Minneapolis, St. Paul & Sault Ste. Marie Railway tank, a mile below, raises water at gage about 3 feet at ordinary low stage. The dam being designed merely to give enough depth of water for the intake-pipe suction, has no sluices, but is not absolutely tight. When discharge is less than about 5 second-feet, the water level falls below crest of dam.

ACCURACY.—Stage-discharge relation affected by changes in Soo Railroad dam (low-water control) during the spring break-up and by ice during the winter. Two rating curves used during the year; both fairly well defined below 2,500 second-feet; the first applicable October 1 to March 15, except during ice period; the second March 20 to September 30. Both curves have a decided reversal due to the submergence of Soo Railroad dam above stage of 6.0 feet gage height. Gage read once a week October 1 to March 30, to nearest half-tenth and daily thereafter. Daily discharge ascertained by applying mean daily gage heights to rating table. During period October 1 to March 30, when the gage was read only once a week, the discharge for days of no gage reading was ascertained by interpolation in order to obtain the mean discharge for month. See footnote to table of monthly discharge. Records prior to April 1 poor; thereafter fair.

Discharge measurements of Mouse River at Minot, N. Dak., during the year ending Sept. 30, 1918.

[Made by E. F. Chandler.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Apr. 7	6.27	278
20	5.67	149
Aug. 9	3.95	1.6

Daily discharge, in second-feet, of Mouse River at Minot, N. Dak., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1			40				750	146	36	5.7	4.4	7.0
2					1.8	40	690	164	45	4.4	4.4	11
3		9					606	204	61	4.4	3.2	11
4							469	260	68	5.7	3.2	14
5				4.0			390	284	50	5.7	3.2	14
6	0.3						362	296	45	4.4	2.8	16
7							296	284	45	4.4	3.2	16
8			24				309	137	36	3.8	2.8	16
9					9.0	88	296	120	31	2.8	2.8	14
10		24					194	96	31	2.8	2.4	14
11							184	36	27	1.8	2.4	16
12				6.0			184	20	23	1.8	2.8	14
13	.8						194	9.0	27	2.4	3.2	11
14							164	4.4	27	2.8	3.2	11
15			13				137	5.7	23	3.2	3.8	11
16					13		128	11	23	3.8	4.4	14
17		40					137	27	20	2.8	5.7	11
18							155	50	20	2.4	5.7	11
19				9.0			164	81	14	1.6	5.7	11
20	4.0						174	103	9.0	1.6	7.0	14
21							146	128	7.0	1.8	9.0	14
22			6.0				137	128	7.0	2.4	9.0	16
23					18	390	164	45	5.7	2.8	11	16
24		50					137	40	4.4	3.2	11	14
25							103	45	3.2	4.4	11	14
26				6.0			96	40	3.2	4.4	9.0	11
27	18						103	68	5.7	5.7	9.0	11
28							120	68	7.0	5.7	7.0	11
29			4.0				120	40	5.7	7.0	7.0	9.0
30						790	128	45	4.4	7.0	5.7	9.0
31								40		5.7	7.0	

NOTE.—Gage read once weekly Oct. 1 to Mar. 31. Daily discharge for intervening days ascertained by interpolation, and monthly means computed accordingly.

Monthly discharge of Mouse River at Minot, N. Dak., for the year ending Sept. 30, 1918.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October			5.24	322
November			31.8	1,890
December			15.3	941
January			5.87	361
February			13.2	733
March	790		258	15,900
April	750	96	241	14,300
May	296	4.4	97.6	6,000
June	68	3.2	23.8	1,420
July	7.0	1.6	3.82	235
August	11.0	2.4	5.55	341
September	16.0	7.0	12.7	756

NOTE.—During winter months, the Stout method of correction for backwater effect used in computations. Record prior to Apr. 1, should be used with caution.

EVAPORATION AT UNIVERSITY, N. DAK.[1]

The evaporation gage at University, N. Dak., was established April 17, 1905, on a pool in a ravine called English Coulee, which runs through the campus of the University of North Dakota, immediately west of Grand Forks, N. Dak., and 2 miles west of the Minnesota boundary.

The coulee drains about 60 square miles of very level prairie. Except for brief freshets the flow in the coulee is small, varying from 1 second-foot or less to 20 second-feet. In very dry weather the water lies in pools with scarcely any perceptible flow.

A heavy galvanized-iron tank, 3 feet square and 18 inches deep, is placed in the center of an anchored raft, so that the water in the tank is at the same level as the water surface outside. The tank is filled nearly to the top, to a height precisely marked by the pointed tip of a vertical rod in the center of the tank. Once each day, after the change produced by evaporation or rainfall, the water level is restored to the original height, the precise amount of water transferred being measured with a cup of such size that one cupful of water is equivalent to 0.01 inch depth in the tank.

On the open prairie about 40 rods distant is a standard rain gage. On days of rainfall the difference (which is usually small) between the quantity measured by the rain gage and the surplus in the tank is considered the total evaporation for the day.

Observations were made usually about half an hour before sunset. The temperature of the water recorded is the observation of the water in the tank. As the tank is made of metal, it has been found that at that time of the day there is rarely a perceptible difference in temperature reading between the water within and without the tank. The temperature of the air as recorded is the mean of the readings of the standard self-recording maximum and the self-recording minimum thermometers for the preceding 24 hours.

The following table shows for each 10-day period during the year ending September 30, 1918, the gross evaporation, the total rainfall, and the mean temperatures for the 10 observations of the water and of the air.

Evaporation observations at University, N. Dak., for the year ending Sept. 30, 1918.

Date.	Evaporation.	Rainfall.	Mean temperature (°F.).		Date.	Evaporation.	Rainfall.	Mean temperature (°F.).	
			Water.	Air.				Water.	Air.
1917–18.	*Inches.*	*Inches.*			1917–18.	*Inches.*	*Inches.*		
Oct. 1–10	1.04	0.22	41	43	June 11–20	1.60	0.01	65	65
11–20	.71	.73	33	32	21–30	1.90	.18	67	61
21–31	.17	.20	32	24	July 1 to Aug. 31 [a]				
Nov. 1–9	.32	.61	33	38	Sept. 1–10	1.32	.10	55	52
Apr. 9–10	.33	.00	34	47	11–20	.89	.23	49	47
11–20	1.86	.25	42	49	21–30	.92	.13	53	52
21–30	1.78	1.82	41	42	Oct. 1–10	.50	.23	52	51
May 1–10	1.45	.69	52	53	11–20	.75	.19	45	51
11–20	1.32	.44	49	48	21–31	.14	.78	34	37
21–31	.80	2.07	51	54	Nov. 1–10	.20	.60	33	36
June 1–10	1.43	.60	61	59	11–20	.18	.42	32	32

[a] No records available.

KAWISHIWI RIVER NEAR WINTON, MINN.

LOCATION.—In sec. 20, T. 62 N., R. 11 W., in pond above lower dam of St. Croix Lumber Co. at Kawishiwi Falls, 500 feet above Fall Lake, 3,000 feet below Garden Lake, near western line of Lake County, 2½ miles east of Winton, St. Louis County.

DRAINAGE AREA.—1,200 square miles.

RECORDS AVAILABLE.—June 21, 1905, to June 20, 1907; and October 14, 1912, to September 30, 1918.

[1] For complete description of this station and records of evaporation, rainfall, and temperature for 1905 to 1908 see U. S. Geol. Survey Water-Supply Paper 245, pp. 64–67, 1910.

GAGE.—Stevens water-stage recorder installed the last part of September, 1912, by the International Joint Commission in cooperation with the United States Geological Survey, at a point just above right end of dam. Well was attached to timbers, which were bolted to the vertical rock wall of right bank of river. Auxiliary staff gage was also attached to one of these timbers. The gage shelter was supported by timbers, which were bolted to the horizontal portion of the rock wall above all possible high water. On May 27, 1913, the Stevens was replaced by a Friez water-stage recorder. During the high water of June, 1914, the well together with the float and weight were carried away by logs. At this time a concrete well was installed by the International Joint Commission a little below the dam and outside the river channel, and connected with pool above the dam by a pipe through the dam. The gage was repaired and again put in operation about July 1, 1914. Attended to by F. W. Byshe.

DISCHARGE MEASUREMENTS.—Made from cable about 1,000 feet above gage.

CHANNEL AND CONTROL.—At the gage the river flows through a small deep pool formed by a timber dam without openings, which constitutes the control of gage, and is permanent unless dam is destroyed or alterations are made in the crest. About 200 feet above dam is a decided fall. Banks high enough to prevent overflow in vicinity of gage. At measuring section bed of stream is composed of rock and boulders; rather rough; current very swift except at low stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.0 feet June 10 (discharge, 2,890 second-feet). Due to nonoperation of the recording gage, stage of 5.0 feet does not represent the absolute maximum stage; minimum discharge recorded, about 37 second-feet on April 8, 15, and 22.

1905–1907 and 1912-1918: Maximum stage recorded, 7.2 feet April 30 and May 7, 1916 (discharge, 5,370 second-feet); no flow August 24, 25, 30, and 31, September 1, 1915, August 6, 8, 1906, and April 23, 24, and 26, 1907.

ICE.—Discharge relation not seriously affected by ice; open-channel rating curve assumed applicable. The operation of the water-stage recorder is affected by ice, and the flow from December to March, which is very constant during this part of the year, is computed from weekly reading of the staff gage.

REGULATION.—St. Croix Lumber Co. has a dam at the outlet of Garden Lake for controlling the level of water in that lake, and for storing water to be used in driving logs over the stretch of rapids between Garden and Fall lakes. This dam is capable of holding the water in Garden Lake about 7 or 8 feet above its natural level at low water before water will flow over the gates. When the water in Garden Lake is held at a high stage, the elevation of water is considerably higher in Farm Lake, and it is understood that the elevation of the surface of White Iron Lake is somewhat affected by the stage of Garden Lake. During the log-driving season, April to November, the water in Garden Lake is held to the elevation of the top of the gates practically all the time. In November some of the gates are opened so that the lake is drawn down to low-water stage, and remains so until spring. St. Croix Lumber Co. has a dam at the outlet of Birch Lake, which controls its elevation, and is capable of holding the water about 5 feet above low water. This dam is left open during the winter and until the high water of the spring break-up has passed. It is then closed, and the lake held as high as possible during the summer. There are a number of low dams in Stony River used for sluicing logs off rapids, but these have no storage of importance back of them. Large volumes of water are allowed to pass through sluices of dam at the outlet of Garden Lake for a few hours at a time, at irregular intervals, when desired to drive logs from Garden Lake to Fall Lake. At other times these gates are closed so that there is only a slight flow caused by leakage through the dam. At other times some of the gates are partly opened to allow passage of sufficient water to prevent flow over crest of dam.

ACCURACY.—Stage-discharge relation permanent; not usually affected by ice and seldom by logs. Rating curve fairly well defined below 2,890 second-feet. Continuous gage record from recording gage during the open-water period; weekly gage readings during the frozen periods. Daily discharge ascertained as follows: October 1–21, July 28 to September 15 and September 22–30 obtained, by means of discharge integrator, from the recording gage record; October 23 to July 26 based on daily gage reading made by observer. Daily discharge record when recording gage was in operation good. Discharge for periods when water-stage recorder was not in operation not determined except for days when gage was read. Information as to operation of gates in dam at outlet of Garden Lake given in footnote to daily discharge table.

Daily discharge, in second-feet, of Kawishiwi River near Winton, Minn., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	650						80				378	230
2	1,060										380	220
3	1,100		356						2,700			218
4	1,060					180						224
5	920	1,340									1,010	206
6	1,070			314							170	218
7	1,180									866	170	228
8	1,440						57				170	194
9	1,200							590			170	202
10	995	590	163						2,890		204	216
11	1,180				235	163					222	150
12	1,000							356			505	150
13	900			314							648	150
14	805									747	662	150
15	520		163				57				584	150
16	385										342	
17	735										257	
18	400				197	163			1,270		163	
19	815	590						446			538	
20	996			314							459	
21	590									163	584	
22			235				57				163	163
23	163										163	196
24									996		282	176
25					197	163					163	176
26		930								133	330	300
27								2,430			298	189
28										392	230	127
29	1,340		274	274						395	258	127
30							80			430	234	310
31										410	230	

NOTE.—Recording gage not in perfect operation Oct. 22 to July 27 and Sept. 16–21. During this period gage was read once weekly and the following information was obtained regarding operation of gates in dam at outlet of Garden Lake: Oct. 24 to Nov. 30, May 1–26, June 18 to July 25 gates were opened occasionally for purpose of log driving, and mean discharge based on weekly readings may be subject to considerable error. Gates were not operated for log-driving purposes from Dec. 1 to Apr. 30 and from May 27 to June 17; mean discharge based on weekly gage height will give a fair estimate of flow. Gates opened only occasionally Sept. 16–21. Low flow during April due to gates in Garden Lake being closed for the purpose of increasing storage in Garden Lake.

UPPER MISSISSIPPI RIVER BASIN.

MISSISSIPPI RIVER AT ELK RIVER, MINN.

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

DRAINAGE AREA.—14,500 square miles.

RECORDS AVAILABLE.—July 22, 1915, to September 30, 1918.

GAGE.—Chain gage bolted to handrail of bridge, downstream side, near right bank; read by W. H. 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, 6.21 feet at 8.08 a. m. June 1 (discharge, 17,700 second-feet); minimum open-water stage, 2.64 feet at 7.45 p. m. September 28 (discharge, 2,130 second-feet).

1915–1918: Maximum stage recorded under unobstructed channel conditions, 10.8 feet April 7, 1916 (discharge, 27,000 second-feet); minimum open-water stage recorded, 2.64 feet at 7.45 p. m. September 28, 1918 (discharge, about 2,130 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; discharge estimated from records of discharge at Coon Rapids power plant, computed by the Minneapolis General Electric Co., allowance being made for the discharge of Crow and Rum rivers, entering between Coon Rapids and the station. During the greater part of the frozen period 1917–1918 no estimates were made as power plant was not in operation.

REGULATION.—Nearest dam above the station on the Mississippi 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 eliminated before reaching the station. 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 between 4,620 and 12,400, and fairly well defined between 12,700 and 26,300 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Open-water records good.

COOPERATION.—Gage readings furnished by U. S. Army Engineer Corps.

The following discharge measurement was made by R. B. Kilgore:

October 1, 1917: Gage height, 4.13 feet; discharge, 5,170 second-feet.

Daily discharge, in second-feet, of Mississippi River at Elk River, Minn., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	4,910	4,620	5,500	3,400	10,200	4,910	3,030	3,030
2	4,910	4,080	4,080	3,400	11,100	4,340	3,210	2,860
3	4,910	3,610	4,910	4,340	10,500	4,910	3,400	2,860
4	5,200	5,200	4,910	5,800	10,500	4,910	3,210	3,030
5	4,910	4,340	4,620	5,500	11,100	5,200	3,030	3,030
6	4,620	4,620	3,840	6,100	10,800	4,620	3,210	2,550
7	4,910	4,910	4,080	4,620	9,840	4,620	3,210	2,700
8	5,200	5,200	4,080	5,200	9,200	4,910	3,210	2,700
9	4,910	5,200	3,840	6,700	10,200	4,080	3,210	2,420
10	4,620	4,620	3,610	7,310	9,840	3,840	3,030	2,550
11	4,910	4,620	3,210	6,700	8,880	5,200	3,210	2,700
12	4,910	4,910	3,210	6,400	8,880	3,840	3,030	2,860
13	4,910	4,620	3,210	6,400	7,620	4,340	3,030	2,550
14	5,800	4,620	3,210	6,700	7,620	4,340	3,210	2,700
15	4,080	4,620	3,030	7,000	7,310	4,080	3,030	2,700
16	4,340	4,080	3,210	7,310	7,000	3,840	2,700	2,420
17	5,500	4,340	3,030	6,100	7,000	3,400	2,860	2,420
18	5,800	4,080	3,210	6,400	6,700	3,840	2,700	2,860
19	5,500	4,080	3,400	6,400	6,100	3,610	2,860	2,550
20	5,500	4,620	3,400	6,400	5,500	3,610	3,210	2,550
21	6,100	3,840	3,210	6,400	5,500	3,610	3,210	2,300
22	5,200	4,080	3,400	7,000	5,500	3,840	3,030	2,420
23	4,620	3,610	3,400	7,000	5,800	3,840	3,030	2,190
24	5,500	3,610	3,210	6,700	5,800	3,610	3,210	2,190
25	5,500	4,080	3,210	7,080	4,910	3,840	3,030	2,420
26	5,500	4,620	3,210	8,880	4,910	3,840	2,860	2,300
27	5,500	3,610	3,400	9,520	4,910	3,610	3,030	2,420
28	5,500	3,400	3,610	8,240	5,200	3,840	2,860	2,300
29	5,500	3,400	3,610	9,520	4,910	3,840	2,860	2,300
30	4,620	2,860	3,210	9,840	4,910	3,610	3,030	2,190
31	4,340	.....	.....	10,200	.....	2,860	3,210	.....

NOTE.—Stage-discharge relation affected by ice Dec. 4 to Mar. 31; discharge not determined.

Monthly discharge of Mississippi River at Elk River, Minn., for the year ending Sept. 30, 1918.

[Drainage area, 14,500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	6,100	4,080	5,100	0.350	0.40
November	5,200	2,860	4,270	.293	.33
April	5,500	3,030	3,640	.250	.28
May	10,200	3,400	6,760	.464	.53
June	11,100	4,910	7,610	.523	.58
July	5,200	2,860	4,090	.281	.32
August	3,400	2,700	3,060	.210	.24
September	3,030	2,190	2,570	.177	.20

MISSISSIPPI RIVER AT ST. PAUL, MINN.

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

DRAINAGE AREA.—35,700 square miles.

RECORDS AVAILABLE.—March 1, 1892, to September 30, 1918. Observation of stage began in 1873 by United States Signal Service and continued by United States Weather Bureau. Many discharge measurements made prior to 1900 by the United States Engineer Corps.

GAGE.—Chain gage installed May 9, 1913, on the handrail, downstream side, of Chicago Great Western Railway bridge, near the foot of Robert Street; read by United States Weather Bureau employees. From 1911 to May 9, 1913, the gage was a vertical staff gage attached to a piling on left bank of river about 800 feet upstream from present gage. Prior to 1911 a vertical staff gage on the Diamond Joe Line Wharf, at the foot of Jackson Street, about 400 feet below the 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 the Chicago, St. Paul, Minneapolis & Omaha Railway bridge 2 miles above the station; in November, 1915, and April, 1916, measurements were made from the Chicago Great Western Railway bridge to which the gage is attached. Since 1916 measurements have been made from the Wabasha Street highway bridge, about 1,000 feet above station.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.5 feet March 24 and 25 (discharge not determined); minimum stage recorded, —1.0 foot December 5 (discharge not determined).

1892–1918: 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 stage recorded, —1.0 foot December 5, 1918 (discharge not determined).

REGULATION.—During extreme low-water regulation of flow through turbines at the 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 changed during the year as indicated by a discharge measurement on November 5, 1918. Change caused by dredging in the vicinity of Daytons Bluff. Sufficient measurements have not been made to develop a rating curve. Gage read once daily to tenths. This perhaps does not represent the mean daily stage accurately on account of artificial regulation at power plants in Minneapolis; occasional additional readings indicate that the error is not large.

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

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.1	1.8	0.6	1.6	0.7	1.2	4.3	1.6	6.0	2.0	2.3	3.5
2	2.1	1.8	— .2	1.6	.7	1.2	4.1	1.7	6.1	2.0	1.6	3.0
3	2.1	1.5	— .3	1.5	.8	1.3	3.9	1.8	6.4	1.9	1.6	2.7
4	1.9	1.3	— .3	1.3	.9	1.0	3.8	2.1	6.5	2.0	1.3	2.6
5	2.0	1.6	—1.0	1.5	.8	1.8	3.5	2.4	6.2	1.7	1.0	2.5
6	2.0	1.8	— .8	1.3	.9	2.1	3.5	2.4	6.3	2.1	1.1	2.2
7	2.0	1.8	.2	1.1	.9	2.3	3.1	2.6	6.1	1.5	1.1	2.1
8	1.9	1.9	.4	1.0	1.1	2.0	2.9	2.0	5.8	1.1	1.2	1.7
9	2.1	1.8	.1	1.0	1.1	2.2	3.2	2.1	6.0	1.9	1.0	1.1
10	1.9	1.9	.3	.9	.8	1.9	2.8	3.0	5.6	1.7	1.3	1.3
11	2.2	1.9	.3	1.0	.9	2.3	2.6	3.1	5.5	1.3	1.3	1.4
12	2.0	1.6	.9	1.0	1.0	3.9	2.4	3.1	4.8	1.6	1.0	1.3
13	1.9	1.7	.7	.8	.9	3.2	2.3	3.3	4.8	1.4	1.5	1.3
14	1.9	1.7	1.3	.2	1.2	1.8	2.2	3.5	4.3	1.6	1.2	1.1
15	2.0	1.8	1.5	1.8	.2	1.0	1.9	3.8	3.9	1.5	1.1	1.1
16	2.1	1.7	1.4	1.2	1.4	2.2	1.7	3.9	3.8	1.5	1.1	.7
17	1.6	1.6	1.5	1.1	1.0	1.7	1.9	4.0	3.4	1.4	1.1	.9
18	1.8	1.5	1.4	1.0	1.2	2.4	2.1	3.4	3.3	1.1	1.4	.8
19	2.0	1.5	1.5	.9	1.1	3.9	1.8	3.4	3.0	1.4	3.0	.9
20	2.0	1.4	1.4	.8	1.0	4.6	1.8	3.5	3.0	1.4	4.0	1.0
21	2.0	1.3	1.3	1.0	.8	6.7	1.8	3.4	2.7	1.4	4.5	.7
22	2.1	1.2	1.3	.8	1.0	6.9	1.5	3.3	2.6	.9	5.2	.7
23	2.3	1.4	1.2	.8	.9	7.2	1.5	3.5	2.7	1.4	5.2	.1
24	1.8	1.2	.6	.9	1.0	7.5	1.8	3.7	2.3	1.4	5.0	.1
25	2.0	1.2	1.0	.9	.2	7.5	1.9	3.9	2.5	1.1	5.4	.1
26	2.2	1.2	1.3	.9	.8	6.7	1.7	4.6	2.3	1.2	5.4	.0
27	2.4	1.2	1.4	.9	.9	6.1	1.6	4.9	2.0	1.1	5.5	.4
28	2.5	.9	1.8	.9	1.3	5.6	1.6	5.2	2.4	1.1	5.2	.0
29	2.3	.8	1.8	.8	.....	5.1	1.4	4.8	2.1	1.3	5.0	.1
30	2.1	.6	1.6	.9	.....	4.7	1.3	5.3	2.3	2.3	4.4	—.3
31	2.0	.....	1.7	.9	.....	4.6	.....	5.8	.....	2.6	3.9	.....

NOTE.—Stage-discharge relation affected by ice from about Dec. 7 to Mar. 19.

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 23, 1909, to September 30, 1918.

GAGE.—Chain gage attached to upstream handrail of the bridge, near the left bank; read by Ben O. Brown and 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 rapid just below the gage, but the control section is not well defined. Banks of medium height and will be overflowed at a stage of about 14 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.05 feet March 30 (discharge, about 1,690 second-feet); minimum open-water stage 1.17 feet September 22 (discharge, about 20 second-feet). This is the lowest open-water stage recorded during the period covered by the records.

1909–1918: Maximum stage recorded 15.16 feet at 6 p. m. April 4, 1917 (discharge about 10,200 second-feet); minimum discharge recorded, 6.8 second-feet (measured by current meter February 9, 1912).

ICE.—Stage-discharge relation seriously affected by ice; no measurements made and daily discharge not determined.

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

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve fairly well defined. Gage read to hundredths twice daily except December 16 to April 19, when it was read at irregular intervals. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records fair except at extreme low stages for which they are subject to considerable error.

Daily discharge, in second-feet, of Minnesota River near Montevideo, Minn., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	123	130	171	.....	.....	592	703	410	112	130
2	116	162	180	.....	.....	566	703	386	116	123
3	116	154	171	.....	.....	566	703	362	106	123
4	114	189	.....	.....	.....	619	731	362	105	116
5	116	216	.....	.....	.....	566	759	338	114	115
6	138	198	.....	.....	1,270	592	759	316	138	116
7	146	180	.....	.....	.....	592	731	294	105	105
8	114	189	.....	.....	.....	566	731	294	123	104
9	154	162	.....	.....	.....	592	703	294	99	82
10	171	198	.....	.....	.....	619	703	274	82	104
11	180	154	.....	.....	.....	619	703	254	89	94
12	198	207	.....	.....	.....	592	703	244	93	108
13	130	189	.....	.....	967	675	647	234	105	97
14	146	189	.....	.....	.....	619	647	234	112	97
15	138	171	.....	.....	.....	619	619	234	138	91
16	130	198	.....	817	.....	566	566	225	189	91
17	138	225	.....	.....	.....	566	566	207	207	79
18	109	198	.....	.....	.....	566	566	207	198	78
19	123	198	.....	.....	.....	514	540	198	198	82
20	130	216	.....	.....	731	566	566	171	198	80
21	130	189	.....	.....	675	462	647	154	216	62
22	130	198	.....	.....	703	436	675	162	216	20
23	116	225	.....	1,610	647	462	540	154	225	58
24	130	216	.....	.....	619	462	566	146	225	72
25	162	116	.....	.....	566	514	566	154	198	56
26	130	154	.....	.....	514	566	488	154	198	74
27	130	162	.....	.....	540	619	514	162	180	67
28	111	154	.....	.....	566	566	514	154	162	81
29	138	189	.....	.....	619	566	462	162	171	74
30	171	180	.....	1,690	619	619	410	138	146	67
31	146	.....	.....	.....	.....	675	.....	123	138	.....

NOTE.—Stage-discharge relation affected by ice from about Dec. 4 to Mar. 10. No discharge computations made.

Monthly discharge of Minnesota River near Montevideo, Minn., for the year ending Sept. 30, 1918.

[Drainage area, 6,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	198	109	136	0.0216	0.02
November	225	116	184	.0292	.03
April 20-30	.....	514	618	.0981	.04
May	675	436	572	.0908	.10
June	759	410	624	.0990	.11
July	410	123	232	.0368	.04
August	225	82	239	.0379	.04
September	130	20	88.2	.0140	.02

MINNESOTA RIVER NEAR MANKATO, MINN.

LOCATION.—In sec. 14, T. 108 N., R. 27 W., in Blue Earth County, at Sibley Park, 2 miles above center of Mankato and 1,000 feet below mouth of Blue Earth River.

DRAINAGE AREA.—14,600 square miles.

RECORDS AVAILABLE.—May 20, 1903, to September 30, 1918.

GAGE.—Chain gage on right bank of river, about 1,000 feet below mouth of Blue Earth River; read by Clarence Staley, observer for United States Weather Bureau. The gage support is a substantial cantilever structure, supported by two heavy posts resting in concrete footings, constructed and maintained by the United States Engineer Corps.

DISCHARGE MEASUREMENTS.—Made from new concrete highway bridge in center of Mankato, by wading a short distance below gage, or at extreme high stages, by boat near gage.

CHANNEL AND CONTROL.—Bed composed of sand and light gravel; fairly permanent, except during high stage; banks moderately high and not subject to overflow, except at stages above gage height of 15 feet. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.7 feet March 20; minimum stage, 1.2 feet during periods in October and November, December January, and February.

1903–1918: Maximum stage recorded, 21.2 feet, June 26, 1908 (discharge, 43,800 second-feet); minimum stage recorded, 0.5 feet August 31, September 1 and 2, 1911 (discharge, 89 second-feet). The highest known stage occurred in 1881, and is shown in Mankato by a well-marked line, approximately 27 feet above the zero of the present gage (discharge, estimated 65,000 second-feet).

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

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

ACCURACY.—Stage-discharge relation not permanent; sufficient measurements have not been made to warrant the publication of daily discharge.

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

Daily gage height, in feet, of Minnesota River near Mankato, Minn., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.3	1.2	1.3	1.3	1.2	3.2	4.9	2.2	7.0	2.5	4.7	4.7
2	1.4	1.2	1.3	1.3	1.2	4.9	4.8	2.2	7.0	2.4	4.5	4.7
3	1.4	1.2	1.3	1.3	1.2	5.2	4.8	2.1	7.0	2.4	4.1	4.9
4	1.4	1.3	1.2	1.3	1.2	5.5	4.7	2.3	7.1	2.4	3.9	4.7
5	1.3	1.3	1.2	1.3	1.2	5.7	4.7	2.4	6.8	2.3	3.5	4.5
6	1.3	1.3	1.2	1.3	1.2	5.6	4.7	2.4	6.2	2.3	3.3	4.4
7	1.3	1.3	1.2	1.3	1.2	5.4	4.4	2.5	5.8	2.3	3.4	4.3
8	1.3	1.3	1.2	1.3	1.2	5.3	4.2	2.6	5.5	2.2	3.9	4.1
9	1.3	1.3	1.2	1.3	1.2	5.1	4.0	2.7	5.4	2.2	3.9	4.1
10	1.2	1.3	1.2	1.2	1.3	5.3	3.9	2.7	5.2	2.2	4.1	4.0
11	1.2	1.2	1.3	1.2	1.3	5.5	3.7	2.7	4.9	2.2	4.1	3.9
12	1.3	1.2	1.3	1.2	1.3	5.5	3.6	2.6	4.7	2.2	4.2	3.9
13	1.3	1.2	1.3	1.2	1.3	5.5	3.5	2.6	4.5	2.2	4.2	3.5
14	1.3	1.2	1.3	1.2	1.3	5.6	3.4	3.0	3.9	2.1	4.1	3.5
15	1.2	1.3	1.3	1.2	1.3	5.7	3.3	3.2	3.8	2.1	4.0	3.4
16	1.2	1.3	1.3	1.2	1.3	5.9	3.3	3.3	3.8	2.3	4.4	3.3
17	1.2	1.3	1.3	1.2	1.3	6.8	3.2	3.4	3.1	2.4	6.6	3.3
18	1.5	1.3	1.3	1.2	1.3	7.6	2.7	3.5	3.3	2.5	8.6	3.4
19	1.5	1.3	1.4	1.2	1.3	10.1	2.7	3.5	3.5	2.4	9.1	3.4
20	1.4	1.2	1.4	1.3	1.3	10.7	2.6	3.5	3.5	2.4	9.2	3.3
21	1.3	1.2	1.3	1.3	1.3	10.4	2.6	3.6	3.4	2.5	8.8	3.1
22	1.3	1.2	1.3	1.3	1.3	9.8	2.5	3.8	3.3	2.5	9.8	3.1
23	1.3	1.2	1.3	1.3	1.5	9.1	2.5	3.8	3.4	2.4	10.8	3.0
24	1.3	1.2	1.3	1.3	1.8	7.7	2.4	4.9	3.4	2.4	10.9	3.0
25	1.2	1.3	1.3	1.3	2.0	7.2	2.4	5.3	3.3	2.3	9.8	2.9
26	1.2	1.3	1.3	1.3	2.2	6.8	2.4	5.3	3.3	2.4	9.1	2.9
27	1.3	1.3	1.3	1.3	2.5	6.7	2.3	5.5	3.3	2.5	8.4	2.8
28	1.3	1.3	1.3	1.3	2.6	5.9	2.3	5.7	2.9	3.7	8.1	2.8
29	1.3	1.3	1.3	1.2	.....	5.8	2.3	6.0	2.7	4.8	7.5	2.8
30	1.3	1.3	1.3	1.2	.....	5.2	2.3	6.3	2.5	5.0	7.1	2.8
31	1.2	.....	1.3	1.2	.....	5.1	.....	6.9	.....	4.8	5.2	.....

NOTE.—Stage-discharge relation affected by ice about Dec. 6, until the latter part of February or early in March.

ST. CROIX RIVER AT SWISS, WIS.

LOCATION.—In sec. 33, T. 42 N., R. 15 W., at highway bridge near post office of Swiss, Burnett County, 2 miles above point where St Croix River becomes boundary line between Wisconsin and Minnesota and 10 miles northeast of Danbury, Minn., on Minneapolis, St. Paul & Sault Ste. Marie Railway. Namakagon River enters from left 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, 1918.

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

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Gravel, smooth; aquatic plants during summer months may cause a small amount of backwater at the gage. Right bank high and not subject to overflow; left bank of medium height and may possibly be overflowed during extreme high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.15 feet at 7.30 a. m. June 2 (discharge, 3,000 second-feet); minimum discharge 700 second-feet, February 2.

1914–1918: Maximum stage recorded, 6.73 feet at 6.45 a. m. April 22, 1916 (discharge, 8,480 second-feet); minimum discharge, estimated, 700 second-feet February 2, 1918.

ACCURACY.—Stage-discharge relation practically permanent, except as affected by ice. Two fairly well defined rating curves used during the year. Gage read twice daily, to quarter-tenths. 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 ascertained from discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of St. Croix River at Swiss, Wis., during the year ending Sept. 30, 1918.

[Made by T. G. Bedford.]

Date.	Gage height.	Discharge.	Date.	Gage. height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 18[a]	1.82	792	Feb. 20[a]	2.32	739
Jan. 18[a]	2.02	797	May 16	1.65	1,570

[a] Made through complete ice cover about 200 feet upstream from gage; complete ice cover at control.

Daily discharge, in second-feet, of St. Croix River at Swiss, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	850	1,130	850	755	725	780	1,220	1,480	2,950	984	942	1,150
2	822	1,130	822	770	700	800	1,220	1,400	2,950	984	924	1,120
3	843	1,130	822	780	705	820	1,220	1,360	2,950	984	906	1,010
4	892	1,100	815	785	710	845	1,220	1,320	2,950	1,150	885	960
5	913	1,060	815	795	705	860	1,180	1,320	2,840	1,150	855	930
6	878	1,060	810	815	700	880	1,070	1,290	2,730	1,150	930	918
7	850	1,020	810	835	710	875	1,220	1,290	2,630	1,120	1,000	895
8	836	976	810	830	715	870	1,220	1,320	2,430	1,070	1,020	880
9	857	962	810	820	715	860	1,180	1,400	2,330	1,030	990	870
10	864	955	800	820	720	850	1,180	1,600	2,230	1,030	972	860
11	892	976	800	820	735	850	1,150	1,640	2,040	996	960	890
12	934	990	800	815	750	850	1,120	1,640	1,860	966	948	936
13	948	990	800	810	760	870	1,120	1,600	1,770	948	930	924
14	955	990	800	800	770	890	1,080	1,520	1,600	936	906	912
15	934	985	800	795	780	960	1,080	1,560	1,440	906	890	918
16	920	962	795	785	785	1,030	1,120	1,600	1,360	900	880	890
17	955	955	795	780	780	1,100	1,180	1,520	1,290	912	875	900
18	1,100	955	795	795	775	1,180	1,220	1,480	1,220	924	870	890
19	1,250	955	805	760	755	1,440	1,220	1,360	1,180	912	850	880
20	1,250	934	815	760	740	1,690	1,220	2,530	1,150	924	840	895
21	1,210	934	830	760	730	1,660	1,180	2,630	1,120	870	855	875
22	1,250	955	850	760	720	1,620	1,150	2,430	1,120	890	948	860
23	1,210	948	825	760	720	1,530	1,080	2,430	1,070	895	960	850
24	1,170	948	800	760	720	1,450	1,080	2,230	1,060	906	972	895
25	1,170	934	780	760	730	1,480	1,070	2,130	1,040	906	960	880
26	1,210	920	755	760	740	1,400	1,070	2,430	1,040	930	948	865
27	1,250	906	745	760	750	1,360	1,060	2,630	1,030	912	936	830
28	1,370	920	730	760	760	1,360	1,150	2,630	1,010	1,030	1,080	800
29	1,330	892	725	760	.....	1,290	1,320	2,630	990	1,060	1,290	810
30	1,250	878	720	755	.....	1,260	1,480	2,630	1,010	1,010	1,260	820
31	1,130	.....	740	750	.....	1,220	.....	2,630	.....	984	1,180	.....

NOTE.—Stage-discharge relation affected by ice Dec. 3 to Mar. 25.

Monthly discharge of St. Croix River at Swiss, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 1,550 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,370	822	1,040	0.671	0.77
November	1,130	878	982	.634	.71
December	850	720	796	.514	.59
January	835	750	783	.505	.58
February	785	700	736	.475	.49
March	1,690	780	1,130	.729	.84
April	1,480	1,060	1,170	.755	.84
May	2,630	1,290	1,880	1.21	1.40
June	2,950	990	1,750	1.13	1.26
July	1,150	870	980	.632	.73
August	1,290	840	960	.619	.71
September	1,150	800	904	.583	.65
The year	2,950	700	1,090	.703	9.57

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, Wis., 50 miles above confluence of St. Croix amd Mississippi rivers, near Hastings, Minn. Apple River, draining an area wholly in Wisconsin, enters from left 20 miles below station; Snake River, draining an area in Minnesota, enters from right 35 miles above station.

DRAINAGE AREA.—5,930 square miles.

RECORDS AVAILABLE.—January 10, 1902, to June 30, 1905; January 1, 1910, to September 30, 1918. Data for 1903 published in Water Supply Paper No. 98, pages 176–177, under "St. Croix River near Taylors Falls, Minn."

DISCHARGE.—Determinations of discharge based on kilowatt output of dynamo and exciters, plus flow over dam and spillway, considered as a weir.

EXTREMES OF DISCHARGE.—Maximum daily discharge recorded during year, 10,100 second-feet June 3 and 4; minimum daily discharge recorded, 603 second-feet July 28.

1902–1905, and 1910–1918: Maximum daily discharge recorded, 35,100 second-feet April 23, 1916; minimum daily discharge recorded, 75 second-feet July 17, 1910; the minimum discharge is not natural but 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 have not been checked, nor have discharge measurements been made, by engineers of the United States Geological Survey; probably reliable.

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 Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,170	3,210	2,370	1,440	1,580	1,880	3,380	3,360	8,920	1,700	2,040	1,030
2	2,330	3,610	1,010	1,370	1,600	1,960	3,980	4,220	8,660	1,960	2,550	1,410
3	2,170	4,010	1,640	1,760	800	1,260	3,060	4,520	10,100	1,890	1,840	2,560
4	2,260	2,310	1,970	1,380	1,540	2,550	3,060	4,240	10,100	1,400	705	2,070
5	2,270	3,500	1,840	1,680	1,930	2,390	2,940	2,020	8,480	2,940	1,540	2,080
6	2,290	3,440	2,150	1,160	1,850	2,000	3,380	3,670	8,690	2,230	1,640	1,900
7	2,000	3,150	2,120	1,500	1,790	2,300	1,080	3,960	7,720	1,340	1,460	1,940
8	2,360	3,140	1,540	1,620	1,700	2,410	2,800	3,050	6,820	1,960	1,540	1,170
9	2,520	3,200	981	1,850	1,720	2,220	3,340	3,540	5,960	2,130	1,600	2,320
10	2,200	3,310	1,740	1,610	1,090	1,390	3,960	4,050	4,920	1,920	1,460	1,940
11	2,680	2,540	1,870	1,680	1,930	2,900	2,880	3,900	4,880	2,020	1,820	1,760
12	3,030	3,070	1,790	1,400	2,140	1,970	3,120	2,050	4,900	1,930	1,660	1,920
13	2,870	3,270	1,470	1,310	2,350	2,180	2,860	4,600	4,820	1,750	2,600	1,930
14	2,170	2,960	1,490	1,910	1,470	1,980	1,230	4,170	4,260	1,060	2,240	1,760
15	2,620	2,710	2,100	1,580	1,510	2,080	2,020	4,040	4,260	1,440	1,730	712
16	3,240	2,930	898	1,750	2,150	1,860	2,560	4,010	2,560	1,820	1,620	1,650
17	3,200	3,170	1,630	1,570	890	1,690	2,430	4,190	3,680	1,800	1,400	1,720
18	3,150	2,870	1,800	1,490	1,980	2,910	2,440	4,060	4,280	1,510	930	1,580
19	3,130	2,820	1,740	1,700	1,980	3,370	2,840	2,140	4,310	1,690	1,220	1,770
20	3,000	2,600	1,880	1,210	1,600	3,810	2,750	6,580	3,900	1,720	1,600	1,570
21	2,200	2,700	1,640	1,610	1,680	3,490	1,330	7,270	4,390	645	1,910	1,620
22	2,970	3,140	2,120	1,540	1,620	3,870	2,170	6,120	2,100	1,740	1,560	660
23	3,190	2,860	617	1,730	2,220	4,250	2,280	7,710	1,390	1,640	2,160	1,550
24	3,090	2,970	1,540	1,630	700	3,100	2,340	7,450	1,710	1,750	1,690	2,000
25	3,230	2,280	467	1,560	1,690	5,960	3,140	6,760	1,630	1,640	1,196	1,390
26	3,800	2,980	1,560	1,710	1,830	4,260	3,300	6,340	2,210	1,590	1,400	1,280
27	4,120	2,770	1,430	808	1,700	4,360	2,620	7,650	2,030	2,090	1,500	1,480
28	3,450	2,610	1,400	1,930	1,860	4,230	1,300	6,730	2,080	603	1,390	1,580
29	4,010	1,740	1,770	1,500	.....	4,060	3,180	8,580	1,850	1,590	2,030	1,020
30	3,290	2,170	865	1,640	.....	3,870	2,730	7,620	1,240	1,930	2,710	1,770
31	3,210	.....	1,830	1,560	.....	1,240	.....	8,740	.....	1,950	2,260	.....

Monthly discharge of St. Croix River near St. Croix Falls, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 5,930 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	4,120	2,000	2,850	0.481	0.55
November	4,010	1,740	2,930	.494	.55
December	2,370	617	1,590	.268	.31
January	1,930	808	1,550	.261	.30
February	2,350	700	1,680	.283	.29
March	5,960	1,240	2,830	.477	.55
April	3,980	1,080	2,650	.447	.50
May	8,740	2,020	5,080	.857	.99
June	10,100	1,240	4,760	.803	.90
July	2,940	603	1,720	.290	.33
August	2,710	705	1,710	.288	.33
September	2,560	660	1,640	.277	.31
The year	10,100	603	2,590	.437	5.91

NOTE.—Computed by engineers of the U. S. Geological Survey from records of daily discharge furnished by Minneapolis General Electric Co.

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, 1918.

GAGE.—Enameled staff fastened to retaining wall, left bank of river, just above railroad bridge; read by G. E. Krenz.

DISCHARGE MEASUREMENTS.—Made from lower chords of railroad bridge.

CHANNEL AND CONTROL.—Coarse gravel; free from vegetation. Banks medium high and not subject to overflow. Small island downstream with rapids on either side forms the control; channel fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.6 feet June 6 (discharge, 1,020 second-feet); minimum discharge, 255 second-feet February 23. 1914–1918: Maximum stage recorded, 3.0 feet April 23, 1916 (discharge, 1,330 second-feet); minimum discharge, 235 second-feet December 19, 1916.

ACCURACY.—Stage-discharge relation permanent, except for ice effect. Rating curve well defined between 330 and 1,330 second-feet; below 330 second-feet extended and subject to error. Gage read once daily to half-tenths, except during period December 9 to June 1, when it was read every other day. Daily discharge ascertained by applying daily gage height to rating table except for period in which stage relation was affected by ice, for which it was obtained by applying to rating table daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Records good for open-water periods; for winter periods fair.

Dishcarge measurements of Namakagon River at Trego, Wis., during the year ending Sept. 30, 1918.

[Made by T. G. Bedford.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 19 [a]	2.41	398
Jan. 19 [a]	2.58	311
Feb. 21 [a]	2.46	261

[a] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Namakagon River at Trego, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	332	393	332	310	290	290	369	369	908	417	350	369
2	320	332	393	320	290	290	381	369	944	417	332	369
3	332	369	417	330	290	290	393	369	908	417	369	369
4	332	369	369	330	300	290	372	369	944	444	350	369
5	332	369	280	330	300	290	350	369	944	417	332	369
6	320	350	310	350	300	290	372	381	1,020	393	350	369
7	332	369	310	350	300	300	393	393	944	332	369	350
8	332	369	300	350	310	300	405	448	873	350	369	350
9	332	369	300	350	310	310	417	502	803	369	369	320
10	350	350	290	330	310	310	368	517	664	369	369	332
11	350	369	300	330	310	320	320	532	733	369	369	369
12	369	369	310	320	300	330	356	502	698	369	369	350
13	350	350	320	320	300	340	393	472	630	369	369	320
14	350	369	330	320	290	360	362	472	532	369	369	332
15	332	369	330	320	290	370	332	472	502	332	369	332
16	350	369	350	310	290	370	374	458	472	369	369	369
17	332	369	370	310	280	380	417	444	472	369	369	369
18	417	369	390	310	270	390	417	430	472	350	369	369
19	444	369	400	310	270	390	417	417	472	350	320	369
20	417	369	400	310	260	400	417	474	444	350	332	369
21	369	350	400	300	260	410	417	532	444	320	369	369
22	369	369	370	300	260	410	393	532	444	308	393	369
23	369	350	350	300	255	420	369	532	417	332	393	369
24	417	350	330	300	260	440	360	564	417	350	369	369
25	417	350	320	300	270	450	350	597	393	369	332	332
26	417	369	310	290	270	472	335	718	393	369	393	332
27	417	417	310	290	280	472	320	838	369	332	369	289
28	417	369	305	290	290	472	344	820	369	417	472	320
29	417	417	305	290	.....	432	369	803	417	417	532	332
30	417	332	300	290	.....	393	369	838	417	369	472	332
31	472	.....	300	290	.....	381	.....	873	.....	369	417	.....

NOTE.—Stage-discharge relation affected by ice Dec. 6 to Mar. 25. Discharge estimated or interpolated every other day Dec. 9 to June 1, as gage was not read.

Monthly discharge of Namakagon River at Trego, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 420 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	472	320	372	0.886	1.02
November	417	332	366	.871	.97
December	417	280	336	.800	.92
January	350	290	315	.750	.86
February	310	255	286	.681	.71
March	472	290	367	.874	1.01
April	417	320	375	.893	1.00
May	873	369	529	1.26	1.45
June	1,020	369	615	1.46	1.63
July	444	308	370	.881	1.02
August	532	320	377	.898	1.04
September	369	289	351	.836	.93
The year	1,020	255	389	.926	12.56

APPLE RIVER NEAR SOMERSET, WIS.

LOCATION.—In sec. 21, T. 31 N., R. 19 W., St. Croix County, at power plant of St. Croix Power Co., 3½ miles below Somerset 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, 1918.

GAGE.—Vertical staff gage; readings not used in determination of flow.

DISCHARGE.—The discharge of the turbines in second-feet corresponding to the number of kilowatts is determined for each hour during day from a record of the number of wheels in operation and the load; the sum of the discharge divided by 24 gives average discharge through the turbines. To this quantity is added the leakage through the average number of wheels idle each day, the sum giving daily flow through power house. Water is seldom wasted over spillway of dam, but when it is so wasted the quantity is computed from weir formulas and added to the flow through 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 daily discharge recorded during the year, 1,160 second-feet, June 3; minimum daily discharge, 63 second-feet, August 1.

1904–1918: Maximum daily discharge, 2,280 second-feet in June, 1905; minimum daily discharge, 38 second-feet May 10, 1910. Due to regulation the minimum discharge has no bearing on the natural minimum flow.

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 as tests on one of the turbines made at flume of Holyoke Water-Power Co., Holyoke, Mass. In the summer of 1909 engineers of 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 about 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 date. In June, 1914, a series of current meter measurements were made by the 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.

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

Daily discharge, in second-feet, of Apple River near Somerset, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	194	251	304	203	184	255	350	244	603	235	63	164
2	202	242	121	199	256	334	292	259	885	225	135	231
3	190	324	233	219	129	282	303	135	1,160	289	223	192
4	210	187	220	213	153	240	383	258	1,020	170	137	206
5	199	239	202	280	196	345	170	151	993	271	155	171
6	281	249	142	138	208	278	342	261	960	268	194	206
7	126	246	196	191	172	280	266	259	869	225	172	219
8	190	255	236	193	207	263	249	234	690	282	159	118
9	214	359	92	191	190	191	276	280	581	235	151	204
10	199	169	113	193	135	194	238	422	686	274	213	228
11	231	211	226	155	157	280	418	462	472	249	132	196
12	247	228	225	272	177	291	141	221	306	95	210	207
13	348	244	250	87	199	258	304	309	336	306	173	210
14	134	249	214	161	132	280	272	378	505	189	168	226
15	296	227	229	199	164	307	257	398	364	235	148	140
16	200	363	131	201	220	430	286	353	230	213	185	202
17	207	251	214	193	131	307	300	391	276	227	213	183
18	219	135	229	328	190	495	290	300	338	161	141	200
19	204	233	202	115	179	642	274	207	343	208	163	181
20	267	268	238	183	164	749	273	310	318	217	159	204
21	219	237	240	204	181	786	214	348	336	111	170	203
22	232	237	262	129	186	618	230	361	349	137	191	153
23	269	243	193	194	244	583	270	318	209	162	227	208
24	240	304	182	196	156	494	249	283	270	176	152	193
25	245	161	159	189	208	208	255	364	284	210	102	181
26	275	248	213	246	229	500	275	591	274	208	162	163
27	309	239	211	164	188	323	265	597	228	211	188	164
28	187	262	171	159	207	328	173	821	238	154	175	191
29	232	149	285	165	.....	363	285	705	266	182	251	126
30	261	228	91	238	.....	370	309	804	205	348	170	218
31	261	.....	189	161	.....	239	.....	895	.....	92	269	.....

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

Monthly discharge of Apple River near Somerset, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 550 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	348	126	229	0.416	0.48
November	363	135	241	.438	.49
December	304	91	200	.364	.42
January	328	87	192	.349	.40
February	256	129	184	.335	.35
March	786	191	371	.675	.78
April	418	141	274	.498	.56
May	895	135	385	.700	.81
June	1,160	205	486	.884	.99
July	348	92	212	.385	.44
August	269	63	173	.315	.36
September	231	118	190	.345	.38
The year	1,160	63	262	.476	6.46

KINNIKINNIC RIVER NEAR RIVER FALLS, WIS.

LOCATION.—In sec. 18, T. 27 N., R. 19 W., at Clifton Hollow bridge, a quarter of a mile downstream from dam of Clifton Falls Power Co., 2 miles above mouth of river and 7 miles downstream from River Falls, Pierce County.

DRAINAGE AREA.—170 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—October 23, 1916, to September 30, 1918.

GAGE.—Gurley graph water-stage recorder, in a wooden well fastened to downstream side of right-hand cushing bridge pier.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Channel of rather heavy gravel and sand; control in head of small rapids 150 feet below the gage and is not permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year by recording gage, 6.6 feet at 10 p. m. June 5 (discharge, roughly approximate, 3,080 second-feet). Minimum stage of between 1.7 and 1.8 feet (discharge, approximately 15 second-feet) occurred several times following complete shutdown of power plant. The maximum is about the natural maximum; minimum is caused by regulation at the power house.

ICE.—Stage-discharge relation affected to some extent by ice.

REGULATION.—The daily flow is regulated almost completely by the Clifton power dam just above the station. There are three dams in River Falls which may also have some effect on the daily flow; the storage at these dams is relatively small, and the monthly flow is considered to be nearly the normal flow.

ACCURACY.—Stage-discharge relation not permanent; one rating curve was used throughout the year. Poorly defined between 28 and 470 second-feet. Continuous record obtained by recording gage, except during winter periods and certain other brief periods when gage was not operating properly. Discharge ascertained by fractional day method.

When recording gage was not in operation discharge was based on flow in adjacent drainage basins. Records poor.

Discharge measurements of Kinnikinnic River, near River Falls, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 13[a]	T. G. Bedford	2.08	54
13	....do	2.46	160
Aug. 20[a]	S. B. Soulé	2.45	135
20	....do	3.06	336

[a] Made by wading a short distance downstream.

Daily discharge, in second-feet, of Kinnikinnic River near River Falls, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	76	66	78	80	65	260	75	85	90
2	76	62	90	110	65	110	75	75	90
3	78	72	57	110	65	96	70	75	75
4	68	66	60	110	70	95	70	70	80
5	74	72	60	110	70	680	65	65	80
6	83	95	60	100	80	490	65	75	85
7	64	78	71	100	80	375	60	110	90
8	56	78	.....	90	80	260	65	105	90
9	56	80	.....	100	100	530	70	75	95
10	66	80	.....	100	90	180	75	75	95
11	56	78	.....	100	90	115	80	95	95
12	65	76	.....	100	40	90	65	80	100
13	58	125	.....	100	72	85	70	65	90
14	62	80	.....	80	80	70	70	95	90
15	54	80	.....	70	80	60	75	95	90
16	53	75	70	56	50	70	75	45	100
17	64	70	70	60	50	75	75	85	95
18	60	104	117	60	50	78	75	55	90
19	52	91	80	60	40	75	100	60	85
20	65	120	80	55	40	75	80	95	85
21	65	104	97	57	50	75	60	70	90
22	52	113	96	60	45	75	52	1100	85
23	56	92	96	60	45	80	65	220	100
24	61	90	.....	60	45	75	190	175	100
25	70	88	.....	60	65	75	105	125	100
26	61	64	.....	60	95	70	60	95	95
27	79	74	.....	60	80	75	75	80	90
28	77	69	.....	65	95	75	75	85	70
29	75	85	.....	65	75	75	55	70	60
30	70	58	.....	65	183	75	55	80	80
31	68	.....	.....	.....	400	.....	45	85	.....

NOTE.—Stage-discharge relation affected by ice and recording gage not in operation from Jan. 1 to Mar. 31; discharge estimated, Jan. 1–31, 60 second-feet; Feb. 1–28, 55 second-feet; Mar. 1–31, 115 second-feet. Recording gage not in operation, discharge estimated Dec. 8 to 15, 24 to 31, 70 second-feet. Recording gage not in perfect operation Nov. 9, 10, 24, Dec. 22, Apr. 6, 7, June 14, Aug. 24, 25.

Monthly discharge of Kinnikinnic River near River Falls, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 170 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	83	52	65.2	0.384	0.44
November	125	58	82.8	.487	.54
December	.....	.....	74.3	.437	.50
January	.....	.....	60	.353	.41
February	.....	.....	55	.324	.34
March	.....	.....	115	.677	.78
April	110	55	78.8	.464	.52
May	400	40	81.8	.481	.55
June	680	60	154	.906	1.01
July	190	45	73.9	.435	.50
August	1,100	45	121	.712	.82
September	100	60	88.7	.522	.58
The year	1,100	.....	87.7	.516	6.99

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 East Fork of Chippewa River (coming in from the left) 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, 1918.

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

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 7.24 feet at 4 p. m. June 1 (discharge, 3,040 second-feet); estimated minimum discharge, during January and February, 180 second-feet.

1913–1918: Maximum stage recorded during period, 9.56 feet, April 22, 1916 (discharge, 6,940 second-feet); minimum discharge estimated at 175 second-feet February 17, 1917.

REGULATION.—Flow regulated to some extent by operation of storage reservoir in sec. 14, T. 41 N., R. 6 W., about 16 miles above station. This reservoir has a capacity of 550,000,000 cubic feet and is used in connection with reservoirs on upper Flambeau River for the purpose of regulating the flow of Chippewa River.

ACCURACY.—Stage-discharge relation permanent except as affected by ice during winter period and by logs during a portion of April and May. Rating curve well defined between 270 and 6,820 second-feet. Gage read to hundredths twice a day. 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 the rating table daily gage heights corrected for ice effect by means of discharge measurements, observer's notes, and weather records; discharge for periods of May, when logs were present, interpolated. Excellent records for open-water period except those for May, which are fair; winter records fair.

Discharge measurements of Chippewa River at Bishop's Bridge, near Winter, Wis., during the year ending Sept. 30, 1918.

[Made by T. G. Bedford.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 26[a]	5.46	337
Jan. 26[a]	5.34	198
Mar. 1[a]	5.62	216

[a] Made through complete ice cover, 20 feet below gage.

Daily discharge, in second-feet, of Chippewa River at Bishop's Bridge, near Winter, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	380	710	345	410	180	200	530	790	2,980	340	304	1,050
2	405	675	345	340	180	210	530	830	2,980	322	322	1,000
3	405	640	345	330	180	210	530	790	2,840	340	304	830
4	405	555	345	320	180	220	530	832	2,570	340	304	790
5	405	530	345	320	180	225	505	874	2,570	580	287	675
6	405	530	340	305	180	220	480	916	2,570	455	287	555
7	380	505	340	295	185	210	505	958	2,310	360	340	505
8	380	505	340	285	195	210	480	1,000	2,050	360	380	405
9	360	505	340	280	195	210	480	1,200	1,570	322	405	405
10	380	505	340	270	195	195	480	1,460	1,520	322	380	340
11	405	505	380	255	195	210	455	1,520	1,460	304	380	380
12	405	505	405	240	195	225	430	1,520	1,100	270	430	480
13	405	480	405	240	195	225	430	1,350	1,050	287	380	480
14	430	480	360	240	185	225	430	1,050	915	270	405	480
15	455	480	380	230	180	225	455	1,050	870	304	340	430
16	455	480	405	225	180	225	455	1,050	710	304	304	380
17	480	455	405	225	195	225	505	1,050	640	270	304	430
18	640	455	380	225	195	255	555	1,050	580	287	270	505
19	960	430	360	210	195	270	580	1,050	505	270	287	530
20	960	405	340	210	195	270	580	1,150	505	304	254	430
21	1,000	380	340	210	195	305	610	1,150	480	304	254	430
22	1,150	380	360	210	195	340	610	1,460	405	287	322	430
23	1,150	360	340	210	195	380	555	1,400	430	304	340	405
24	1,100	365	340	210	210	430	640	1,350	380	287	480	455
25	915	360	320	200	225	455	580	1,570	380	304	505	430
26	870	360	340	195	225	480	505	1,980	340	304	480	405
27	915	355	340	190	225	530	455	2,310	322	270	480	430
28	1,000	355	340	180	210	555	455	2,440	322	340	505	380
29	830	350	340	180	.....	555	480	2,440	287	322	790	380
30	675	350	410	180	.....	530	530	2,570	340	340	790	360
31	750	.....	285	180	.....	530	.....	2,700	.....	322	960	.....

NOTE.—Stage-discharge relation affected by ice Nov. 24 to Mar. 27. Discharge interpolated because of logs on control, May 4–7.

Monthly discharge of Chippewa River at Bishop's Bridge, near Winter, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 775 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,150	360	640	0.826	0.95
November	710	350	465	.600	.67
December	410	285	355	.458	.53
January	410	180	245	.316	.36
February	225	180	194	.250	.26
March	555	195	308	.397	.46
April	640	430	512	.661	.74
May	2,700	790	1,380	1.78	2.05
June	2,980	287	1,200	1.55	1.73
July	580	270	322	.415	.48
August	960	254	406	.524	.60
September	1,050	340	506	.653	.73
The year	2,980	180	546	.705	9.56

CHIPPEWA RIVER AT 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 right immediately above station, and Flambeau River from right 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, 1918.

GAGE.—Chain gage, attached to downstream side of Minneapolis, St. Paul & Sault Ste. Marie Railroad bridge; read by H. C. Gardner.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

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 during low stages with sand worked in by Thornapple River. Flow except during extreme high stages is confined within the banks.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.7 feet at 7 a. m. June 2 (discharge, 9,380 second-feet); minimum stage recorded 1.15 feet, morning and afternoon of August 21 (discharge, about 260 second-feet).

1910–1918: Maximum stage recorded during period, 12.3 feet at 5.45 p.m., April 22, 1916 (discharge, 13,400 second-feet); minimum discharge, when river was frozen, approximately 310 second-feet during January and February, 1917; minimum open-water stage recorded 1.15 feet morning and afternoon reading August 21, 1918 (discharge, about 260 second-feet); caused by regulation.

REGULATION.—Flow modified to some extent by reservoir on West Fork of Chippewa River, in sec. 14, T. 41 N., R. 6 W. This reservoir has a capacity of 550,000,000 cubic feet, and is used in connection with reservoirs on upper Flambeau River, for the purpose of regulating the flow of Chippewa River. No diurnal fluctuation is observed.

ACCURACY.—Stage-discharge relation not permanent; affected by ice during winter periods and changes caused by shifting control during periods of low water. Two rating curves used during the year; the first, which is fairly well defined throughout, is applicable from October 1 to March 28; the second, which is fairly well defined between 390 and 3,100 second-feet, is applicable March 29 to September 30. Gage read twice daily to quarter-tenths. Daily discharge ascertained by applying mean daily gage height to rating table, except for the period in which stage-discharge relation was affected by ice, for which periods it was obtained by applying to rating table mean daily gage heights corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records fair; winter records subject to error.

Discharge measurements of Chippewa River at Bruce, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 24	R. B. Kilgore	3.04	1,630	Feb. 26[a]	T. G. Bedford	3.31	359
Dec. 24[a]	T. G. Bedford	2.82	541	May 5	do	3.77	2,220
Jan. 24[a]	do	2.99	390	Aug. 22	S. B. Soulé	1.78	721

[a] Complete ice cover at control and measuring station.

Daily discharge, in second-feet, of Chippewa River at Bruce, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	510	1,300	690	455	355	430	935	1,940	8,400	620	620	1,190
2	314	1,100	690	455	340	440	1,270	1,940	9,240	620	374	1,270
3	480	1,100	650	440	330	455	1,430	1,190	7,720	620	417	1,190
4	575	1,020	650	430	330	455	1,270	1,510	6,040	620	480	1,080
5	610	930	540	430	330	455	1,270	1,430	4,970	795	515	1,000
6	610	890	610	430	330	440	1,270	1,430	4,420	900	480	935
7	610	890	610	455	330	430	1,350	2,030	3,870	900	480	830
8	575	850	610	480	330	430	1,350	2,120	3,430	725	690	830
9	540	850	610	455	330	430	1,270	2,700	2,900	690	725	550
10	1,600	810	575	430	340	430	1,190	4,970	2,400	620	655	620
11	1,600	770	610	430	355	430	1,110	5,560	2,210	550	620	480
12	650	770	630	430	355	450	1,110	4,750	1,940	515	620	585
13	610	770	650	420	355	480	1,010	3,870	1,760	515	655	550
14	650	770	630	405	340	480	970	2,900	1,510	480	655	480
15	650	730	610	420	330	480	1,000	2,500	1,430	480	655	515
16	730	690	610	430	320	510	1,080	2,500	1,350	515	320	404
17	930	690	610	415	310	610	1,350	2,300	1,190	515	466	830
18	1,060	690	590	405	330	770	1,510	2,120	1,110	515	473	760
19	1,600	690	575	405	355	1,020	1,510	1,940	1,000	480	445	830
20	1,800	650	540	405	340	1,200	1,350	2,210	900	480	550	473
21	1,800	610	510	405	330	1,500	1,350	2,210	865	480	260	760
22	1,600	540	525	405	330	1,800	1,350	2,300	830	480	585	725
23	1,700	575	540	390	330	2,000	1,270	2,800	795	515	795	725
24	1,600	575	540	380	330	1,900	1,150	2,300	725	515	900	655
25	1,500	575	510	380	340	1,700	1,110	3,210	690	515	830	620
26	1,400	575	510	380	355	1,500	1,110	5,800	690	515	795	655
27	1,600	610	510	380	355	1,200	1,000	7,720	620	480	480	655
28	1,700	690	480	380	360	1,020	935	7,200	620	620	725	620
29	1,700	690	455	370	.....	970	970	6,290	585	970	1,040	620
30	1,300	690	450	355	.....	970	2,120	5,080	585	760	1,190	585
31	1,060	.....	455	350	.....	935	.....	5,680	.....	690	1,190	.....

NOTE.—Stage-discharge relation affected by ice Dec. 5 to Mar. 28.

Monthly discharge of Chippewa River at Bruce, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 1,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,800	314	1,090	0.681	0.79
November	1,300	540	770	.481	.54
December	690	450	573	.358	.41
January	480	350	413	.258	.30
February	360	310	338	.211	.22
March	2,000	430	849	.531	.61
April	2,120	935	1,230	.769	.86
May	7,720	1,190	3,310	2.07	2.39
June	9,240	585	2,490	1.56	1.74
July	970	480	603	.377	.43
August	1,190	260	635	.397	.46
September	1,270	404	734	.459	.51
The year	9,240	260	1,090	.681	9.26

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, which comes in from right.

DRAINAGE AREA.—5,600 square miles.

RECORDS AVAILABLE.—June 22, 1888, to September 30, 1918. The gage was originally established by Chippewa Lumber & Boom Co., which has kept a continuous record since 1889. Since 1904 the United States Weather Bureau has obtained gage readings during flood season of each year. On June 1, 1906, the United States Geological Survey began making discharge measurements and maintaining gage readings.

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

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

CHANNEL AND CONTROL.—Heavy gravel; fairly permanent. Both banks high and are rarely overflowed.

EXTREMES OF STAGE.—Maximum stage recorded during year, 12.4 feet at 5 p. m. June 1 (discharge, about 43,700 second-feet); estimated minimum discharge, 175 second-feet January 20; caused by regulation at Wissota dam.

1888–1918: Maximum stage recorded during period, 26.03 feet December 6, 1896. September 10, 1884, a stage of 26.94 feet was reached; discharge not estimated; minimum recorded approximately 40 second-feet February 4, 1917.

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

REGULATION.—Flow past station controlled to a considerable extent by the operation of the Wissota gates. Large diurnal fluctuation.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 530 and 56,200 second-feet; below 530 second-feet poorly defined. Operation of the water-stage recorder was satisfactory throughout the year, except for periods when stage-discharge relation was affected by ice. Daily discharge October 1 to September 30 obtained by discharge integrator. Daily discharge during periods when stage-discharge relation was affected by ice ascertained by applying to rating curve mean daily gage heights corrected for the ice effect by means of discharge measurements, observer's notes, and weather records and to some extent on computations of flow through the Wissota dam. Open-water records good; winter records fair.

Discharge measurements of Chippewa River at Chippewa Falls, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 16[a]	Hoyt and Bedford	0.27	1,040	Feb. 18[a]	T. G. Bedford	.50	1,520
Jan. 16[a]	T. G. Bedford	.49	1,320	Aug. 21	S. B. Soulé	.91	2,400

[a] Incomplete ice cover at control; measurement made through complete ice cover.

Daily discharge, in second-feet, of Chippewa River at Chippewa Falls, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,210	4,360	1,820	1,600	1,330	1,440	7,600	7,380	36,300	1,310	3,140	4,030
2	2,280	4,840	1,910	1,750	1,330	1,360	7,320	6,600		1,930	2,880	5,350
3	2,580	3,220	1,750	1,670	986	1,280		5,400		2,400	2,780	5,540
4	2,370	4,030	1,900	1,670	1,340	1,100		7,620		1,400	2,700	3,930
5	2,370	4,010	1,810	1,750	1,170	1,100	6,570	5,280	27 500	1,300	2,130	3,900
6	3,060	3,580	1,660	900	1,280	1,620		5,440		2,120	2,920	3,790
7	1,150	3,700	1,510	1,240	1,190	1,530		6,760		2,120	2,860	3,470
8	2,080	3,610	1,360	1,330	1,190	1,530	6,080	5,680		2,200	2,180	3,450
9	2,260	4,040	1,360	1,330	1,190	2,210	6,500	7,640	10,600	2,150	4,790	4,000
10	2,340	3,850	1,600	1,330	1,040	1,620	5,540	9,060	11,100	2,240	6,370	4,040
11	1,840	2,020	1,440	1,410	1,050	3,010	4,460	14,000	7,120	2,140	5,560	4,120
12	2,080	3,940	1,500	1,580	1,240	3,500	4,920	14,600	7,550	2,250	4,780	4,100
13	2,220	2,970	1,560	1,220	1,260	2,880	4,970	15,100	5,720	2,220	5,010	2,640
14	2,600	2,930	1,380	1,380	1,280	2,620	5,480	12,600	4,710	1,950	5,030	2,740
15	825	2,900	1,280	1,360	1,630	2,550	5,980	9,270	4,300	832	4,550	1,780
16	700	2,740	1,090	1,340	1,480	2,420	5,180	7,500	3,280	1,610	4,050	2,560
17	2,450	3,890	1,340	1,260	1,330	2,300	5,030	8,650	5,870	1,890	3,280	3,440
18	1,660	2,300	1,550	1,160	1,510	3,000	5,670	6,580	4,620	1,770	2,500	3,690
19	4,570	2,860	1,620	815	1,680	3,490	4,720	6,260	3,440	1,900	2,620	3,340
20	6,970	2,840	1,630	175	1,770	3,040	3,960	8,190	3,580	1,720	2,810	3,310
21	8,350	2,840	1,480	210	1,700	4,100	4,200	6,120	3,540	1,420	2,740	3,260
22	6,900	3,340	2,740	1,670	1,620	8,000	5,570	7,440	2,620	828	2,720	2,880
23	6,040	2,850	2,190	1,670	1,440	10,900	5,080	9,460	1,640	1,800	3,200	2,960
24	4,420	3,300	2,210	1,330	1,190	12,000	5,130	9,220	1,530	3,540	7,140	2,970
25	5,330	1,400	1,610	1,160	1,190	13,400	4,400	9,960	1,960	2,740	6,820	3,100
26	5,010	2,720	1,450	1,240	1,440	12,400	4,100	20,300	2,100	2,720	5,200	2,970
27	4,810	2,710	1,560	986	1,440	11,700	4,160	30,600	1,920	2,120	4,800	2,880
28	6,670	2,170	1,670	1,070	1,440	9,780	3,300	34,000	1,920	1,180	4,350	2,640
29	6,350	2,140	1,780	1,240	.....	9,110	4,290	33,000	1,730	3,000	4,460	2,120
30	5,960	2,100	1,760	1,330	.....	8,440	6,080	28,800	940	3,500	6,300	1,960
31	4,430	.....	1,670	1,330	.....	7,770	.....	30,200	.....	3,000	6,560	.....

NOTE.—Stage-discharge relation affected by ice Dec. 5 to Mar. 10. Recording gage not in perfect operation Mar. 16, 22–23, 30, Apr. 3–7, 14, June 2–8, July 29–31; discharge partly estimated.

Monthly discharge of Chippewa River at Chippewa Falls, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 5,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	8,350	700	3,640	0.650	0.75
November	4,840	1,400	3,140	.561	.63
December	2,740	1,090	1,650	.295	.34
January	1,750	175	1,270	.227	.26
February	1,770	986	1,350	.241	.25
March	13,400	1,100	4,880	.871	1.00
April	.....	3,300	5,420	.968	1.08
May	34,000	5,280	12,500	2.23	2.57
June	.....	940	10,700	1.91	2.13
July	3,540	828	2,040	.364	.42
August	7,140	2,130	4,100	.732	.84
September	5,540	1,780	3,370	.602	.67
The year	.....	175	4,520	.807	10.94

FLAMBEAU RIVER NEAR BUTTERNUT, WIS.

LOCATION.—In NW. ¼ SE. ¼ sec. 33, T. 41 N., R. 1 E., Ashland County, 6 miles southeast of Butternut 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, 1918.

GAGE.—Standard chain gage supported by built-up cantilever, attached to posts set in right bank of river; installed May 26, 1916; read by Miss Mathilda Schulz. 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 a cable 1,500 feet downstream from the 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, the bed is rocky and the banks high. Control is at head of Schultz Rapids, about 200 feet below cable and 1,700 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year: 4.5 feet, June 3 (discharge, 1,680 second-feet); minimum discharge estimated at 250 second-feet March 1 to 10.

1914–1918: Maximum stage recorded during period, 9.0 feet, April 22 and 23, 1916 (discharge, 5,430 second-feet); minimum discharge, estimated 250 second-feet, March 1 to 10, 1918.

REGULATION.—Storage reservoirs are maintained by Chippewa & Flambeau Improvement Co. on headwaters of Flambeau River. Of these reservoirs, Rest Lake, in sec. 9, T. 42 N., R. 5 E., with an allowable capacity of approximately 1½ billion cubic feet, is the largest.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 356 and 3,480 second-feet. Gage read twice daily to quarter-tenths. Daily discharge ascertained by applying mean daily gage height to rating table except for periods in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table daily gage heights 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 Flambeau River near Butternut, Wis., during the year ending Sept. 30, 1918.

[Made by T. G. Bedford.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 21[a]	2.18	459	Feb. 23[a]	2.44	272
Jan. 22[a]	2.29	322	June 7	3.79	1,240

[a] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Flambeau River near Butternut, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	416	673	500	355	305	250	850	760	1,330	518	592	592
2	400	632	490	330	305	250	850	760	1,500	554	554	592
3	385	592	485	315	305	250	850	716	1,680	592	554	554
4	400	592	475	305	310	250	805	716	1,620	632	554	483
5	400	554	465	290	315	250	716	673	1,560	554	632	466
6	416	554	465	290	320	250	632	716	1,380	554	449	432
7	416	554	465	285	325	250	632	760	1,330	518	432	416
8	400	592	465	285	325	250	632	805	1,280	518	483	385
9	385	632	465	280	330	250	632	805	1,120	483	554	370
10	416	673	465	280	330	250	632	940	1,080	449	554	356
11	518	673	460	280	330	260	592	1,080	985	416	554	385
12	592	673	460	280	330	260	592	1,030	895	416	554	416
13	632	673	460	280	330	270	592	940	805	385	554	449
14	673	632	460	280	320	270	592	850	760	342	518	416
15	673	632	460	280	315	270	592	850	716	356	483	400
16	592	632	460	290	310	270	592	850	716	385	466	385
17	554	632	460	300	305	270	632	805	632	416	449	416
18	805	632	460	300	300	270	673	850	592	416	432	449
19	895	632	460	305	290	280	673	850	554	449	416	483
20	985	592	460	310	280	300	632	940	518	554	416	466
21	985	632	460	315	275	330	632	985	483	554	385	432
22	940	632	450	320	270	340	632	985	466	554	356	432
23	895	632	450	320	270	370	592	1,030	449	554	356	432
24	850	554	450	315	270	400	595	1,030	449	554	329	432
25	805	592	450	315	270	415	592	1,120	400	554	329	416
26	760	554	440	310	270	450	554	1,280	400	554	416	400
27	805	540	430	310	270	480	518	1,500	416	554	416	385
28	760	530	415	310	270	535	518	1,500	385	592	432	356
29	716	520	400	305	.....	590	673	1,500	385	632	554	370
30	805	510	390	305	.....	670	760	1,380	483	632	632	370
31	673	.....	385	305	.....	720	.....	1,280	.....	632	716	.....

NOTE.—Stage-discharge relation affected by ice Nov. 27 to Apr. 1.

Monthly discharge of Flambeau River near Butternut, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 660 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	985	385	643	0.974	1.12
November	673	510	605	.917	1.02
December	500	385	454	.688	.79
January	355	280	302	.458	.53
February	330	270	302	.458	.48
March	720	250	339	.514	.59
April	850	518	649	.983	1.10
May	1,500	673	977	1.48	1.71
June	1,680	385	846	1.28	1.43
July	632	342	512	.776	.89
August	716	329	488	.739	.85
September	592	356	431	.653	.73
The year	1,680	250	547	.829	11.24

FLAMBEAU RIVER NEAR LADYSMITH, WIS.

LOCATION.—In SE. ¼ sec. 20, T. 35 N., R. 5 W., at H. J. Cornelissen's farm, 6 miles by road northeast of Ladysmith, Rusk County, 21 miles below mouth of South Fork of Flambeau River, which comes in from left, 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, 1918. From February 15, 1903, to December 2, 1906, records were collected at a station in the city of Ladysmith, three-quarters of a mile south of Minnespolis, St. Paul & Sault Ste. Marie Railway station, half a mile below dam of Menasha Pulp Co., and about 6 miles below present station.

GAGE.—Chain gage fastened to a cantilever arm, supported by two trees on left bank of river, on the 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 fairly permanent. At gage section, channel is divided by a small sandy island; at cable section the river flows in one channel. Banks are medium high, wooded, and not subject to overflow. Control not well defined; formed by channel below the gage.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded during year, 7.2 feet June 2 (discharge, 9,520 second-feet); minimum discharge (during frozen period), 540 second-feet in February and March.

1903–1906 and 1914–1918: Maximum discharge recorded during period, 17,400 second-feet April 23, 1916; minimum discharge, 390 second-feet December 4, 1904.

ICE.—Stage-discharge relation seriously affected by large quantities of frazil ice which form on the falls and rapids above the station and fill the channel for a distance of several miles from the gage to pond of the Paper Co.'s dam at Ladysmith.

REGULATION.—Chippewa & Flambeau Improvement Co. operates storage reservoirs on Rest Lake and smaller reservoirs on Manitowish and Turtle rivers and Bear Creek. Weekly fluctuations at gage are caused by operation of power plants at Park Falls and storage reservoirs. No daily fluctuation has been observed.

ACCURACY.—Stage-discharge relation permanent except as affected by logs and ice. Rating curve well defined between 770 and 17,000 second-feet, approximate above and below these limits. Gage read once daily to quarter-tenths. Daily discharge ascertained by applying daily gage height to rating table, except for periods in which stage-discharge relation was affected by ice and logs, for which discharge was obtained by applying to rating table mean daily gage heights corrected for backwater by means of discharge measurements, observer's notes, and weather records. Open-water records excellent except during July and September, when logs were in river, for which period they are fair; winter records fair.

Discharge measurements of Flambeau River near Ladysmith, Wis., during the year ending Sept. 30, 1918.

[Made by T. G. Bedford.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 22[a]	3.85	646	Feb. 25[a]	4.05	546
Jan. 23[a]	4.00	607	May 18	3.46	2,280

[a] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Flambeau River near Ladysmith, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,000	1,620	880	620	580	540	1,340	1,910	8,960	920	1,620	1,340
2	1,000	1,560	870	620	580	540	1,400	1,790	9,520	740	920	1,450
3	960	1,560	860	620	580	550	1,450	1,670	8,400	920	1,000	1,340
4	880	1,560	840	520	580	550	1,560	1,670	7,880	1,000	1,000	1,560
5	1,000	1,560	820	620	580	560	1,670	1,670	8,400	920	1,000	1,240
6	960	1,500	810	620	580	560	1,790	2,030	5,800	1,000	770	1,240
7	960	1,500	800	620	580	570	1,910	2,150	4,140	1,240	740	
8	840	1,500	780	620	590	570	2,150	2,390	3,970	920	1,080	
9	840	1,450	770	620	590	580	1,910	2,510	3,640	960	1,160	
10	880	1,340	750	620	600	580	1,620	3,330	3,180	1,040	1,240	
11	920	1,340	740	610	600	590	1,340	3,800	2,640	1,000	1,670	
12	920	1,340	730	610	610	600	2,030	4,480	2,640	920	1,790	
13	1,080	1,400	720	610	610	610	1,790	3,480	2,510	880	1,560	
14	1,240	1,000	710	610	620	620	1,160	3,180	2,510	1,160	1,290	
15	1,240	1,340	700	610	620	620	1,670	4,140	2,150	1,120	1,160	
16	1,340	1,290	690	610	620	640	1,670	2,900	1,670	840	1,080	
17	1,290	1,400	680	610	610	660	1,670	2,900	1,620	1,160	1,000	
18	1,340	1,240	670	600	610	680	1,910	2,510	1,450	1,160	1,000	
19	1,670	1,340	670	600	600	710	1,500	2,390	1,500	1,160	960	870
20	2,900	1,240	660	600	600	740	1,500	1,910	1,080	1,160	880	
21	2,770	1,080	650	600	590	760	1,560	2,510	960	1,050	840	
22	2,510	1,240	640	600	580	770	1,670	2,640	1,080	1,050	960	
23	2,150	1,240	640	600	570	840	1,620	2,510	1,000	1,050	1,290	
24	2,030	1,160	630	600	560	880	1,240	2,770	1,000	1,050	1,340	
25	1,910	1,240	630	600	550	920	1,560	2,770	758	1,160	1,340	
26	1,790	1,040	620	590	550	1,000	1,500	4,140	920	1,160	1,160	
27	2,150	920	620	590	550	1,040	1,560	5,210	920	1,160	1,160	
28	1,910	920	620	590	540	1,080	1,560	5,600	920	1,450	1,120	
29	2,150	920	620	580	.....	1,160	1,450	6,000	880	1,670	1,240	
30	2,030	880	620	580	.....	1,200	1,790	6,000	920	1,080	1,340	
31	1,670	.....	620	580	.....	1,240	.....	6,220	.....	1,120	1,340	.....

NOTE.—Stage-discharge relation affected by ice, Nov. 28 to Apr. 6; by logs July 21–25 and Sept. 7 to 30. Gage assumed as reading 1 foot too high Aug. 31 to Sept. 3.

Monthly discharge of Flambeau River near Ladysmith, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 1,940 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,900	840	1,490	0.768	0.89
November	1,620	880	1,290	.665	.74
December	880	620	712	.367	.42
January	620	580	606	.312	.36
February	620	540	587	.303	.32
March	1,240	540	741	.382	.44
April	2,150	1,160	1,620	.835	.93
May	6,220	1,670	3,200	1.65	1.90
June	9,520	758	3,100	1.60	1.78
July	.....	740	1,070	.552	.64
August	1,790	740	1,160	.598	.69
September	.....	.....	968	.499	.56
The year	.....	.....	1,380	.711	9.67

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 confluence of Jump and Chippewa rivers.

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, 1918.

GAGE.—Chain gage bolted to downstream handrail of bridge.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

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, 8.95 feet May 27 (discharge, 7,800 second-feet); minimum discharge, estimated 15 second-feet Feb. 3 and 4.

1915–1918: Maximum discharge during period, 8,600 second-feet April 22, 1916; minimum discharge approximately 15 second-feet Feb. 3–4, 1918.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 45 and 5,930 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 heights 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 Sept. 30, 1918.

[Made by T. G. Bedford.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 23[a]	3.58	42	Feb. 26[a]	3.90	31
Jan. 24[a]	3.54	26	May 20	3.80	436

[a] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Jump River at Sheldon, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	148	405	85	35	20	35	1,020	1,020	7,230	60	126	760
2	148	355	85	35	20	35	930	720	6,850	70	122	485
3	133	330	80	35	15	40	840	610	4,540	70	133	355
4	122	305	75	30	15	40	680	540	2,950	70	102	330
5	164	330	70	30	15	45	575	485	1,980	84	88	230
6	235	355	65	30	15	45	485	458	1,400	84	105	200
7	305	330	60	30	15	50	540	458	1,110	70	164	172
8	210	305	55	30	20	50	680	512	840	70	575	148
9	190	330	50	30	20	55	575	575	645	65	1,300	136
10	172	305	45	30	25	60	485	1,620	540	48	1,200	122
11	172	280	40	30	30	65	458	1,860	430	45	800	133
12	185	260	40	30	30	70	405	1,620	355	39	540	156
13	305	250	35	30	30	80	380	1,200	280	38	575	255
14	330	230	30	30	30	90	355	885	240	39	610	235
15	280	230	30	30	30	105	330	720	190	44	485	210
16	270	220	30	30	30	120	355	575	148	68	355	190
17	305	205	30	30	30	130	430	512	133	50	260	180
18	430	200	30	25	25	140	485	458	126	45	176	220
19	1,110	185	40	25	20	180	610	458	108	45	140	610
20	1,110	176	50	25	20	230	575	430	98	42	126	680
21	885	172	60	25	20	540	512	430	88	39	122	575
22	720	172	70	25	25	1,300	485	540	77	36	380	458
23	610	150	70	25	30	2,370	430	760	77	38	2,510	355
24	540	145	60	25	30	2,110	380	645	68	68	2,110	330
25	485	140	50	25	30	1,860	330	1,860	60	74	1,400	355
26	485	130	50	20	30	1,620	305	7,230	58	70	1,020	330
27	645	120	40	20	35	1,510	280	7,800	50	77	512	240
28	720	110	40	20	35	1,300	355	6,660	50	176	540	225
29	645	105	35	20	.....	1,200	575	5,750	48	148	1,400	180
30	575	95	35	20	.....	1,200	1,020	5,220	50	148	1,510	185
31	458	.....	35	20	.....	1,110	.....	5,220	.....	133	1,110	.....

NOTE.—Stage-discharge relation affected by ice Nov. 23 to Mar. 28.

Monthly discharge of Jump River at Sheldon, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 510 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,110	122	422	.827	0.95
November	405	95	231	.453	.51
December	85	30	50.6	.0992	.11
January	35	20	27.3	.0535	.06
February	35	15	24.6	.0482	.05
March	2,370	35	574	1.13	1.30
April	1,020	280	529	1.04	1.16
May	7,800	430	1,870	3.67	4.23
June	7,230	48	1,030	2.02	2.25
July	176	36	69.5	.136	.16
August	2,510	88	664	1.30	1.50
September	760	122	301	.590	.66
The year	7,800	15	486	.953	12.94

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, 1918.

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 about 500 feet downstream from bridge.

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

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded during year, 9.1 feet at 8 a. m. May 27 (discharge, 5,620 second-feet); minimum discharge, estimated 35 second-feet, from discharge measurements made January 27, 1918.

1914–1918: Maximum open-water stage recorded, 10.6 feet at noon April 1, 1916 (discharge, 7,180 second-feet); minimum open-water stage recorded, 0.10 foot September 2, 1916 (discharge, 40 second-feet); minimum discharge, estimated 35 second-feet, January 27, 1918.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice Rating curve well defined from 69 to 5,520 second-feet, poorly defined outside these limits. Gage read to quarter-tenths once a day. Daily discharge ascertained by applying daily gage height to rating curve, except for period in which the stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage heights corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records good, except for low stages for which they are fair; winter records fair.

Discharge measurements of Eau Claire River near Augusta, Wis., during the year ending Sept. 30, 1918.

[Made by T. G. Bedford.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 27 [a]	0.95	41	May 10	4.38	1,730
Jan. 27 [a]	2.18	3	Sept. 3 [b]	.28	68

[a] Complete ice cover at control and measuring section.
[b] Made by wading 500 feet downstream from gage.

Daily discharge, in second-feet, of Eau Claire River near Augusta, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	83	235	87				585	655	4,660	134	87	73
2	69	207	107				550	516	4,370	129	73	69
3	78	201	87			15	466	417	2,430	111	69	62
4	69	201	78				417	323	1,630	118	69	62
5	87	179					353	293	1,120	107	66	66
6	83	179					353	278	930	103	62	66
7	78	174					466	263	1,120	97	66	62
8	78	166				20	655	235	845	87	87	62
9	97	153					533	338	1,810	87	148	62
10	73	141					449	2,220	1,690	87	166	66
11	87	129				25	385	2,290	1,020	83	125	78
12	111	129				30	338	1,570	690	78	118	83
13	129	129				40	323	930	466	73	249	83
14	129	125				45	308	620	417	73	338	78
15	118	118			15	55	293	499	323	78	179	69
16	118	107		20		80	293	466	278	134	141	66
17	107	107				85	353	369	229	153	107	66
18	129	107	55			235	433	323	235	120	118	78
19	207	103				1,130	620	308	221	97	87	87
20	249	97				2,760	550	323	193	87	78	111
21	221	107				2,520	482	323	193	78	78	107
22	201	107				1,960	499	449	166	73	118	97
23	166	125				1,760	449	765	141	73	174	91
24	153	107				1,510	369	620	141	83	158	83
25	174	118				1,460	323	499	134	87	118	78
26	235	129				1,220	293	3,710	129	83	97	69
27	401	97				885	263	5,620	118	78	83	69
28	499	87				805	278	4,750	111	83	87	66
29	369	97				690	620	3,620	107	134	87	66
30	308	87			.....	620	845	2,430	125	118	87	66
31	278	.....			.....	620	.....	2,860	.....	91	83	.....

NOTE.—Stage-discharge relation affected by ice Dec. 5 to Mar. 25.

Monthly discharge of Eau Claire River near Augusta, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	499	69	167	0.334	0.39
November	235	87	135	.270	.30
December	107	.....	59.5	.119	.14
January	.....	.....	20	.040	.05
February	.....	.....	15	.030	.03
March	2,760	.....	604	1.21	1.40
April	845	263	438	.876	.98
May	5,620	235	1,250	2.50	2.88
June	4,660	107	868	1.74	1.94
July	153	73	97.3	.195	.22
August	338	62	116	.232	.27
September	111	62	74.7	.149	.17
The year	5,620	.....	323	.646	8.77

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 station, and Trout Creek, also from right, 3½ miles above.

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 10, 1914, to September 30, 1918.

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

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

CHANNEL AND CONTROL.—Bed composed of rock and gravel; small amount of grass growth during summer months. 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, 4.05 feet June 1 (discharge, 3,180 second-feet); minimum discharge recorded, 368 second-feet, February 19 (by current-meter measurement).

1914–1918: Maximum stage recorded during period, 6.8 feet at 1 p. m., March 31, 1916 (discharge, 6,990 second-feet); minimum stage recorded 0.80 foot November 19, 1914 (discharge, about 385 second-feet); apparently caused by temporary holding back of the water by ice. Discharge measurement made February 19, 1918, gave a discharge of 368 second-feet.

REGULATION.[4]—The following dams and reservoirs are used to regulate the flow in Red Cedar River. Owing to operation of these reservoirs the flow at station is not natural.

Dam.	Location.	Approximate capacity (millions of cubic feet).
Long Lake	Sec. 24, T. 37 N., R. 11 W.	1,000
Cedar Lake	Sec. 21, T. 36 N., R. 10 W.	965
Birch Lake	Sec. 25, T. 37 N., R. 10 W.	1,174
Bear Lake	Sec. 7, T. 36 N., R. 11 W.	280
Chetek Lake	Sec. 20, T. 33 N., R. 10 W.	998
		4,417

ACCURACY.—Stage-discharge relation nearly permanent, except as affected by ice, and possibly by grass from June to September. Rating curve well defined between 653 and 4,450 second-feet; curve extended and approximate only outside these limits. Gage read twice daily to quarter-tenths. 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 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. Open-water records good; winter records subject to error.

[4] From data on file in Engineering Department of Railroad Commission of Wisconsin.

Discharge measurements of Red Cedar River near Colfax, Wis., during the year ending Sept. 30, 1918.

[Made by T. G. Bedford.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 17[a]	2.17	522	Feb. 19[b]	2.83	368
Jan. 17[b]	3.09	490	May 14	1.45	660

[a] Made from bridge and ice, incomplete ice cover at control section.
[b] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Red Cedar River near Colfax, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	490	820	585				890	635	3,120	450	560	720
2	535	750	635				820	585	2,880	490	585	635
3	512	690	560				785	535	2,880	490	512	662
4	535	690	635				750	490	2,880	535	535	690
5	490	635	350				690	490	1,680	535	490	720
				520	505	770						
6	490	690					785	560	1,300	690	535	750
7	470	690					820	585	1,040	560	585	720
8	470	690					820	635	1,210	470	690	690
9	535	610					750	855	1,210	490	610	690
10	512	585					720	1,040	1,120	535	585	750
			455									
11	512	690					690	890	925	512	535	855
12	490	585					690	850	820	490	585	785
13	490	662					662	690	750	490	610	820
14	490	690					662	635	690	450	585	750
15	512	690					635	635	720	450	585	690
				510	460							
16	635	662				1,430	610	690	635	490	535	635
17	662	690					635	610	610	490	585	690
18	820	635					635	635	635	490	635	690
19	1,040	512					635	635	635	490	585	750
20	820	662					585	585	610	535	560	785
21	820	662					585	585	610	490	585	750
22	750	662				2,200	585	635	585	490	690	750
23	750	635				2,200	662	585	585	535	610	635
24	690	690	540			1,680	610	535	535	960	585	720
25	635	690			440	1,780	635	750	512	690	560	720
				535								
26	750	490				1,580	635	1,580	512	560	560	750
27	750	690				925	635	3,120	490	512	560	720
28	750	662				750	635	3,120	490	720	610	662
29	610	585			.....	820	690	1,980	490	585	635	560
30	690	535			.....	820	662	1,480	535	585	720	490
31	785	.....			.....	785	.....	1,780	.....	535	720	.....

NOTE.—Stage-discharge relation affected by ice Dec. 6 to Mar. 21.

Monthly discharge of Red Cedar River near Colfax, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 1,100 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,040	470	629	0.572	0.66
November	820	490	654	.595	.66
December	.....	.....	515	.468	.54
January	.....	.....	522	.475	.55
February	.....	.....	470	.427	.44
March	.....	.....	1,190	1.08	1.24
April	890	585	687	.625	.70
May	3,120	490	949	.863	.99
June	3,120	490	1,060	.964	1.08
July	960	450	542	.493	.57
August	720	490	591	.537	.62
September	855	490	708	.644	.72
The year	3,120	.....	711	.646	8.77

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, 4½ miles above crossing of Chicago, St. Paul, Minneapolis & Omaha Railway.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 1, 1909, to September 30, 1918.

GAGE.—Staff gage fastened to bridge pier; read by John G. Wood.

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 not subject to overflow.

EXTREMES OF STAGE.—Maximum stage recorded during year, 5.15 feet March 19; minimum stage, 1.2 feet, 12 noon October 21.

1909–1918: Maximum stage recorded, 6.1 feet April 1–3, 1916; minimum stage recorded 0.0 foot at 5 p. m. March 11, 1917. Minimum stages are caused by closing gates and wheels in dam above station.

REGULATION.—The operation of storage reservoirs in the headwaters of the river (see "Regulation" in station description for Red Cedar River at Colfax, Wis.), together with storage at power plant above gaging station, regulate the flow.

ACCURACY.—No measurements have been made, but stage-discharge relation believed permanent. Gage read twice daily to half-tenths. Considerable diurnal fluctuation is observed, so that mean daily gage heights does not represent the average stage.

COOPERATION.—Gage-height record furnished by Wisconsin & Minnesota Light & Power Co.

Daily gage height, in feet, of Red Cedar River at Cedar Falls, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.4	2.6	2.7	2.4	2.8	2.5	3.3	2.65	4.65	2.55	2.6	2.35
2	2.55	2.55	1.55	3.1	2.7	2.35	3.1	2.6	4.85	2.6	2.6	1.4
3	2.5	2.65	2.65	3.65	1.4	1.4	3.0	2.6	4.75	2.05	2.35	2.55
4	2.6	1.55	2.65	3.65	2.6	2.45	3.2	2.6	4.5	1.4	1.75	2.6
5	2.5	2.6	2.5	3.35	2.75	3.4	3.15	1.9	4.3	2.45	2.15	2.6
6	2.45	2.55	2.65	1.6	2.8	3.65	3.15	2.5	3.95	2.5	2.55	2.6
7	2.05	2.6	2.45	2.35	2.7	3.7	3.0	2.6	3.85	1.4	2.65	2.65
8	2.6	2.6	2.55	2.3	2.9	3.6	3.1	2.75	3.95	2.55	2.6	2.0
9	2.55	2.55	1.7	2.4	2.7	3.6	3.1	3.2	3.75	2.6	3.35	3.05
10	2.65	2.65	2.45	3.1	1.4	1.9	3.2	3.55	3.8	2.45	2.55	2.55
11	2.65	2.0	2.45	3.5	2.55	2.6	3.25	2.9	3.7	2.55	2.35	2.45
12	2.95	2.6	2.5	2.65	2.9	3.65	3.15	2.5	3.55	2.15	2.65	2.6
13	2.55	2.8	2.65	2.25	2.65	3.5	3.15	2.65	3.55	2.45	2.55	2.45
14	1.8	2.55	2.7	3.05	2.6	3.55	2.9	2.55	3.7	2.25	2.5	2.5
15	2.55	2.6	2.6	2.75	2.7	2.7	3.3	2.5	3.75	2.4	2.6	1.9
16	2.6	3.25	2.25	2.65	2.75	2.65	3.65	2.8	2.0	2.75	2.65	2.7
17	2.5	3.25	2.65	2.55	1.4	1.9	3.0	2.6	2.85	2.45	2.6	2.55
18	2.65	1.85	2.65	3.05	2.7	4.15	2.85	2.65	2.75	2.5	1.4	3.15
19	2.55	2.6	2.8	3.45	2.7	5.15	2.85	1.95	2.7	2.4	2.6	2.6
20	2.4	2.65	2.7	2.2	2.6	5.4	2.7	2.6	2.8	2.45	2.4	2.6
21	1.55	2.55	2.65	2.15	2.6	5.2	1.8	2.6	2.8	1.9	2.65	2.45
22	2.6	2.65	2.85	2.55	2.5	4.9	2.85	2.8	2.55	2.35	2.35	1.4
23	2.6	2.75	1.9	2.9	2.35	4.6	2.75	2.95	2.05	2.45	2.4	2.6
24	2.55	2.65	2.5	2.9	1.4	3.4	2.65	3.25	2.65	2.25	2.45	2.6
25	2.6	2.6	2.0	2.95	2.6	3.55	2.65	2.6	2.55	2.6	1.8	2.35
26	2.45	2.8	3.45	2.8	2.5	3.65	2.75	3.05	2.45	2.55	2.45	2.55
27	2.45	2.65	3.1	1.4	2.6	3.5	2.55	4.35	2.6	2.45	3.7	2.45
28	1.85	2.6	3.2	2.5	2.35	3.3	1.9	4.6	2.3	1.95	2.55	2.55
29	2.6	2.05	3.25	2.85	.....	3.25	2.65	4.6	1.85	2.8	2.7	1.4
30	2.55	3.05	1.9	2.7	.....	3.05	2.75	4.45	1.4	2.6	2.8	2.6
31	2.65	.....	2.6	2.7	.....	2.8	.....	4.25	.....	2.55	2.4	.....

RED CEDAR RIVER AT MENOMONIE, WIS.

LOCATION.—In sec. 21, T. 28 N., R. 13 W., 900 feet below power house of Wisconsin & Minnesota Light & Power Co., Menomonie, Dunn County, and 13 miles above confluence of Red Cedar and Chippewa rivers. Wilson Creek discharges from right into service reservoir, just above station.

DRAINAGE AREA.—1,810 square miles (measured on map issued by Wisconsin Geological and 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, 1918.

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

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, approximately 6.05 feet March 20 (discharge, 7.570 second-feet); minimum stage, 1.65 feet at midnight July 22 (discharge, about 220 second-feet).

1907–8 and 1913–1918: Maximum discharge, 12.700 second-feet March 31 and April 1, 1916; minimum discharge, 100 second-feet November 9, 1907.

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

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

ACCURACY.—Stage-discharge relation changed during high water of April, 1916, but has been fairly permanent since with ordinary conditions of flow. Rating curve used well defined between 610 and 1,910 second-feet, and between 3,910 and 9,220 second-feet. Curve extended outside these limits and approximate only. Water-stage recorder gave satisfactory results except for brief periods. Daily discharge records October 1 to September 30, except for brief periods, obtained with Fuller discharge integrator. Records good except for periods when gage was not in operation, for which they are only approximate. Ice does not affect the stage-discharge relation at this station, due to relatively warm water coming from service reservoir.

The following discharge measurement was made by T. G. Bedford:

Gage height, 2.55 feet; discharge, 933 second-feet May 11, 1918.

Daily discharge, in second-feet, of Red Cedar River at Menomonie, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	695	1,030	1,170	635	1,100	845	1,260	1,110	2,400	460	975	1,100
2	930	1,010	750	1,080	930	890	1,250	640	3,870	690	1,000	770
3	980	1,040	820	1,140	550	900	1,030	870	4,000	550	900	735
4	995	700	1,020	1,210	630	1,000	1,130	835	3,090	470	550	970
5	1,160	770	940	990	1,010	1,390	1,020	490	2,080	535	695	1,120
6	935	935	935	535	1,160	2,150	1,000	670	1,690	575	640	995
7	812	970	900	510	950	1,730	685	820	1,500	480	840	990
8	920	1,090	790	560	1,160	1,760	1,180	820	1,580	565	780	855
9	1,120	1,090	500	620	1,120	1,580	1,160	925	1,240	630	980	585
10	1,020	1,040	640	840	530	1,160	1,040	1,050	1,810	625	1,070	850
11	1,190	615	940	820	775	1,760	1,010	770	1,560	740	760	1,050
12	1,120	715	875	1,220	965	1,020	1,090	640	1,470	735	945	870
13	1,040	1,000	865	690	1,110	1,780	950	1,010	1,220	500	1,030	825
14	670	835	825	870	970	1,730	515	1,160	1,170	455	830	820
15	925	935	915	1,010	1,120	1,370	1,320	880	1,160	600	905	505
16	1,010	1,120	600	1,060	1,160	985	1,330	905	1,110	705	845	850
17	1,040	1,420	730	920	610	900	1,410	885	872	770	710	880
18	975	815	1,070	1,030	800	2,320	1,160	905	1,330	705	440	1,020
19	1,020	720	1,030	1,140	1,080	4,600	650	630	1,260	700	565	1,240
20	805	880	1,170	1,080	1,080	6,970	865	775	1,220	760	620	1,290
21	500	885	1,180	1,020	1,100	5,950	540	1,000	1,080	605	715	1,180
22	775	935	1,090	940	840	4,890	760	1,040	1,060	1,210	775	670
23	905	930	820	870	855	3,120	890	1,120	835	785	925	870
24	1,010	940	935	1,120	470	2,700	880	955	895	730	755	1,030
25	910	915	695	1,120	715	1,720	740	830	1,050	935	620	950
26	1,120	1,090	725	1,120	840	1,560	745	890	820	635	615	1,070
27	985	1,070	1,070	490	1,060	1,570	770	3,100	930	960	750	1,030
28	875	945	1,030	520	875	1,390	450	3,420	830	735	870	1,010
29	975	785	1,110	930	.....	1,290	935	2,980	530	825	1,040	785
30	925	1,100	835	1,160	.....	1,240	1,160	2,280	425	1,090	1,090	605
31	1,030	.....	725	1,160	.....	850	.....	2,490	.....	1,040	1,480	.....

Monthly discharge of Red Cedar River at Menomonie, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 1,810 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,190	500	947	0.523	0.60
November	1,420	615	944	.522	.58
December	1,180	500	893	.493	.57
January	1,220	490	916	.506	.58
February	1,160	470	913	.504	.52
March	6,970	845	2,040	1.13	1.30
April	1,410	450	964	.533	.59
May	3,420	490	1,190	.657	.76
June	4,000	425	1,470	.812	.91
July	1,210	455	703	.388	.45
August	1,480	440	830	.459	.53
September	1,290	505	917	.507	.57
The year	6,970	425	1,060	.586	7.96

TREMPEALEAU RIVER AT DODGE, WIS.

LOCATION.—In sec. 11, T. 19 N., R. 10 W., at highway bridge in Dodge, Trempealeau County, 9 miles above mouth of river.

DRAINAGE AREA.—633 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 13, 1913, to September 30, 1918.

GAGE.—Chain gage attached to downstream side of bridge; read by F. E. Shappee and M. W. MacDonald.

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

CHANNEL AND CONTROL.—Bed composed of sand; likely to shift. Banks of medium height and may be overflowed during extreme floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.85 feet at 5 p. m. March 20 (discharge, roughly approximate, 3,360 second-feet); minimum discharge, about 105 second-feet, February 4 and 5.

1914–1917: Maximum stage recorded, 8.35 feet June 9, 1914 (discharge, 3,340 second-feet); minimum discharge, about 105 second-feet, February 4–5, 1918.

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

REGULATION.—No power plants above station have sufficient capacity to affect natural flow of river.

ACCURACY.—Stage-discharge relation not permanent. A rating curve, fairly well defined between 196 and 3,080 second-feet, was used October 1 to March 10, shifting-channel method used March 11 to September 30. Gage read twice daily to quarter-tenths, except on Sundays, April 14 to September 30. Daily discharge ascertained by applying mean daily gage height to rating table, except during period when 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, and except for days when no reading of gage was taken, for which the discharge was interpolated. Records fair.

Discharge measurements of Trempealeau River at Dodge, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 8[a]	R. B. Kilgore	1.52	206	Apr. 1	T. G. Bedford	3.03	416
Jan. 14[b]	T. G. Bedford	2.38	146	Sept. 4	W. G. Hoyt	1.37	211
Feb. 15[b]	do	3.52	249				

[a] Made by wading 200 feet downstream from gage.
[b] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Trempealeau River at Dodge, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	196	309	257	165	115	980	420	272	747	272	224	197
2	220	309	257	175	110	980	408	248	682	296	236	213
3	220	309	220	170	110	980	333	224	616	320	260	224
4	220	296	196	165	105	1,040	358	202	485	358	248	224
5	220	283	190	170	105	1,090	358	202	433	308	236	213
6	220	283	180	170	110	1,060	333	202	420	272	224	191
7	220	270	175	175	110	875	358	202	396	266	236	181
8	186	257	170	175	115	695	358	136	370	260	248	192
9	220	283	160	175	115	615	358	383	1,050	248	260	202
10	232	283	155	165	120	565	333	433	1,730	236	248	224
11	270	270	145	160	125	537	320	511	2,980	224	254	236
12	296	244	135	155	130	603	296	447	2,400	213	260	248
13	296	270	155	150	140	747	296	383	1,580	202	272	248
14	283	270	170	145	190	890	284	308	864	213	296	213
15	257	257	170	145	250	982	272	308	616	224	272	213
16	270	257	170	140	260	942	296	260	682	272	248	213
17	270	257	170	145	285	903	272	284	747	272	236	225
18	296	244	170	145	310	1,160	296	320	459	248	230	248
19	309	244	170	140	335	2,660	320	296	433	224	224	248
20	309	270	215	135	360	3,280	333	272	408	202	202	236
21	296	257	205	135	385	2,910	308	296	383	208	236	213
22	270	244	205	135	410	2,260	284	320	358	213	272	213
23	309	244	205	135	435	1,520	260	446	352	236	284	213
24	296	244	165	135	460	1,090	260	396	346	202	284	213
25	309	244	165	130	510	773	236	420	320	224	266	202
26	426	220	155	130	615	642	236	800	320	213	248	191
27	426	244	150	130	825	616	213	1,180	296	202	224	181
28	426	244	155	125	1,010	537	236	1,120	272	237	224	181
29	374	220	155	125	.....	511	260	1,010	260	272	202	176
30	348	232	150	120	.....	459	296	773	266	248	191	171
31	322	.....	150	120	.....	433	.....	642	.....	236	181	.....

NOTE.—Stage-discharge relation affected by ice Dec. 5 to Mar. 10. Gage not read Apr. 14, 21, 28, May 5, 12, 19, 26, June 2, 9, 16, 23, 30, July 6, 13, 21, 28, Aug. 4, 11, 18, 25, Sept. 1, 8, 15, 22, 29; discharge interpolated.

Monthly discharge of Trempealeau River at Dodge, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 633 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	426	186	284	0.449	0.52
November	309	220	262	.414	.46
December	257	135	177	.280	.32
January	175	120	148	.234	.27
February	1,010	105	291	.460	.48
March	3,280	433	1,080	1.71	1.97
April	420	213	306	.483	.54
May	1,180	136	429	.678	.78
June	2,980	260	709	1.12	1.25
July	358	202	246	.389	.45
August	296	181	243	.384	.44
September	248	171	211	.333	.37
The year	3,280	105	366	.578	7.85

BLACK RIVER AT NEILLSVILLE, WIS.

LOCATION.—In sec. 15, T. 24 N., R. 2 W., at lower highway bridge in Neillsville, Clark County. O'Neil 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 7, 1905, to March 31, 1909; December 11, 1913, to September 30, 1918.

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 in vicinity of bridge.

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; will not be overflowed at gage section.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.45 feet at 5 p. m. May 26 (discharge, 9,060 second-feet). An estimate of 5 second-feet for minimum discharge may be considerably in error, but discharge must have been low, as shown by flow of 7 second-feet measured January 15, 1918. Station records of Hatfield power station, Wisconsin Railway, Light & Power Co., show that with gates closed and no generation, pond did not raise until February 28.

1905–1909 and 1913–1918: Maximum stage recorded, 19.8 feet June 6, 1905 (discharge, approximately 29,400 second-feet). It is probable that the maximum discharge, which occurred October 6, 1911, exceeded 29,000 second-feet, although data are not available regarding the stage at the gage section during this flood; minimum stage recorded during open-water periods, 2.4 feet October 9, 1905 (discharge, approximately 20 second-feet); an estimated minimum discharge of 5 second-feet during frozen period, February, 1918.

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

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined 48 to 14,300 second-feet, fairly well defined below 48 second-feet, and extended above 14,300 second-feet. Gage read twice daily to quarter-tenths. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods in which stage-discharge relation was affected

by ice, for which it was obtained by applying to rating table gage heights corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records good, except at extremely low stages, for which they are fair; winter records fair.

The following discharge measurement was made through a complete ice cover by T. G. Bedford:

January 15, 1918: gage height, 3.66 feet; discharge, 7.4 second-feet.

Daily discharge, in second-feet, of Black River at Neillsville, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	87	334	116				1,220	1,290	6,280	49	57	97
2	83	296	122				1,080	1,010	5,640	42	57	94
3	83	244	86				950	770	3,680	40	49	84
4	78	244	108				770	585	2,560	44	43	71
5	69	228	118				660	485	1,720	60	38	63
6	86	244	110				560	416	1,800	52	37	76
7	69	260	84				710	374	1,800	47	42	57
8	65	244	48			355	1,080	395	1,570	54	58	40
9	70	241	38				890	890	2,560	49	73	41
10	84	201					710	3,260	1,430	44	69	42
11	90	192					585	2,360	950	43	167	53
12	112	165					1,150	1,720	610	43	201	53
13	116	100					438	1,220	460	41	176	43
14	147	130					374	830	334	43	228	43
15	157	139			5		374	635	260	45	187	56
16	142	147		10			395	485	116	57	130	40
17	144	132					485	416	65	49	98	46
18	170	122					710	374	97	45	73	46
19	296	118					1,290	395	100	43	58	47
20	560	118					1,150	460	73	44	57	90
21	485	125	25			1,930	1,010	460	78	42	53	198
22	416	110					890	1,430	81	42	64	225
23	395	104					770	1,500	76	38	94	144
24	296	102					660	1,150	76	42	87	144
25	257	87					510	1,570	71	40	213	165
26	374	108					416	7,620	48	37	173	100
27	560	110				1,720	374	7,620	45	37	122	92
28	770	94				2,160	560	7,280	42	41	118	84
29	710	116				1,430	1,220	6,120	41	37	90	87
30	510	90			.....	1,220	1,570	3,790	132	38	83	76
31	354	.....			.....	1,150	.....	4,290	.....	45	83	.....

NOTE.—Stage-discharge relation affected by ice Nov. 23–28, Dec. 6 to Apr. 1.

Monthly discharge of Black River at Neillsville, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 774 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	770	65	253	0.327	0.38
November	334	87	165	.213	.24
December	122	.....	44	.057	.07
January	.....	.....	10	.013	.01
February	.....	.....	5	.006	.01
March	2,160	.....	1,100	1.42	1.64
April	1,570	374	785	1.01	1.13
May	7,620	374	1,970	2.55	2.94
June	6,280	41	1,090	1.41	1.57
July	60	37	44	.057	.07
August	228	37	99	.128	.15
September	225	40	83	.107	.12
The year	7,620	40	475	.614	8.33

LA CROSSE RIVER NEAR WEST SALEM, WIS.

LOCATION.—In sec. 32, T. 17 N., R. 6 W., La Crosse County, at highway bridge 2 miles west of West Salem 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, 1918.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.8 feet, at 7 a. m., March 14 (discharge, 2,480 second-feet); minimum discharge about 125 second-feet, December 30.

1913–1918: Maximum stage recorded, 7.4 feet at 5 p. m. March 24, 1917 (discharge, approximately 2,850 second-feet); minimum discharge, about 130 second-feet November 17, 1914, minimum discharge during frozen period, about 125 second-feet, December 30, 1917.

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 the operation of power plants, especially the Neshonock dam a few miles above station.

ACCURACY.—Stage-discharge relation permanent, except as affected by ice. Rating curve well defined between 181 and 2,300 second-feet. Gage read twice daily to quarter-tenths. Daily discharge ascertained by applying mean daily gage height to rating table except for periods in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage heights corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records good, except for low stages, for which they are fair; winter records fair.

Discharge measurements of La Crosse River near West Salem, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 7[a]	R. B. Kilgore	1.38	210	Mar. 30	T. G. Bedford	1.72	334
Jan. 13[b]	T. G. Bedford	1.58	152	Sept. 5[c]	W. G. Hoyt	1.37	196
Feb. 14[b]	....do	3.54	363				

[a] Made by wading, 1,500 feet downstream from gage.
[b] Complete ice cover at control and measuring section.
[c] Made by wading, 500 feet downstream from gage.

Daily discharge, in second-feet, of La Crosse River near West Salem, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	241	308	248	155	245	1,030	328	308	573	394	268	226
2	230	308	234	165	235	1,060	350	268	506	371	268	230
3	248	308	244	160	155	1,120	350	268	416	371	268	244
4	248	288	248	180	235	1,150	328	248	394	371	241	268
5	234	328	248	175	240	1,060	308	248	350	506	288	230
6	216	328	250	150	245	945	328	248	371	616	268	241
7	209	308	245	215	245	750	350	268	328	484	268	226
8	241	248	240	250	235	640	371	308	308	350	506	248
9	248	196	240	250	205	550	328	308	506	328	638	219
10	244	268	235	215	170	550	308	573	807	308	528	248
11	248	268	230	225	210	528	308	715	1,060	308	328	308
12	288	268	225	225	250	889	308	678	835	288	350	308
13	288	288	220	175	330	1,750	288	416	506	268	328	288
14	244	268	215	245	365	2,240	268	328	416	268	288	248
15	268	268	210	235	415	1,750	288	328	371	308	288	244
16	248	268	160	225	370	889	288	328	350	308	288	230
17	268	268	205	235	330	1,310	308	308	308	308	328	244
18	308	244	190	210	290	2,300	328	394	308	268	288	268
19	268	268	195	185	270	2,060	328	416	328	288	288	288
20	248	268	250	155	250	1,350	308	658	308	288	268	288
21	244	268	240	205	270	1,090	308	551	308	268	248	288
22	248	268	250	210	290	889	328	573	308	268	248	248
23	248	268	185	235	290	715	328	551	288	288	288	226
24	288	268	240	235	460	551	308	438	288	308	248	241
25	328	248	285	240	805	461	288	371	416	328	241	226
26	328	268	150	225	1,000	416	288	328	484	328	248	212
27	371	268	145	140	1,190	394	268	371	350	308	230	244
28	328	268	140	210	1,120	350	268	528	328	288	226	230
29	371	248	150	250	.....	350	288	551	350	328	244	216
30	328	248	125	255	.....	350	328	461	328	308	248	234
31	308	.....	145	245	.....	350	.....	416	.....	288	244	.....

NOTE.—Stage-discharge relation affected by ice Dec. 6 to Mar. 10.

Monthly discharge of La Crosse River near West Salem, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 412 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	371	209	272	0.660	0.76
November	328	196	273	.663	.74
December	250	125	209	.507	.58
January	255	140	209	.507	.58
February	1,190	155	383	.930	.97
March	2,300	350	962	2.33	2.69
April	371	268	312	.757	.84
May	715	248	411	.998	1.15
June	1,060	288	427	1.04	1.16
July	616	268	332	.806	.93
August	638	226	300	.728	.84
September	308	212	249	.604	.67
The year	2,300	125	362	.879	11.91

WISCONSIN RIVER AT WHIRLPOOL RAPIDS, NEAR RHINELANDER, WIS.

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

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, 1918; December 1, 1905, to September 30, 1915, records were collected at a station about 3 miles upstream.

GAGE.—Stevens water-stage recorder, on right bank in wooden shelter, attended by C. W. Jewell.

DISCHARGE MEASUREMENTS.—Made from cable about 150 feet upstream from 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, 4.2 feet at 11 p. m. June 1 (discharge, 3,030 second-feet); minimum stage recorded 0.65 feet at 8 p. m. July 7 (discharge, 165 second-feet).

1905-1918: Maximum stage recorded, 5.61 feet at 10 p. m. April 22, 1916 (discharge, 5,250 second-feet); minimum discharge recorded, at old station, 0.0 foot during August and September, 1907, and June, 1908. The minimum flows are caused almost entirely by regulation; at the location of new station the discharge will never be zero. Minimum discharge at new location 1915-1918, 0.65 foot 8 p. m. July 7, 1918 (discharge, 165 second-feet).

REGULATION.—Above the station are 14 reservoirs[5] which are operated by the Wisconsin Valley Improvement Co. for the purpose of regulating the flow in Wisconsin River. The aggregate capacity of these reservoirs is 2.8 billion cubic feet during the summer and 3.6 billion cubic feet during the winter. Owing to the operation of these various storage reservoirs and the service reservoirs of three power plants on the river above, the flow at the station is not natural.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 212 and 5,410 second-feet. Recording gage not in operation December 10 to March 28 and September 10-15. Daily discharge ascertained by use of discharge integrator except during periods when stage-discharge relation was affected by ice or recording gage was not in operation, for which it was obtained from gage readings and discharge measurements at Hat Rapids, weather records, and comparison of flow of Tomahawk River near Bradley and Wisconsin River at Merrill. Open water records excellent, except for periods when recording gage was not in operation, for which they are fair; winter records possibly poor.

Discharge measurements of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 14[a]	L. L. Smith.....	[b]2.76	476	June 10	T. G. Bedford.....	3.53	2,110
Feb. 18[a]	.....do.....	[b]3.60	808				

[a] Measurement made at highway bridge below Hat Rapids power plant; nearly complete ice cover.
[b] Chain gage reading at Hat Rapids Bridge.

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

Daily discharge, in second-feet, of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	550	604	690				1,040	961	2,650	652	794	810
2	990	570	488				1,060	915	2,680	832	518	500
3	820	571	649				1,050	916	2,640	770	458	1,030
4	690	766	773				922	923	2,520	292	328	1,140
5	660	601	777				846	706	2,420	376	622	1,090
6	750	740	641				720	758	2,360	916	948	1,240
7	520	749	607				624	962	2,340	530	1,100	489
8	620	669	922				903	912	2,300	876	1,450	426
9	740	760	807				1,080	1,150	1,900	1,160	1,520	724
10	570	680					904	1,200	2,120	1,060	1,820	
11	540	566					800	1,240	1,740	1,020	1,120	1,000
12	590	604					754	887	1,580	977	1,880	
13	834	804					679	1,000	1,350	868	1,740	
14	631	788					426	1,160	1,340	522	1,680	
15	830	738			720	1,020	542	1,080	1,300	628	1,460	420
16	718	759		650			720	1,130	812	878	1,270	782
17	747	842					756	1,110	760	729	1,140	899
18	762	723					822	1,260	990	392	729	1,080
19	914	653					982	785	892	392	765	1,140
20	1,040	691	750				1,070	980	901	588	986	1,080
21	712	712					697	1,280	898	386	828	1,240
22	746	734					985	1,230	852	546	1,120	477
23	1,080	755					1,130	1,280	526	810	1,320	800
24	801	727					924	1,280	590	769	1,540	791
25	812	380					828	1,460	795	796	998	866
26	627	575					770	1,380	814	883	1,220	1,020
27	811	633					747	1,920	810	860	1,340	922
28	611	612					584	2,360	800	450	1,320	940
29	741	510			.....	1,420	892	2,300	792	653	1,280	520
30	726	622			.....	1,260	1,220	2,310	526	844	1,280	666
31	670	.....			.....	1,190	.....	2,500	.....	800	1,220	.....

NOTE.—Stage-discharge relation affected by ice Dec. 10 to Mar. 28. Recording gage not in operation Dec. 10 to Mar. 28 and Sept. 10–15; discharge estimated by comparison of flow of Tomahawk River near Bradley, and Wisconsin River at Merrill, and from gage heights at Hat Rapids, and two discharge measurements made at Hat Rapids.

Monthly discharge of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis. for the year ending Sept. 30, 1918.

[Drainage area, 1,160 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,080	520	737	0.635	0.73
November	842	380	671	.578	.64
December	.....	.....	737	.635	.73
January	.....	.....	650	.560	.65
February	.....	.....	720	.621	.65
March	.....	.....	1,050	.905	1.04
April	1,220	426	849	.732	.82
May	2,500	706	1,270	1.09	1.26
June	2,680	526	1,430	1.23	1.37
July	1,160	292	718	.619	.71
August	1,880	328	1,150	.991	1.14
September	1,240	.....	870	.750	.84
The year	.....	.....	906	.781	10.58

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, coming in from left.

DRAINAGE AREA.—2,630 square miles.

RECORDS AVAILABLE.—November 17, 1902, to September 30, 1918.

GAGE.—Stevens water-stage recorder installed September 11, 1914; November 17, 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 June 17, 1903, questionable.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.7 feet at 9 a. m. May 28 (discharge, 13,400 second-feet); minimum stage recorded, 3.0 feet at 6 a. m. July 23 (discharge, approximately 450 second-feet).

1912–1918: Maximum stage recorded, approximately 17.5 feet at 5 a. m. July 24, 1912 (discharge, 45,000 second-feet). During the preceding 24 hours 11.25 inches of rain fell in the vicinity of 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. Minimum stage recorded for the period, 2.7 feet, July 7, 1910 (discharge, approximately 389 second-feet).

REGULATION.—Above the gaging station are 17 reservoirs,[6] which are operated by the Wisconsin Valley Improvement Co. for the purpose of regulating the flow in the Wisconsin River. The aggregate capacity of these reservoirs is about 6¼ billion cubic feet. In addition to the above reservoirs there are on Wisconsin and Tomahawk rivers above the station eight dams operated for power.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve fairly well defined between 1,600 and 19,400 second-feet. Water-stage recorder gave satisfactory results throughout the year. Daily discharge determined by means of Fuller discharge integrator. Open-water records good; winter records fair.

Discharge measurements of Wisconsin River at Merrill, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Jan. 11[a]	L. L. Smith	4.76	1,300
Feb. 15[a]	....do	5.21	1,470
June 12	T. G. Bedford	5.27	2,290

[a] Made from ice and bridge at bridge section; incomplete ice cover at control.

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

Daily discharge, in second-feet, of Wisconsin River at Merrill, Wis., for the year ending Sept. 30, 1918.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,680	2,040	1,360	1,420	1,400	1,630	4,780	3,900	11,200	1,640	1,580	2,740
2	1,450	1,720	1,460	1,300	1,660	1,640	4,610	3,080	11,600	1,710	1,540	2,380
3	1,470	1,800	1,220	1,350	1,490	1,640	3,970	2,960	10,200	1,940	1,810	2,400
4	1,830	1,660	1,150	1,340	1,420	1,730	3,800	2,520	8,120	1,500	1,420	2,010
5	1,540	1,410	1,470	1,280	1,580	1,370	3,400	2,580	6,750	1,920	1,190	2,710
6	1,540	1,970	1,340	1,500	1,680	1,540	3,320	2,260	6,480	2,060	1,500	2,360
7	1,770	1,930	1,470	1,250	1,650	1,420	3,760	2,650	5,880	1,660	2,220	2,480
8	1,580	1,880	1,410	1,340	1,540	1,400	2,900	2,660	5,380	1,540	3,980	2,170
9	1,640	1,910	1,240	1,300	1,560	1,400	3,140	3,660	4,920	1,840	4,520	1,870
10	1,540	2,050	1,040	1,280	1,510	1,420	3,010	4,290	3,830	1,900	4,780	2,070
11	1,620	1,710	1,320	1,320	1,400	1,450	2,740	4,910	4,240	1,900	4,600	2,320
12	1,830	1,320	1,320	1,350	1,360	1,330	2,540	5,540	3,200	1,680	3,170	2,640
13	1,700	1,580	1,170	1,390	1,460	1,300	2,540	3,570	2,860	1,800	3,940	2,390
14	1,750	1,740	1,100	1,280	1,480	1,340	2,170	3,680	2,490	1,600	3,300	2,500
15	1,220	1,960	1,420	1,320	1,480	1,280	1,860	3,000	2,300	1,840	2,780	2,730
16	1,900	1,710	1,520	1,500	1,480	1,280	2,180	2,900	2,360	1,540	2,700	1,580
17	2,000	1,900	1,630	1,360	1,330	1,340	2,600	3,120	1,720	1,570	2,340	2,490
18	2,480	1,720	1,700	1,250	1,290	1,660	3,010	3,370	1,600	1,520	2,200	2,560
19	2,400	1,280	1,810	1,140	1,410	2,130	2,880	3,240	1,980	1,520	1,990	2,610
20	3,100	1,670	1,460	1,200	1,610	3,240	2,890	2,760	1,600	1,430	1,790	2,570
21	2,400	1,740	1,200	1,270	1,520	3,880	2,600	3,030	1,730	1,300	1,790	2,540
22	2,150	1,920	1,200	1,340	1,520	4,830	2,220	3,940	1,660	655	2,530	2,500
23	2,610	1,600	1,090	1,260	1,580	5,080	2,720	3,840	1,730	1,480	3,930	1,820
24	2,080	1,740	1,180	1,220	1,590	5,320	2,420	3,750	1,180	1,360	4,520	1,920
25	2,120	1,540	1,280	1,100	1,640	5,000	2,330	4,510	1,460	1,360	4,460	1,960
26	2,360	1,220	1,540	1,200	1,660	5,620	2,190	7,270	1,590	1,460	3,020	1,980
27	2,300	1,560	1,420	1,260	1,600	5,360	2,160	10,500	1,680	1,450	2,610	1,860
28	2,330	1,550	1,120	1,240	1,610	5,260	2,470	12,900	1,580	1,790	2,780	1,840
29	1,660	1,560	930	1,480	.....	5,180	2,640	11,400	1,600	1,820	2,680	1,900
30	1,810	1,450	1,250	1,440	.....	4,940	4,020	9,880	1,870	1,640	2,860	1,690
31	1,780	.....	1,280	1,580	.....	4,910	.....	10,100	.....	1,800	2,900	.....

NOTE.—Stage-discharge relation affected by ice Dec. 9 to Mar. 24. Discharge for May 10, 11, and Sept. 20 and 21 based on gage heights for less than 24-hour period.

Monthly discharge of Wisconsin River at Merrill, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 2,630 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,100	1,220	1,920	0.730	0.84
November	2,050	1,220	1,690	.643	.72
December	1,810	930	1,330	.506	.58
January	1,580	1,100	1,320	.502	.58
February	1,680	1,290	1,520	.578	.60
March	5,620	1,280	2,800	1.06	1.22
April	4,780	1,860	2,930	1.11	1.24
May	12,900	2,260	4,770	1.81	2.09
June	11,600	1,180	3,830	1.46	1.63
July	2,060	655	1,620	.616	.71
August	4,780	1,190	2,820	1.07	1.23
September	2,740	1,580	2,250	.856	.96
The year	12,900	655	2,400	.913	12.40

WISCONSIN RIVER AT 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.

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, 1918.

GAGE.—Stevens water-stage recorder installed July 18, 1916, in wooden shelter on right bank; prior to that date Gurley water-stage recorder at same location. Gage attended by Henry Mans.

DISCHARGE MEASUREMENTS.—Made from cable a short distance above gage house.

CHANNEL AND CONTROL.—Bed composed of gravel; clean; practically permanent. Banks high and will be rarely overflowed.

EXTREMES OF DISCHARGE.—Maximum stage during year, 12.22 feet at 2 a. m. May 30 (discharge, 34,000 second-feet); minimum stage, effective gage height, 0.82 foot 12 noon July 23, (discharge, 1,060 second-feet).

1914–1918: Maximum stage, approximately 15.3 feet during the flood of June 6 to 9, 1914, as determined by levels run to high-water marks after water had receded (discharge, approximately 54,600 second-feet); minimum discharge recorded 0.45 foot at 11 a. m. October 7, 1915 (discharge, 595 second-feet); minimum flow is due to regulation.

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

REGULATION.—No storage reservoirs discharging into the 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 practically permanent, except as affected by ice. Rating curve well defined between 1,160 and 52,100 second-feet. Operation of recording gage satisfactory except June 20–22. Daily discharge ascertained by use of discharge integrator. Open-water records excellent; winter records fair.

Discharge measurements of Wisconsin River at Nekoosa, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Jan. 8[a]	L. L. Smith	2.78	1,410
Feb. 12[a]	do	3.25	1,540
June 17	T. G. Bedford	3.00	4,580

[a] Complete ice cover at gage and measuring section.

Daily discharge, in second-feet, of Wisconsin River at Nekoosa, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,720	3,400	2,320	1,780	2,680	2,270	10,600	9,560	23,800	2,960	3,040	3,240
2	2,110	3,280	2,220	1,960	2,900	2,550	9,710	9,480	23,700	1,880	2,840	3,720
3	1,950	3,400	2,260	2,060	2,410	2,160	9,300	7,080	25,000	2,890	2,780	3,960
4	2,350	4,040	1,960	1,990	2,480	2,120	8,860	6,510	22,600	2,740	2,750	3,760
5	2,560	3,540	2,040	2,180	2,380	2,300	7,620	5,720	17,400	2,800	2,760	3,210
6	2,610	3,380	2,160	1,730	1,980	2,620	6,520	4,820	13,700	2,310	2,060	3,010
7	2,280	2,780	2,460	2,460	1,940	3,300	5,980	5,090	12,300	2,320	2,820	3,020
8	2,790	2,320	4,400	1,630	1,890	3,540	6,000	4,800	12,800	3,390	3,600	4,120
9	2,400	2,440	3,900	1,620	1,840	4,930	7,100	5,200	12,000	2,400	2,770	2,980
10	2,800	3,170	3,390	1,870	1,800	4,770	5,880	9,500	10,600	3,060	5,370	2,260
11	2,380	3,520	2,880	2,210	2,380	5,420	6,070	15,000	8,480	2,480	5,640	3,240
12	2,730	2,820	2,380	2,380	2,160	3,310	5,620	17,900	7,860	3,020	6,520	3,040
13	2,880	3,840	2,260	2,180	1,400	3,860	4,830	14,700	7,110	2,610	6,180	3,130
14	2,760	3,230	2,400	2,810	1,900	4,580	5,180	11,600	5,420	2,300	5,580	3,490
15	2,820	3,000	2,460	1,940	2,660	4,080	4,060	7,860	4,920	2,790	4,460	3,920
16	1,980	2,840	2,380	1,890	2,740	4,540	4,860	7,640	4,480	2,730	4,520	3,080
17	2,680	2,640	2,480	2,690	2,410	4,960	4,250	6,280	4,540	2,600	4,420	3,680
18	2,800	3,070	1,720	2,240	2,050	5,320	3,680	6,120	3,560	2,680	3,520	3,360
19	3,080	2,560	1,400	3,020	1,730	6,930	5,320	6,490	3,520	2,530	3,560	2,700
20	4,020	2,380	1,380	2,480	1,440	12,600	6,810	6,910	3,430	2,580	2,620	3,070
21	4,480	2,840	1,420	1,950	1,830	14,300	5,870	7,220	3,340	2,580	3,160	3,610
22	4,560	2,700	1,700	1,670	2,160	14,900	5,970	7,360	3,250	2,000	3,120	3,390
23	4,540	2,450	1,680	2,260	2,500	16,500	6,380	9,480	3,160	1,260	2,800	3,560
24	3,680	3,110	2,150	2,860	2,360	19,600	5,600	10,300	2,080	2,700	3,480	3,340
25	3,710	2,800	1,350	2,250	2,350	20,500	5,580	11,300	1,770	2,340	5,180	3,610
26	3,900	2,360	1,880	2,690	1,790	20,000	4,820	12,700	2,740	2,440	5,760	2,960
27	3,810	1,980	2,400	2,640	1,530	15,600	4,540	20,000	2,940	2,340	4,950	2,730
28	4,740	3,240	2,520	3,220	1,910	12,800	4,290	30,200	2,490	2,080	4,320	2,660
29	4,980	2,420	2,170	2,930	.....	11,200	5,180	33,200	2,510	2,540	3,840	2,560
30	5,400	2,400	2,340	1,720	.....	10,600	7,600	32,100	2,630	2,600	4,530	2,540
31	4,260	.....	2,660	2,160	.....	10,400	.....	26,800	.....	4,070	3,540	.....

NOTE.—Stage-discharge relation affected by ice Dec. 9 to Mar. 19. Gage not operating satisfactorily June 20–22; discharge interpolated.

Monthly discharge of Wisconsin River at Nekoosa, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 5,500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	5,400	1,950	3,250	0.591	0.68
November	4,540	1,980	2,970	.540	.60
December	4,400	1,350	2,290	.416	.48
January	3,220	1,620	2,240	.407	.47
February	2,900	1,400	2,130	.387	.40
March	20,500	2,120	8,150	1.48	1.71
April	10,600	3,680	6,140	1.12	1.25
May	33,200	4,800	11,900	2.16	2.49
June	25,000	1,770	8,470	1.54	1.72
July	4,070	1,260	2,580	.469	.54
August	6,520	2,060	3,950	.718	.83
September	4,120	2,260	3,230	.587	.65
The year	33,200	1,350	4,790	.871	11.82

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, 1918. 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 hand railing on upstream side of bridge; read by William Hessler. Elevation of zero of present gage approximately 12.62 feet above that of gage maintained December 20, 1902, to December 3, 1913, elevation of gage during period November, 1908, to December 3, 1913, as read and published by United States Weather Bureau was approximately 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, 8.04 feet at 5 p. m. June 4 (discharge, about 40,300 second-feet); minimum discharge, estimated 2,000 second-feet, February 11; water apparently held in service reservoir of Prairie du Sac dam.

1903 and 1914–1918: Maximum stage recorded, 22.70 feet September 23, 1903, corresponding to 10.1 feet for present gage datum (discharge, about 60,500 second-feet); minimum open-water stage recorded, 0.7 foot at 5 p. m. December 2, 1914, and July 24, 1915 (discharge, approximately 3,140 second-feet); estimated discharge of 2,000 second-feet, under frozen conditions, February 11, 1918; water apparently held in service reservoir of Prairie du Sac dam.

According to the records of the United States Weather Bureau [7] (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 possible changes in channel and datum of gage.

REGULATION.—Nearest power plant above station is at Prairie du Sac, about 40 miles distant; since the latter part of 1915 considerable diurnal fluctuation has been observed at the gage. Owing to regulation by storage in headwaters, the flow at this station is not natural.

[7] Daily river stages, pt. 10, p. 98.

ACCURACY.—Stage-discharge relation not permanent. Two rating curves used during 1918; the first, October 1 to March 23, is fairly well defined between 4,230 and 15,900 second-feet; poorly defined outside these limits; the second, March 24 to September 30, is fairly well defined between 4,500 and 13,700 second-feet; poorly defined outside these limits. Gage read twice a day to quarter-tenths. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage heights corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records good, except during extreme high and low stages, for which they are fair; winter records roughly approximate.

Discharge measurements of Wisconsin River at Muscoda, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 10[a]	Hoyt and Bedford	2.72	3,550	Apr 2	T. G. Bedford	4.73	17,300
Feb. 12[a]	Bedford and Schwada	2.80	2,870	Aug. 1	W. G. Hoyt	1.67	5,200

[a] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Wisconsin River at Muscoda, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	4,450	7,760	6,380	3,560	3,700	12,200	16,300	9,430	24,200	5,980	5,030	6,310
2	4,690	8,140	6,380	3,530	3,430	11,300	16,300	8,700	34,400	6,640	4,750	5,330
3	4,940	10,100	5,480	3,500	3,580	11,300	17,300	8,350	39,000	6,310	4,750	4,750
4	5,200	7,760	6,380	3,470	2,720	11,300	15,400	8,700	39,900	6,640	4,490	5,980
5	5,200	6,060	6,380	3,450	2,920	12,600	14,600	12,900	39,900	6,640	4,020	5,980
6	4,690	8,900	6,380	3,470	3,320	14,800	14,600	14,600	35,300	6,640	4,750	5,650
7	4,940	8,520	4,940	3,500	3,430	15,300	13,300	11,300	31,800	6,980	5,330	5,330
8	4,450	7,760	4,750	3,520	3,430	14,400	11,700	8,700	30,900	6,310	5,330	5,650
9	4,940	8,140	4,690	3,540	3,160	13,000	12,900	9,060	27,700	6,640	5,330	4,250
10	4,940	7,400	4,630	3,560	3,380	10,900	11,300	9,430	22,400	6,640	5,030	5,030
11	5,480	7,400	4,570	3,380	2,000	10,500	9,800	12,500	19,200	6,980	5,030	5,650
12	5,200	6,060	4,510	3,140	2,880	12,600	9,800	10,200	17,300	6,310	4,750	5,980
13	4,940	7,040	4,450	3,320	3,160	14,800	11,300	11,300	17,300	5,980	5,650	5,330
14	5,200	7,400	4,400	3,280	3,630	18,700	10,900	13,700	17,300	5,980	5,330	5,330
15	4,690	7,400	4,360	3,410	3,820	20,300	9,800	15,900	12,500	5,650	5,980	5,330
16	5,480	7,040	4,300	3,500	3,520	20,300	9,800	20,800	12,900	6,640	8,000	4,020
17	5,760	6,700	4,220	3,450	3,600	19,700	9,430	22,400	13,700	5,980	8,350	5,030
18	6,380	6,700	4,170	3,320	3,120	19,200	9,430	19,200	12,100	6,310	8,350	5,330
19	6,380	5,480	4,150	3,140	2,700	18,700	9,060	18,200	10,200	5,980	6,640	5,030
20	5,480	6,380	4,070	3,000	2,680	17,700	9,060	17,300	9,060	5,980	5,980	5,030
21	5,480	6,700	4,000	2,880	3,010	17,700	9,430	16,800	9,430	5,650	6,310	5,030
22	4,690	7,040	3,950	3,140	3,100	18,700	7,660	17,300	9,060	5,030	5,980	5,030
23	6,060	6,380	3,910	3,160	2,990	19,700	9,060	16,300	8,000	5,650	5,980	4,020
24	6,700	6,060	3,870	3,190	3,080	20,200	11,700	16,800	7,320	5,980	6,310	4,750
25	6,700	5,760	3,820	3,410	4,220	21,900	11,700	16,300	8,000	5,330	5,650	4,490
26	7,400	5,200	3,780	3,000	7,400	24,800	9,430	16,800	7,660	5,980	5,030	4,490
27	7,400	6,060	3,740	3,560	11,300	29,300	9,060	15,400	7,660	5,650	5,650	4,750
28	8,900	6,380	3,710	2,900	13,000	26,200	10,200	17,700	6,310	5,030	5,650	4,490
29	7,400	6,380	3,650	3,380	.....	27,700	9,800	20,200	5,980	4,490	5,650	4,750
30	9,300	5,760	3,600	3,410	.....	30,100	10,600	20,200	5,650	5,030	6,310	4,490
31	9,700	.....	3,560	3,560	.....	23,600	.....	21,300	.....	5,030	6,310	.....

NOTE.—Stage discharge relation affected by ice Dec. 8 to Mar. 23.

Monthly discharge of Wisconsin River at Muscoda, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 10,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	9,700	4,450	5,910	0.574	0.66
November	10,100	5,200	7,000	.680	.76
December	6,380	3,560	4,550	.442	.51
January	3,560	2,880	3,340	.324	.37
February	13,000	2,000	4,010	.389	.41
March	30,100	10,500	18,000	1.75	2.02
April	17,300	9,060	11,400	1.11	1.24
May	22,400	8,350	14,800	1.44	1.66
June	39,900	5,650	18,100	1.76	1.96
July	6,980	4,490	6,000	.583	.67
August	8,350	4,020	5,730	.556	.64
September	6,310	4,020	5,090	.494	.55
The year	39,900	2,000	8,670	.842	11.45

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 comes in from right, and 8 miles above mouth of river.

DRAINAGE AREA.—422 square miles.

RECORDS AVAILABLE.—September 18, 1914, to September 30, 1918.

GAGE.—Chain gage fastened to cantilever arm on right bank; read by Frank Sutherland.

DISCHARGE MEASUREMENTS.—Made from cable about half a mile below gage.

CHANNEL AND CONTROL.—Bed at gage and a short distance below sandy and likely to shift; bed at cable section heavy gravel and permanent. Control is formed by rapids about 2,000 feet below the gage. 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 are below gage, and may affect the stage-discharge relation.

EXTREMES OF STAGE.—Maximum stage recorded during year, 4.81 feet, at 7.25 p. m., June 4 (discharge, 1,130 second-feet); minimum stage, 1.45 feet at 6.25 p. m., July 22 (discharge, about 191 second-feet).

1914–1918: Maximum stage recorded, 6.88 feet April 24, 1916 (discharge, 2,120 second-feet); minimum stage, 1.45 feet July 22, 1918 (discharge, about 191 second-feet).

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

REGULATION.—The following reservoirs are maintained upstream from the station for the purpose of regulating the flow of Wisconsin River:

Dams and reservoirs on Tomahawk 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
Total			14.31	98.67	443	803

ACCURACY.—Stage-discharge relation practically permanent, except as affected by ice and for a few days in April by logs. Rating curve is well defined between 240 and 1,970 second-feet. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods in which stage-discharge relation was affected by ice, for which it was 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; and for a few days in April when there was backwater from logs, for which discharge was interpolated. Open-water records good, except at extremely low stages, when they are fair; winter records fair.

Discharge measurements of Tomahawk River near Bradley, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Jan. 12[a]	L. L. Smith	2.95	306
June 11	T. G. Bedford	3.09	534

[a] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Tomahawk River near Bradley, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	370	460	405	305	270	380	619	434	1,040	258	276	421
2	358	474	400	310	265	385	589	408	1,040	265	300	384
3	354	460	395	310	255	390	604	384	1,080	258	282	354
4	358	434	395	310	245	395	559	370	1,120	258	255	324
5	365	447	395	310	250	395	502	363	1,120	265	237	304
6	384	434	390	310	255	395	488	360	1,040	261	260	289
7	384	434	390	310	260	400	516	372	886	246	261	276
8	367	421	385	305	265	405	516	408	798	234	408	266
9	360	421	385	305	270	415	516	516	697	226	559	258
10	354	408	385	305	275	435	516	604	619	219	589	252
11	356	408	380	305	290	440	530	634	530	212	574	282
12	384	421	380	305	305	460	528	619	460	205	530	338
13	408	447	375	310	310	475	525	604	408	198	460	354
14	421	447	375	310	300	480	523	516	396	201	408	347
15	421	447	370	310	310	490	521	460	384	209	358	332
16	408	460	365	305	310	480	518	434	360	211	324	310
17	408	447	360	305	320	510	516	408	347	227	295	295
18	516	447	350	305	325	540	530	408	328	219	271	354
19	589	447	360	310	330	575	516	408	297	209	255	367
20	619	434	370	310	330	620	512	434	276	204	248	367
21	619	434	385	305	330	650	509	447	265	201	240	354
22	604	434	395	300	330	681	506	460	258	195	328	336
23	574	434	395	295	330	748	502	460	250	202	421	312
24	544	420	395	290	335	815	372	434	242	212	460	297
25	502	415	385	290	345	798	308	460	236	229	434	285
26	502	415	370	285	355	780	297	666	237	240	384	273
27	516	410	360	280	365	850	289	780	236	240	345	265
28	516	410	350	285	375	923	308	850	234	250	332	255
29	516	410	330	290	.....	1,000	408	923	232	268	408	249
30	460	410	310	280	.....	798	447	961	242	275	460	243
31	460	.....	305	275	.....	666	.....	961	.....	271	447	.....

NOTE.—Stage-discharge relation affected by ice Nov. 21 to Mar. 21. Stage-discharge relation affected by logs Apr. 9, 12–16, 20–22; discharge interpolated.

Monthly discharge of Tomahawk River near Bradley, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 422 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	619	354	452	1.07	1.23
November	474	408	433	1.03	1.15
December	405	305	374	.886	1.02
January	310	275	301	.713	.82
February	375	245	304	.720	.75
March	1,000	380	573	1.36	1.57
April	619	289	486	1.15	1.28
May	961	360	534	1.27	1.46
June	1,120	232	522	1.24	1.38
July	275	195	231	.547	.63
August	589	237	368	.872	1.01
September	421	243	311	.737	.82
The year	1,120	195	408	.967	13.12

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 18, 1914, to September 30, 1918.

GAGE.—Chain gage attached to upstream side of bridge; read by Mrs. Meta Krause.

DISCHARGE MEASUREMENTS.—From downstream side of bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel; clean and free from vegetation. Left bank high, not subject to overflow; both banks wooded. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.0 feet May 28 (discharge, 1,420 second-feet); minimum discharge, about 75 second-feet, during January and February.

1914–1918: Maximum stage recorded, 6.1 feet April 22, 1916 (discharge, 2,290 second-feet); minimum discharge, 72 second-feet, by discharge measurement made January 4, 1915. Absolute minimum occurred during winter period 1914–1915, and was probably somewhat less than 72 second-feet.

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 103 and 2,200 second-feet. Gage read once a day to half-tenths. Daily discharge ascertained by applying daily gage height to rating table, except for periods in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage heights 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 Prairie River near Merrill, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Jan. 11[a]	L. L. Smith	1.84	83
Feb. 16[a]	do	1.78	80

[a] Incomplete ice cover at control and at measuring section.

Daily discharge, in second-feet, of Prairie River near Merrill, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	103	137	110	80	80	85	313	421	963	137	110	137
2	101	137	105	80	80	85	313	348	1,010	137	118	137
3	101	133	105	80	80	85	296	348	781	148	137	137
4	110	137	100	80	80	85	278	244	574	148	137	122
5	133	137	100	80	80	85	278	244	458	159	137	118
6	133	137	100	80	80	85	244	212	421	159	137	115
7	122	148	100	80	80	85	244	212	421	133	148	110
8	115	137	100	80	80	90	244	278	366	122	458	110
9	110	137	95	80	80	90	228	313	313	110	535	110
10	115	137	95	80	80	95	212	574	278	106	496	106
11	118	137	95	85	80	95	184	655	228	101	421	118
12	118	137	95	80	75	100	184	614	212	97	402	137
13	115	133	95	80	80	100	159	535	184	91	313	148
14	118	128	95	80	80	105	159	402	159	91	278	148
15	122	128	95	80	80	110	159	313	148	97	228	137
16	122	128	95	80	80	110	172	244	137	103	184	110
17	137	122	95	80	80	115	198	198	128	103	159	118
18	159	122	90	80	80	122	261	212	122	101	137	148
19	159	128	95	80	80	244	244	244	115	97	133	148
20	159	122	90	80	80	348	212	278	106	97	118	137
21	159	122	90	80	80	535	212	244	106	93	110	137
22	159	122	90	80	85	496	184	313	103	91	118	137
23	159	118	85	80	85	458	184	348	103	93	212	137
24	159	118	90	80	85	421	172	296	103	103	458	137
25	159	118	85	75	85	366	159	366	101	118	384	133
26	159	122	85	75	85	348	159	963	103	122	366	128
27	148	110	85	80	85	348	137	1,110	103	115	313	118
28	159	110	90	75	85	348	184	1,420	110	103	244	110
29	172	110	85	75	.....	313	366	1,220	118	106	212	106
30	159	115	85	75	.....	330	384	1,010	159	148	159	110
31	137	.....	85	75	.....	330	.....	1,110	.....	137	137	.....

NOTE.—Stage-discharge relation affected by ice Dec. 2 to Mar. 15.

Monthly discharge of Prairie River near Merrill, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 164 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	172	101	135	0.823	0.95
November	148	110	128	.781	.87
December	110	85	93.7	.571	.66
January	85	75	79.2	.483	.56
February	85	75	81.1	.495	.52
March	535	85	213	1.30	1.50
April	384	137	224	1.37	1.53
May	1,420	198	493	3.01	3.47
June	1,010	101	274	1.67	1.86
July	159	91	115	.701	.81
August	535	110	242	1.48	1.71
September	148	106	127	.774	.86
The year	1,420	75	185	1.13	15.30

EAU CLAIRE RIVER AT KELLY, WIS.

LOCATION.—In sec. 13, T. 28 N., R. 8 E., at highway bridge three-quarters of a mile below 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, 1918.

GAGE.—Chain gage fastened to downstream side of highway bridge, read by William Woolsey.

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

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Gage is in the rapids which form the control. Banks medium high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.4 feet at 4.30 p. m., May 27 (discharge, 2,450 second-feet); minimum discharge estimated 30 second-feet December. 6.

1914-1918: Maximum stage recorded, 5.1 feet April 22 and 23, 1916 (discharge, 3,270 second-feet); minimum open-water stage recorded, 0.45 foot, August 13, 14, 15, October 2 and 3, 1914 (discharge, about 40 second-feet). Discharge December 6, 1917, was estimated as 30 second-feet.

ACCURACY.—Stage-discharge relation permanent, except as affected by ice. Rating curve well defined between 71 and 3,150 second-feet. Gage read to quarter-tenths twice daily except Sundays. Daily discharge ascertained by applying mean daily gage height to the rating table, except for periods in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage heights corrected for ice effect by means of discharge measurements, observer's notes, and weather records; discharge for all Sundays interpolated. Open-water records good; winter records fair.

Discharge measurements of Eau Claire River at Kelly, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Jan. 10[a]	L. L. Smith	1.20	67
Feb. 14[a]	do	1.29	60
June 13[b]	T. G. Bedford	1.33	218

[a] Complete ice cover at control and measuring section.
[b] Made by wading 80 feet downstream from gage.

Daily discharge, in second-feet, of Eau Claire River at Kelly, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	85	182	50	55	70	70	499	617	1,130	112	158	126
2	85	188	55	50	70	70	390	471	1,100	139	150	112
3	87	199	55	50	70	70	365	390	1,060	132	134	116
4	89	196	55	50	70	70	320	340	738	104	124	109
5	91	193	40	45	65	70	267	304	557	114	114	104
6	89	182	30	55	55	75	249	267	499	116	106	104
7	91	179	45	55	55	75	332	267	528	120	104	100
8	93	179	50	55	55	75	416	320	471	124	160	98
9	89	177	45	55	55	75	340	443	396	109	188	96
10	93	168	40	65	50	75	300	1,290	320	104	300	104
11	100	164	45	85	45	80	255	1,370	267	104	282	119
12	102	160	45	70	50	80	238	1,020	232	104	264	129
13	100	155	45	70	45	80	227	677	213	104	244	129
14	102	152	50	70	60	80	218	557	196	100	227	129
15	104	145	55	85	60	80	210	416	177	96	188	116
16	100	142	55	70	60	85	218	320	160	104	166	104
17	104	134	55	70	60	85	244	267	142	104	142	106
18	142	134	55	65	65	85	267	232	145	93	128	139
19	252	134	55	70	65	130	340	338	132	87	114	139
20	267	129	55	70	65	300	365	443	116	85	104	139
21	240	134	55	85	65	1,370	342	443	116	85	104	137
22	213	116	55	75	70	1,290	320	557	114	85	129	126
23	182	93	55	85	70	1,130	300	557	109	87	188	116
24	179	79	55	65	70	990	249	443	104	109	284	114
25	185	70	55	60	70	925	216	499	104	160	244	124
26	188	70	55	60	70	862	204	1,470	104	185	204	116
27	238	65	55	65	70	862	199	2,450	109	171	193	109
28	238	60	55	70	70	738	423	2,140	109	184	177	100
29	238	50	55	70	.....	708	647	1,460	104	196	166	97
30	227	50	55	70	.....	677	677	1,370	108	193	155	94
31	210	.....	70	70	.....	588	.....	1,130	.....	177	139	.....

NOTE.—Stage-discharge relation affected by ice Dec. 13 to Apr. 2. Discharge for all Sundays interpolated.

Monthly discharge of Eau Claire River at Kelly, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 326 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	267	85	148	0.454	0.52
November	199	50	136	.417	.47
December	70	30	52	.158	.18
January	85	45	65	.201	.23
February	70	45	62	.191	.20
March	1,370	70	385	1.18	1.36
April	677	199	321	.985	1.10
May	2,450	232	738	2.26	2.61
June	1,130	104	322	.988	1.10
July	196	85	122	.374	.43
August	300	104	174	.534	.62
September	139	94	115	.353	.39
The year	2,450	30	221	.678	9.21

BIG EAU PLEINE RIVER NEAR STRATFORD, WIS.

LOCATION.—In sec. 13, T. 27 N., R. 3 E., at highway bridge at 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 Geolo-g ical and Natural History Survey, edition of 1911; scale, 1 inch=6 miles.)

RECORDS AVAILABLE.—July 24, 1914, to September 30, 1918.

GAGE.—Sloping gage, reading from 1.0 to 15.6 feet, on right bank of the 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 about 1,000 feet below gage or from highway bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Control at head of rapids 400 feet below gage. Both banks at gage are high and will be overflowed only at stage of about 15 feet and above.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded during year, 8.45 feet at 7.30 p. m. March 19, as ice was leaving river (discharge, about 4,980 second-feet); minimum open-water stage, 1.3 feet at 7 p. m. July 20 (discharge, about 3 second-feet).

1914–1918: Maximum recorded stage 8.85 feet at 6 p. m. April 21 (discharge, 5,540 second-feet); minimum discharge recorded, 3.0 second-feet (by meter measurement) February 5, 1915, and 7 p. m. July 20, 1918. The flood of June, 1914, reached a maximum height of 20.7 feet as determined by levels run to high-water marks.

ACCURACY.—Stage-discharge relation practically permanent, except for ice effect. Rating curve fairly well defined between 150 and 4,000 second-feet; poorly defined outside these limits. Gage read twice daily to quarter-tenths. Daily discharge ascertained by applying daily gage height to rating table, except for periods when discharge relation was affected by ice, December 5 to March 18, for which no daily discharge was estimated. Open-water records for high stages good; for medium and low stages poor.

The following discharge measurement was made by wading a quarter of a mile below gage, May 21, 1918, by T. G. Bedford:

Gage height, 2.28 feet; discharge, 108 second-feet.

Daily discharge, in second-feet, of Big Eau Pleine River near Stratford, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	12	75	18	.....	344	280	2,050	16	13	13
2	10	60	18	.....	310	208	840	14	10	13
3	12	50	18	.....	241	165	447	13	9	12
4	12	60	18	.....	182	129	344	14	8	8
5	12	60	18	.....	152	107	241	16	6	7
6	12	60	18	.....	134	96	1,410	14	5	6
7	12	60	18	.....	208	85	642	13	6	5
8	12	55	17	.....	182	107	310	10	33	5
9	12	50	.....	.....	172	178	327	9	43	4
10	15	47	.....	.....	134	1,730	269	7	27	4
11	17	44	.....	.....	118	668	182	6	19	6
12	25	40	.....	.....	103	403	112	5	19	9
13	29	36	.....	.....	85	233	69	4	112	10
14	27	33	.....	.....	85	178	53	4	65	10
15	24	31	.....	.....	85	148	39	5	36	9
16	22	29	.....	.....	112	118	31	6	25	8
17	24	29	.....	.....	172	81	27	6	18	6
18	60	29	.....	.....	295	75	23	5	14	8
19	134	29	.....	4,920	382	90	21	5	12	9
20	96	25	.....	3,420	269	118	19	4	9	12
21	63	25	.....	2,590	228	103	18	3	8	13
22	60	29	.....	2,390	241	780	21	3	18	13
23	55	27	.....	1,730	190	470	13	6	53	10
24	44	25	.....	1,180	141	260	13	12	50	10
25	47	25	.....	905	112	424	10	13	27	8
26	101	22	.....	694	96	5,190	10	12	19	6
27	295	22	.....	494	85	2,790	12	9	13	6
28	220	22	.....	424	255	2,130	10	13	13	5
29	158	22	.....	344	668	1,110	9	27	13	5
30	112	18	.....	327	424	720	12	23	13	5
31	127	.....	.....	344	.....	1,650	.....	13	13	.....

NOTE.—Stage-discharge relation affected by ice Dec. 8 to Mar. 19; daily discharge not determined.

Monthly discharge of Big Eau Pleine River near Stratford, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 223 square miles,]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	295	10	60.0	0.269	0.31
November	75	18	38.0	.170	.19
December 1–8	18	17	17.9	.080	.02
March 19–31	4,920	327	1,520	6.82	3.30
April	668	85	207	.928	1.04
May	5,190	75	672	3.01	3.47
June	2,050	9	25.3	.113	.13
July	27	3	10.0	.045	.05
August	112	5	23.5	.105	.12
September	13	4	8.2	.037	.41

PLOVER RIVER NEAR STEVENS POINT, WIS.

LOCATION.—In sec. 1, T. 24 N., R. 8 E., Portage County, at East Waters highway bridge, 7 miles above mouth of river and 5 miles northeast of Stevens Point.

DRAINAGE AREA.—136 square miles.

RECORDS AVAILABLE.—January 5, 1914, to September 30, 1918.

GAGE.—Metal vertical staff gage bolted to left abutment, downstream side of bridge; read by Ethel Van Order.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and small rock; free from vegetation; permanent. At high stages both banks will be overflowed around the bridge. Control not well defined but is probably small rapids below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.3 feet at 5.30 p. m., May 28 (discharge, 670 second-feet); minimum discharge, estimated 55 second-feet, January 1–15 and February 1–15. Observer unable to reach gage May 29 to June 1, so that maximum stage during this period probably was somewhat above the maximum recorded on May 29.

1914–1918: Maximum stage recorded, 4.75 feet, June 5, 1914 (discharge, approximately 1,570 second-feet); minimum discharge estimated 45 second-feet, February 5–7, 1917.

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

REGULATION.—Two dams are used in connection with grist mills above station, but the plants have little pondage, so that the flow at gage, except for brief periods, is nearly natural.

ACCURACY.—Stage-discharge relation probably permanent, except as affected by ice. Rating curves well defined between 82 and 410 second-feet; poorly defined outside these limits. Gage read twice daily to quarter-tenths. Daily discharge ascertained by applying mean daily gage height to rating table, except during periods when stage-discharge relation is affected by ice, for which it is ascertained by applying to rating table mean daily gage heights corrected for ice effect by results of discharge measurements, observer's notes, and weather records; daily discharge interpolated October 1–6 and May 29 to June 1, when gage was not read. Open-water records fair, except at extremely low stages, when diurnal fluctuation may cause some error; winter records roughly approximate.

Discharge measurements of Plover River near Stevens Point, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 25[a]	R. B. Kilgore	1.24	122	Feb. 13[b]	L. L. Smith	2.76	96
Jan. 9[b]	L. L. Smith	1.99	63	Mar. 29	T. G. Bedford	1.95	264

[a] Made by wading 300 feet upstream from gage.
[b] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Plover River near Stevens Point, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	122	123					234	234	484	212	150	98
2	121	114					234	201	438	132	114	106
3	120	132					201	180	438	132	141	90
4	118	114					201	212	382	132	114	106
5	117	150					190	170	356	170	132	98
6	115	114					170	170	330	150	123	98
7	114	114					190	190	280	114	114	98
8	98	98	60	55	55	215	190	201	330	132	160	82
9	98	114					190	212	280	132	190	98
10	114	114					160	382	256	114	190	98
11	114	98					160	500	256	98	190	98
12	123	98					132	469	245	114	170	114
13	114	123					170	438	223	98	190	98
14	106	98					141	256	223	98	132	114
15	114	106					150	280	212	132	132	132
16	114	98					150	234	150	132	132	132
17	82	98					150	234	132	132	132	114
18	160	98					160	256	150	123	114	123
19	98	106					160	280	114	132	132	132
20	132	98					150	256	150	106	106	132
21	114	114				365	150	256	170	98	114	114
22	106	114					190	330	150	114	114	114
23	98	98			110		190	330	98	132	98	98
24	132	90	65	65			150	304	132	114	114	114
25	132	71					141	280	114	132	123	98
26	123	106				330	150	438	141	141	90	123
27	150	98				268	170	565	132	132	114	114
28	150	114				245	170	670	170	114	114	114
29	150	98				234	234	624	132	150	114	123
30	141	106			.....	223	234	577	150	190	114	123
31	114	.....			.....	234	.....	531	.....	132	98	.....

NOTE.—Stage-discharge relation affected by ice Dec. 1 to Mar. 25. Gage not read Oct. 1–6, and May 25 to June 1; discharge interpolated.

Monthly discharge of Plover River near Stevens Point, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 136 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	160	82	119	0.875	1.01
November	150	71	107	.787	.88
December	.....	.....	63	.460	.53
January	.....	.....	60	.443	.51
February	.....	.....	80	.592	.62
March	.....	.....	271	1.99	2.29
April	234	132	175	1.29	1.44
May	670	170	331	2.43	2.80
June	484	98	227	1.67	1.86
July	212	98	130	.956	1.10
August	190	90	131	.963	1.11
September	132	82	110	.809	.90
The year	.....	.....	151	1.11	15.05

BARABOO RIVER NEAR BARABOO, WIS.

LOCATION.—In sec. 33, T. 12 N., R. 7 E., at highway bridge 4 miles downstream from Baraboo, Sauk County, 3 miles below creek that rises near Devils Lake and comes in from right, and 15 miles above mouth of river.

DRAINAGE AREA.—572 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911, scale, 1 inch=6 miles.)

RECORDS AVAILABLE.—December 18, 1913, to September 30, 1918.

GAGE.—Chain gage, attached to upstream side of bridge; read by Miss Agnes Schneider.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and mud. Control not well defined. Water confined to one channel, except at flood stages when right bank is overflowed for a distance of 1,000 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.03 feet at 8 a. m., March 20 (discharge, 3,280 second-feet); minimum stage, 1.15 feet at 4 p. m., December 2 (discharge, about 78 second-feet); caused apparently by temporary holding back of water by ice or otherwise.

1914–1918: Maximum stage recorded, approximately 17.5 feet March 26, 1917 (discharge, 4,200 second-feet); minimum stage, 0.71 foot at 7.30 a. m., July 26, 1916 (discharge, 76 second-feet).

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

REGULATION.—In the vicinity of Baraboo, 4 miles above station, there are four dams and one at Reedsburg, 18 miles above. Smaller plants are also operated on tributaries. Operation of these various plants causes diurnal fluctuation at gage of about 0.3 foot at low-water stages. Estimates of mean monthly discharge probably represent nearly the natural flow.

ACCURACY.—Stage-discharge relation changed during high water of March, 1917, and again during May, 1917. Rating curve used October 1 to March 12, 1918, fairly well defined between 150 and 3,270 second-feet; extended and approximate above and below these limits. Curve used March 13 to May 20 poorly defined throughout. Curve used May 21 to September 30 fairly well defined between 167 and 3,270 second-feet; extended and approximate only outside these limits. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods when stage-discharge relation was affected by ice, for which it was 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. Open-water records fair; winter records roughly approximate.

Discharge measurements of Baraboo River near Baraboo, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 2	R. B. Kilgore	3.15	303	May 9[b]	T. G. Bedford	2.32	230
19	do	2.38	203	9[b]	do	2.78	276
Jan. 14[a]	W. G. Hoyt	3.29	206	July 13[c]	W. G. Hoyt	2.40	245

[a] Complete ice cover at control and measuring section.
[b] Débris at measuring section.
[c] Tree on downstream side; possibly some backwater.

Daily discharge, in second-feet, of Baraboo River near Baraboo, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	162	299	198	100	160	890	378	465	1,930	378	226	109
2	150	285	84	150	150	930	364	420	1,330	527	220	158
3	186	285	145	125	120	1,010	350	336	1,090	587	186	164
4	205	299	180	85	180	1,110	336	266	722	557	183	169
5	198	327	180	110	210	1,170	294	266	452	617	166	139
6	180	355	175	80	180	1,240	294	294	407	617	178	154
7	168	355	170	140	180	1,290	308	308	378	662	183	128
8	162	355	160	135	190	1,340	364	246	392	557	188	112
9	154	327	155	145	165	1,390	364	234	322	350	172	174
10	192	299	155	150	165	1,440	350	696	336	287	136	144
11	198	231	150	125	140	1,460	322	1,220	452	322	165	189
12	205	198	150	160	240	1,540	280	1,440	527	294	226	190
13	192	198	150	130	225	1,780	253	1,540	422	239	213	190
14	186	228	145	165	315	2,180	240	1,340	308	206	206	200
15	192	244	130	145	315	2,120	266	728	246	226	193	187
16	205	228	115	175	325	2,050	260	392	226	252	195	213
17	257	218	115	175	315	2,260	260	308	232	246	169	186
18	228	231	145	120	300	2,820	301	1,290	239	239	160	193
19	257	212	145	130	300	3,100	336	1,870	226	226	198	206
20	228	192	145	145	315	3,240	308	2,430	232	183	192	180
21	244	205	145	145	315	3,130	364	2,680	206	177	213	198
22	250	224	160	170	325	3,020	450	2,570	186	206	187	192
23	264	231	185	155	340	2,680	525	2,710	176	206	169	252
24	257	218	190	170	355	2,120	465	2,360	182	206	146	166
25	244	186	230	175	545	1,240	420	1,930	226	194	136	152
26	383	205	250	145	655	760	350	1,230	172	220	171	171
27	470	224	230	100	765	540	308	1,380	512	226	176	154
28	470	231	205	155	910	435	322	1,990	422	239	166	144
29	515	224	145	170	.....	406	465	2,290	266	259	163	142
30	425	205	155	190	.....	378	495	2,430	294	198	152	162
31	313	.....	160	170	.....	364	.....	2,320	.....	220	138	.....

NOTE.—Stage-discharge relation affected by ice Dec. 3 to Mar. 12, and Mar. 15.

Monthly discharge of Baraboo River near Baraboo, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 572 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	515	150	250	0.437	0.50
November	355	186	251	.439	.49
December	250	84	163	.285	.33
January	190	80	143	.250	.29
February	910	120	311	.544	.57
March	3,240	364	1,590	2.78	3.20
April	525	240	346	.605	.68
May	2,710	234	1,290	2.26	2.61
June	1,930	172	437	.764	.85
July	662	177	320	.559	.64
August	226	136	180	.315	.36
September	252	109	171	.299	.33
The year	3,240	80	457	.799	10.85

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, 25 miles above mouth of river, and 2 miles below mouth of Tainter Creek, which enters from right.

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, 1918.

GAGE.—Chain gage fastened to downstream side of bridge; read by N. T. Norwood.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading a short distance downstream from the gage.

CHANNEL AND CONTROL.—Bed composed of rock covered by a deposit of sand. Banks at gage fairly high and not subject to overflow at ordinary high-water stage. Control is at head of small rapids about 300 feet below gage; not permanent; the plotting of the discharge measurements indicate that at a stage of about 2 feet on the gage the control is charged to some point below, causing a reversal in the curve.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.15 feet at 5.35 p. m., March 19 (discharge, about 2,900 second-feet); minimum discharge, about 245 second-feet, during January.

1914–1918: Maximum stage recorded, 15.05 feet March 24, 1917 (discharge, approximately 6,300 second-feet); minimum stage for open-water, 0.86 foot at 8 a. m., November 29, 1914 (discharge, 201 second-feet). Absolute minimum was approximately 100 second-feet, and occurred during the later part of January, 1915.

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

REGULATION.—Mills at Gays Mills immediately above station, Soldiers Grove about 7 miles upstream, and at several points above Soldiers Grove, use comparatively little storage, so that the recorded flow past station represents nearly the natural flow. During low stages a small diurnal fluctuation is observed at the gage

ACCURACY.—Stage-discharge relation not permanent. Shifts occurred during months of March, April, and May. One rating curve used during year; fairly well defined between 285 and 870 second-feet; extended and subject to error outside these limits. Shifting-channel method used March 13 to May 25. Gage read twice daily to nearest quarter-tenth. Daily 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 the rating table mean daily gage heights corrected for ice effect by discharge measurements, observer's notes, and weather records. Open-water records fair; winter records subject to error.

Discharge measurements of Kickapoo River at Gays Mills, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 4	W. G. Hoyt	1.58	349	Apr. 3	T. G. Bedford	1.99	382
Jan. 11[a]	T. G. Bedford	2.18	246	May 31	do	3.12	675
Feb. 13[a]	do	3.20	405	Aug. 2[b]	W. G. Hoyt	1.40	320

[a] Made through complete ice cover 150 feet downstream from gage.
[b] Made by wading 200 feet downstream from gage.

Daily discharge, in second-feet, of Kickapoo River at Gays Mills, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	315	445	375	245	300	1,110	420	375	795	565	330	272
2	330	435	360	260	315	945	390	330	700	375	315	272
3	345	445	360	260	285	1,050	390	315	550	420	315	272
4	375	475	375	270	270	1,020	360	300	535	550	315	272
5	360	495	330	270	285	1,230	330	285	535	745	330	285
6	345	515	285	260	285	1,200	375	300	515	720	315	272
7	330	515	285	260	270	1,000	455	315	475	515	300	272
8	315	455	285	270	260	640	455	315	475	405	345	258
9	330	435	285	300	260	515	390	495	475	390	405	272
10	345	435	285	260	260	435	345	2,520	745	405	330	285
11	375	405	285	245	260	500	345	2,100	610	405	405	375
12	420	405	285	245	285	820	315	1,360	495	375	345	390
13	420	405	285	270	405	2,080	315	695	455	345	345	360
14	390	405	300	285	770	2,620	300	535	435	345	345	315
15	375	390	315	285	700	2,420	285	475	420	390	315	300
16	360	375	360	300	625	2,180	315	445	420	435	315	300
17	360	360	390	285	580	1,940	345	625	390	435	345	285
18	405	345	390	260	550	2,500	375	1,290	375	375	315	300
19	405	360	405	285	515	2,740	405	1,560	375	360	345	300
20	405	375	420	245	475	2,740	360	1,710	375	345	285	315
21	375	375	420	245	455	2,380	375	1,710	375	330	285	285
22	390	375	420	270	335	1,550	405	1,500	375	330	285	285
23	405	375	405	260	475	710	435	895	375	315	285	285
24	405	375	375	270	550	588	405	595	375	330	285	272
25	435	345	345	300	720	558	345	565	455	550	285	272
26	515	330	315	300	995	525	315	595	610	455	285	272
27	595	345	285	255	1,110	485	315	1,320	455	435	285	258
28	565	360	270	270	1,140	465	345	1,670	405	390	285	285
29	515	360	270	270	.....	445	420	1,290	375	475	285	258
30	495	375	270	285	.....	445	405	770	515	375	272	272
31	455	.....	260	300	.....	420	.....	640	.....	330	258	.....

NOTE.—Stage-discharge relation affected by ice Dec. 8 to Mar. 11.

Monthly discharge of Kickapoo River at Gays Mills, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 629 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	595	315	402	0.639	0.74
November	515	330	403	.641	.72
December	420	260	332	.528	.61
January	300	245	270	.429	.49
February	1,140	260	494	.785	.82
March	2,740	420	1,230	1.96	2.26
April	455	285	368	.585	.65
May	2,520	285	897	1.43	1.65
June	795	375	482	.766	.85
July	745	315	426	.677	.78
August	405	258	315	.501	.58
September	390	258	291	.463	.52
The year	2,740	245	494	.785	10.67

MAQUOKETA RIVER BELOW MOUTH OF NORTH FORK OF MAQUOKETA RIVER, NEAR MAQUOKETA, IOWA.

LOCATION.—In southwest corner of NE.¼ sec. 17, T. 84 N., R. 3 E., at Bridgeport Bridge, 3 miles northeast of Maquoketa, Jackson County, 1,200 feet above mouth of Mill Creek, and 2 miles below mouth of North Fork of Maquoketa River.

DRAINAGE AREA.—1,600 square miles (measured on map issued by United States Geological Survey, scale, 1 to 500,000). Drainage area at mouth, 1,960 square miles.

RECORDS AVAILABLE.—September 1, 1913, to September 30, 1918, except October, 1914, to March 20, 1915, when station was temporarily discontinued.

GAGE.—Chain gage attached to down stream 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.—Bed of stream composed of sand; shifting. Two channels at all stages up to 12 feet, when there is overflow under pile-trestle approach on left side.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.4 feet, February 15, affected by ice; minimum stage recorded 1.75 feet, November 25 and 27 (discharge, 294 second-feet.) Prior to 1918: Maximum stage about 23.5 feet, probably in 1905 (discharge, about 24,300 second-feet).

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Two rating curves used during 1918; October 1 to December 4, and June 5 to September 30, well defined between 300 and 20,000 second-feet; February 16 to June 4, well defined between 300 and 20,000 second-feet. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage heights to rating table, except for days when gage was not read, for which the discharge was interpolated. December 4 to February 15 and February 21 to 23, stage-discharge relation affected by ice; discharge not determined. Open-water records good.

The following discharge measurement was made by Bolster and Gregg:

March 27: Gage height, 2.23 feet; discharge, 505 second-feet.

Daily discharge, in second-feet, of Maquoketa River below mouth of North Fork of Maquoketa River, near Maquoketa, Iowa, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	324	339	309	.....	2,160	439	405	1,270	1,220	469	486
2	294	355	324	.....	1,700	439	405	1,270	1,020	452	435
3	324	339	339	.....	2,500	422	388	1,060	741	419	419
4	324	339	309	.....	3,000	388	372	6,050	655	410	419
5	324	355	.....	.....	2,750	388	372	6,430	615	402	419
6	309	339	.....	.....	2,570	372	356	3,160	879	402	402
7	324	339	.....	.....	1,650	456	456	2,130	879	386	402
8	309	339	.....	.....	1,220	492	405	1,710	1,280	370	386
9	294	324	.....	.....	1,110	474	439	1,330	1,380	355	386
10	309	324	.....	.....	1,220	422	511	1,120	1,020	355	370
11	309	339	.....	.....	765	405	675	1,020	832	355	435
12	324	339	.....	.....	860	405	652	879	655	355	577
13	324	324	.....	.....	959	372	632	786	615	339	577
14	332	324	.....	.....	3,920	372	530	697	577	355	486
15	339	324	.....	.....	3,190	356	474	615	540	577	460
16	324	324	.....	3,320	1,760	372	456	577		577	435
17	339	324	.....	1,820	1,410	405	422	577		2,380	402
18	339	324	.....	1,220	1,060	439	2,280	540		4,400	402
19	339	339	.....	1,160	1,010	422	3,120	540		1,770	370
20	355	309	.....	1,060	959	422	1,430	741	500	1,120	370
21	324	324	.....	.....	860	422	1,060	927		879	370
22	339	324	.....	.....	719	439	909	879		741	355
23	324	324	.....	.....	632	439	3,000	741		655	355
24	324	309	.....	2,570	590	439	1,930	655		615	355
25	339	294	.....	4,960	570	439	3,510	655	1,000	577	355
26	370	309	.....	5,240	531	439	2,450	927	1,330	540	355
27	386	294	.....	5,240	492	405	1,590	786	1,280	504	355
28	386	324	.....	3,320	474	439	2,750	879	832	469	339
29	386	339	.....	.....	456	422	2,220	786	615	452	339
30	370	339	.....	.....	456	422	1,930	786	577	452	339
31	370	.....	.....	.....	422	.....	1,430	.....	452	522	.....

NOTE.—Discharge interpolated Oct. 14, Nov. 22, Mar. 17 and 26, Apr. 24, May 12, Aug. 4, Sept. 15. Discharge Mar. 3, July 16 to 25, estimated from discharge at Cedar Rapids and Janesville, and from climatologic data. Stage-discharge relation affected by ice Dec. 4 to Feb. 15 and Feb. 21 to 23; discharge not determined.

Monthly discharge of Maquoketa River near Maquoketa, Iowa, for the year ending Sept. 30, 1918.

[Drainage area, 1,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	386	294	335	0.209	0.24
November	355	294	328	.205	.23
February	5,240	.....	2,990	1.87	.69
March	3,920	422	1,350	.844	.97
April	492	356	419	.261	.29
May	3,510	356	1,210	.756	.87
June	6,430	540	1,350	.844	.94
July	1,380	452	758	.474	.55
August	4,400	339	731	.457	.53
September	577	339	405	.253	.28

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 quarters of a 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, 1918.

GAGE.—Chain gage fastened to downstream side of bridge; read by Albert Engelke, and Leslie Seales.

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

CHANNEL AND CONTROL.—Banks medium high, and will not be overflowed to any extent at flood stages. Bed composed of gravel and clean silt; practically permanent. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.51 feet at noon March 26 (discharge, 12,700 second-feet); minimum stage 0.94 feet at 8.30 p. m. August 4 (discharge, 612 second-feet).

1914–1918: Maximum discharge recorded, 10.51 feet at noon March 26, 1918 (discharge, 12,700 second-feet); minimum stage recorded 0.5 foot at 7 a. m., August 16, 1914 (discharge, approximately 459 second-feet).

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

REGULATION.—Operation of power plants at Janesville and above causes fluctuations at gage during low stages.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 638 and 12,700 second-feet. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods when stage discharge relation was affected by ice, for which it was 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; daily discharge interpolated September 28–30 when gage was not read. Open-water records excellent, except at extreme low stages, when they are fair; winter records fair.

Discharge measurements of Rock River at Afton, Wis., during the year ending Sept, 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Jan. 3[a]	W. G. Hoyt	3.22	1,020
Feb. 6[a]	T. G. Bedford	2.97	829
Mar. 26	W. G. Hoyt	10.51	12,700

[a] Complete ice cover at measuring section, incomplete at control.

Daily discharge, in second-feet, of Rock River at Afton, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,170	2,850	1,500	1,010	935	3,450	10,700	3,240	2,940	1,040	848	719
2	1,110	3,240	1,460	730	945	3,240	10,700	2,760	2,850	1,000	719	701
3	1,170	2,760	1,500	1,230	735	4,280	10,300	2,850	3,040	1,070	674	724
4	1,080	3,040	1,430	910	750	4,520	10,100	2,670	2,940	1,020	656	710
5	1,140	3,140	1,400	905	845	5,810	8,920	2,490	2,850	1,140	811	719
6	1,100	2,940	1,360	888	780	5,810	8,550	2,940	2,760	1,080	802	710
7	946	2,940	1,350	1,090	850	5,290	8,370	3,040	2,760	1,000	710	719
8	1,100	2,670	1,340	915	840	5,550	8,200	2,760	2,580	1,050	751	701
9	990	2,580	1,330	1,060	865	6,210	7,370	2,850	2,140	1,050	678	714
10	1,110	2,760	1,300	915	835	6,210	7,060	3,240	3,040	1,230	765	728
11	1,060	2,400	1,290	940	855	6,630	6,630	2,850	1,980	1,170	638	728
12	1,070	2,760	1,280	735	855	8,030	6,210	2,670	1,820	1,050	696	737
13	1,040	2,490	1,270	730	875	9,500	5,680	2,760	2,060	1,000	737	728
14	960	2,310	1,280	850	1,400	10,900	5,420	2,670	1,540	995	756	719
15	990	2,310	1,280	880	2,060	8,920	5,160	2,580	1,430	1,030	683	719
16	995	2,140	1,270	905	1,540	8,730	4,900	1,400	1,400	970	714	742
17	1,110	2,140	1,270	875	1,410	9,110	4,640	2,490	936	985	710	733
18	1,110	2,060	1,270	770	1,110	9,900	4,520	2,400	898	769	647	728
19	1,140	2,060	1,280	770	1,060	10,300	4,640	2,490	985	779	825	719
20	1,070	1,980	1,280	820	1,090	10,700	4,400	2,670	1,040	815	674	719
21	1,230	1,980	1,270	905	1,110	11,600	3,920	2,400	1,140	737	710	724
22	1,230	1,980	1,250	765	1,080	12,300	3,920	3,240	995	742	737	728
23	1,400	2,060	1,230	825	1,100	12,500	4,040	5,290	936	706	701	728
24	1,430	1,540	1,200	950	1,140	12,700	4,280	2,940	975	724	701	714
25	1,320	1,460	1,170	865	3,800	12,700	4,040	3,140	1,040	733	710	728
26	1,660	1,540	1,150	800	3,920	12,700	3,560	2,940	1,100	733	710	737
27	1,820	1,580	1,140	775	3,680	12,500	3,340	3,240	1,100	706	719	746
28	1,900	1,500	1,110	860	4,040	12,300	3,450	3,240	1,050	660	719	746
29	1,980	1,540	1,080	880	.....	12,500	3,040	3,140	1,060	871	719	746
30	2,490	1,620	1,050	735	.....	11,600	3,240	3,040	1,050	1,000	719	746
31	3,140	.....	1,010	715	.....	11,200	.....	3,040	.....	917	696	.....

NOTE.—Stage-discharge relation affected by ice Dec. 5 to Feb. 26. Gage not read Sept. 28–30; discharge interpolated.

Monthly discharge of Rock River at Afton, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 3,190 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,140	946	1,320	0.414	0.48
November	3,240	1,460	2,280	.715	.80
December	1,500	1,010	1,270	.398	.46
January	1,230	715	871	.273	.31
February	4,040	735	1,450	.455	.47
March	12,700	3,240	8,960	2.81	3.24
April	10,700	3,040	5,980	1.87	2.09
May	5,290	2,400	2,920	.915	1.05
June	3,040	898	1,750	.549	.61
July	1,230	660	928	.291	.34
August	848	638	720	.226	.26
September	746	701	725	.227	.25
The year	12,700	638	2,440	.765	10.36

ROCK RIVER AT ROCKFORD, ILL.

LOCATION.—In sec. 34, T. 44 N., R. 1 E., at highway bridge at Nelson Avenue, Rockford, Winnebago County, 1 mile below mouth of Kent Creek.

DRAINAGE AREA.—6,520 square miles.

RECORDS AVAILABLE.—July 30, 1914, to September 30, 1918.

GAGE.—Chain gage attached to upstream side of bridge; read by Winston Burrows.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Coarse gravel and rock; may shift in high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.3 feet at 8 a. m. March 14 (discharge, 24,600 second-feet); minimum stage, 0.78 foot at 5 p. m. July 28 (discharge, 840 second-feet).

1914–1918: Maximum stage recorded, 15.5 feet February 15, 1915 (discharge not determined because of backwater from ice); maximum open-water stage

recorded 13.0 feet March 30 and 31, 1916 (discharge, 32,000 second-feet); minimum discharge recorded, 483 second-feet August 9, 1914.

REGULATION.—Operation of power plant at dam 2 miles upstream in Rockford causes slight fluctuation at gage. During low stages water is stored at night for use in manufacturing plants during day.

ACCURACY.—Stage-discharge relation changed during high water in February; seriously affected by ice during winter. Rating curve used to February 14 fairly well defined; curves used after that date fairly well defined above 1,040 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating tables, except for period when stage-discharge relation was affected by ice, for which it was determined from gage heights, observer's notes, weather records, and records of flow of Rock River at Afton, Wis. Records good for medium and high stages during open-water periods; probably somewhat too large for low stages during October, June, and July, on account of gage readings having been taken during day, when flow, due to regulation at dam, was somewhat greater than during night; winter records poor.

Discharge measurements of Rock River at Rockford, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec-ft.*		*Feet.*	*Sec-ft.*
Nov. 7	4.24	5,020	July 31	2.40	2,060
May 8	4.10	4,470	Aug. 18	1.60	1,300

Daily discharge, in second-feet, of Rock River at Rockford, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,750	4,400	2,500			16,400	9,940	4,210	6,100	1,640	1,640	1,220
2	1,650	4,610	2,360			16,200	10,200	4,030	5,880	1,840	1,540	1,290
3	1,760	4,820	2,360			15,900	10,200	4,210	5,450	1,840	1,450	1,370
4	1,980	4,610	2,640			18,200	10,500	4,030	5,030	1,640	1,160	1,450
5	2,100	4,610	2,640			19,700	10,500	3,860	4,400	1,540	1,540	1,450
				2,230								
6	2,100	4,610	2,790			18,200	10,700	3,860	4,030	1,450	1,540	1,540
7	1,980	4,610	2,940			17,900	10,200	3,860	3,690	1,160	1,840	1,540
8	2,230	4,820	3,100		2,280	17,600	9,680	4,400	3,530	1,370	1,540	1,040
9	2,500	5,240				17,300	9,430	4,820	3,380	1,640	1,540	1,290
10	2,640	5,240				17,000	8,930	4,610	3,530	1,740	1,450	1,450
11	2,500	5,030				18,200	8,680	4,400	3,380	1,640	1,220	1,450
12	2,500	4,610				19,700	8,430	4,610	3,380	1,640	1,370	1,450
13	2,640	4,200				22,200	8,190	4,610	3,100	1,740	1,370	1,640
14	2,790	4,000				24,200	7,710	4,210	2,680	1,540	1,540	1,840
15	2,940	4,000	2,850		22,600	22,200	7,470	3,860	2,540	1,540	1,640	1,740
				1,920								
16	2,940	3,620			20,300	20,600	7,230	4,210	2,540	1,540	1,640	1,740
17	2,640	3,440			18,800	20,300	7,000	4,820	2,540	1,540	1,540	1,740
18	2,500	3,270			17,300	19,700	6,540	5,450	2,290	1,740	1,290	1,540
19	2,230	3,270			16,400	19,400	6,540	5,240	2,170	1,840	1,450	1,540
20	1,980	3,270			15,900	19,100	6,320	5,660	1,950	1,740	1,290	1,540
21	2,100	3,270			14,800	18,200	6,100	5,880	1,840	1,290	1,450	1,540
22	2,500	3,270			14,200	17,600	5,880	6,320	1,640	1,450	1,450	1,290
23	2,790	3,100			11,500	17,300	5,660	5,880	1,540	1,640	1,370	1,290
24	2,940	2,940			10,200	16,200	5,450	6,100	1,540	1,740	1,370	1,290
25	3,100	2,790			14,500	15,000	5,340	6,320	1,450	1,450	1,220	1,370
26	3,270	2,940	2,500	1,670	17,300	14,200	5,030	6,100	1,540	1,220	1,220	1,370
27	3,810	2,940			16,400	13,400	4,820	5,240	1,840	1,040	1,220	1,220
28	4,000	2,640			15,900	12,000	4,610	5,450	2,060	880	1,290	1,290
29	4,000	2,640			.....	10,700	4,610	5,660	2,170	1,100	1,370	1,100
30	4,200	2,500			.....	9,680	4,400	5,880	1,220	1,220	1,290	1,160
31	4,400	.....			.....	9,940	.....	6,320	.....	1,450	1,290	.....

NOTE.—Discharge Dec. 9 to Feb. 14 estimated, because of ice, from gage heights, observer's notes, weather records, and flow of Rock River at Afton, Wis. Braced figures show mean discharge for periods included.

Monthly discharge of Rock River at Rockford, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 6,520 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	4,400	1,450	2,680	0.411	0.47
November	5,240	2,500	3,840	.589	.66
December	.....	.....	2,680	.411	.47
January	.....	.....	1,930	.296	.34
February	22,600	.....	9,220	1.41	1.47
March	24,200	9,680	17,200	2.64	3.04
April	10,700	4,400	7,540	1.16	1.29
May	6,320	3,860	4,970	.762	.88
June	6,100	1,220	2,950	.452	.50
July	1,840	880	1,510	.232	.27
August	1,840	1,160	1,420	.218	.25
September	1,840	1,040	1,430	.219	.24
The year	24,200	880	4,760	.730	9.88

ROCK RIVER AT LYNDON, ILL.

LOCATION.—In sec. 21, T. 20 N., R. 5 E., at highway bridge known as Lyndon Bridge, in eastern part of 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, 1918.

GAGE.—Chain gage attached to bridge; read by John Shepard until August 8 and by George Cady thereafter.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Gravel; may shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 19.6 feet February 16 (discharge not determined because of backwater from ice); maximum open water stage recorded, 14.4 feet at 6 a. m. March 16 (discharge, 28,600 second-feet); minimum stage recorded, 3.72 feet at 7 a. m. September 27 (discharge, 536 second-feet).

1915–1918: 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 is diverted at Sterling dam to feed Illinois and Mississippi canal; probably averages about 100 second-feet.

REGULATION.—Flow past gage is regulated by power plants in city of Sterling and above.

ACCURACY.—Stage-discharge relation practically permanent; seriously affected by ice during winter. Rating curve well defined above 1,030 second-feet. 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 for period when stage-discharge relation was affected by ice, for which it was ascertained from gage heights, observer's notes, weather records, and records of flow of Rock River at Rockford, Ill., and Afton, Wis., discharge interpolated for several days March 1–20. Records good for medium and high stages and fair for low stages, during open-water period; winter records poor.

Discharge measurements of Rock River at Lyndon, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 9	6.48	4,430	Aug. 9	4.42	1,050
9	6.48	4,490	9	4.83	1,580
May 6	6.63	4,540			

Daily discharge, in second-feet, of Rock River at Lyndon, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,500	4,940	3,030			24,000	13,900	4,740	5,780	2,670	1,740	1,300
2	2,670	4,740	2,670			22,600	13,000	5,570	5,150	2,030	1,480	1,610
3	2,500	4,740	3,210			17,100	12,400	5,780	5,360	2,180	1,880	1,610
4	2,500	4,740	2,850			19,400	11,200	5,150	5,360	2,030	1,880	1,480
5	2,500	5,360	3,030	3,040	2,340	21,800	11,500	4,740	5,150	2,180	1,240	1,360
6	2,500	4,940	3,210			23,600	11,200	4,940	4,540	1,880	1,300	1,540
7	2,340	4,940				25,400	10,500	4,740	4,540	2,340	1,740	1,540
8	1,180	4,740				23,800	10,200	4,150	4,540	2,030	1,300	980
9	2,500	4,740				22,200	10,000	4,840	4,150	3,030	1,480	1,610
10	2,500	4,540				19,200	9,500	6,200	4,540	1,130	1,480	3,030
11	2,500	3,960				19,000	9,250	6,410	4,340	1,740	1,360	1,420
12	2,500	4,540				18,800	8,750	4,540	4,340	2,180	1,610	1,130
13	1,610	2,850				19,400	8,000	5,150	4,150	2,180	1,540	1,610
14	2,030	5,150	3,950			19,900	7,760	4,940	3,960	2,340	1,420	1,360
15	2,500	4,150				24,200	7,520	4,940	3,770	1,030	1,740	1,300
16	2,500	3,960		2,670	26,000	28,600	7,280	4,940	2,850	2,180	1,610	1,740
17	3,030	3,770				25,400	7,050	4,540	3,390	1,300	2,180	1,740
18	5,360	3,390				24,000	6,410	4,540	3,390	2,340	2,340	1,420
19	3,770	3,580				22,600	6,620	4,340	2,500	1,880	3,030	1,480
20	3,770	3,580				22,000	6,410	4,740	2,500	2,030	2,030	2,180
21	3,030	3,030				21,500	5,990	5,150	2,180	2,340	1,880	1,740
22	3,210	3,390				21,000	6,830	4,340	2,500	2,180	2,030	1,540
23	3,210	2,670				19,900	6,620	5,360	2,340	930	2,030	1,740
24	2,850	3,030				18,800	6,410	6,830	2,030	2,340	1,880	1,360
25	2,670	3,210			26,800	17,800	6,200	7,280	1,360	2,340	2,180	1,880
26	2,670	3,210	3,360	2,670		17,100	6,200	7,760	2,340	1,880	1,680	2,030
27	3,770	3,030				15,700	5,990	8,250	2,180	1,480	1,420	610
28	3,770	3,030				16,800	5,990	7,520	3,030	2,670	1,740	765
29	3,960	2,670				15,700	5,570	7,520	2,340	1,610	1,240	1,680
30	4,740	3,030				15,100	5,360	6,200	2,670	2,030	1,360	885
31	4,540	.....				14,200	.....	6,200	.....	1,300	1,480	.....

NOTE.—Discharge, Mar. 1, 4, 6, 8, 11,13, 15, 18, 20 and 21 interpolated, for lack of gage-height record; estimated Dec. 7 to Feb. 28, because of ice, from gage heights, observer's notes, weather records, and records of flow of Rock River at Rockford, Ill., and Afton, Wis. Braced figures show mean daily discharge for period included.

Monthly discharge of Rock River at Lyndon, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 9,010 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	5,360	1,180	2,960	0.329	0.38
November	5,360	2,670	3,920	.435	.49
December	.....	.....	3,560	.395	.46
January	.....	.....	2,790	.310	.36
February	.....	.....	17,800	1.98	2.06
March	28,600	14,200	20,500	2.28	2.63
April	13,900	5,360	8,320	.923	1.03
May	8,250	4,150	5,550	.616	.71
June	5,780	1,360	3,580	.397	.44
July	3,030	930	1,990	.221	.25
August	3,030	1,240	1,720	.191	.22
September	3,030	610	1,520	.169	.19
The year	.....	610	6,110	.678	9.22

PECATONICA RIVER AT DILL, WIS.

LOCATION.—In sec. 6, T. 1 N., R. 6 E., at Illinois Central Railroad bridge at Dill (Ramona post office), Green County, 1 mile below junction of East and West branches of Pecatonica River and 9 miles above Illinois State line.

DRAINAGE AREA.—959 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch = 6 miles).

RECORDS AVAILABLE.—February 9, 1914, to September 30, 1918.

GAGE.—Chain gage fastened to downstream side of bridge; read by S. A. Frank. Prior to August 2, 1916, vertical staff gage on left abutment.

DISCHARGE MEASUREMENTS.—At low and medium stages made from upstream side of highway bridge about 400 feet above gage; during extremely high water considerable water overflows to left of highway bridge and measurements are made from railroad bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and mud; undoubtedly shifting. Banks only medium height and will be overflowed at flood stages. Except during extreme flood stages all water passes under railroad bridge to which gage is fastened. There is little fall in river below the gage and no well defined control.

EXTREMES OF DISCHARGE.—Maximum stage during year, 13.25 feet at 9 a. m. February 28 (discharge, about 5,850 second-feet); minimum stage, 0.60 foot, at 5 p. m. September 9 (discharge about 176 second-feet).

1914–1918: Maximum stage, 19.1 feet March 27, 1916, determined from flood marks by leveling (discharge, approximately 13,100 second-feet); minimum stage September 9, 1918 (estimated discharge, 176 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Operation of dams at Argyle, on East Branch of Pecatonica River, and at Darlington, on West Branch of Pecatonica River, cause little if any diurnal fluctuation at gage.

ACCURACY.—Stage-discharge relation apparently permanent, throughout the year. Rating curve fairly well defined between 176 and 1,520 second-feet; poorly defined between 1,520 and 6,000 second-feet. Extension of curve above 6,000 second-feet is based on the flow of Pecatonica River at Freeport, Ill. Daily 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 mean daily gage heights corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records subject to error.

Discharge measurements of Pecatonica River at Dill, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Nov. 9	R. B. Kilgore	1.22	308	May 28	T. G. Bedford	2.64	783
Jan. 4[a]	W. G. Hoyt	1.34	244	Aug. 18	W. G. Hoyt	1.50	360
Feb. 8[a]	T. G. Bedford	1.74	216				

[a] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Pecatonica River at Dill, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	283	328	283	235	230	5,400	340	340	404	352	214	210
2	283	328	272	235	225	4,800	328	316	404	364	230	210
3	283	328	272	240	225	4,580	328	294	390	294	226	212
4	294	340	272	240	225	4,330	316	283	364	283	226	208
5	294	340	272	245	220	4,580	305	294	340	283	222	210
6	283	328	261	245	220	4,380	316	305	328	272	228	210
7	283	328	261	245	215	3,930	352	316	328	294	218	206
8	283	316	261	245	215	2,880	352	316	328	272	205	199
9	283	316	230	245	225	1,800	328	328	316	250	186	182
10	283	305	230	245	235	1,720	316	352	340	283	199	196
11	294	305	230	240	290	1,680	305	340	316	316	352	210
12	305	305	226	240	305	1,920	294	316	294	283	550	226
13	316	305	250	240	920	2,980	294	283	272	250	283	230
14	305	305	250	240	1,720	5,080	294	283	250	250	305	242
15	305	305	250	235	2,330	4,860	283	272	244	250	328	228
16	305	305	250	235	2,930	3,780	294	272	242	272	272	224
17	316	305	250	235	2,880	2,600	305	261	240	294	294	220
18	340	294	250	235	2,510	2,330	340	433	240	283	283	226
19	328	294	250	230	2,150	2,330	364	586	242	272	272	210
20	328	283	260	230	1,520	2,150	364	662	248	261	261	194
21	305	283	325	230	1,160	1,840	364	377	250	250	236	197
22	294	283	390	230	950	1,560	364	3,080	261	244	232	201
23	316	272	400	230	825	990	364	2,330	250	234	220	205
24	328	272	390	230	1,880	780	328	1,040	250	244	212	210
25	352	272	365	225	3,630	586	305	624	261	250	214	208
26	390	272	325	225	4,480	418	283	550	305	272	212	208
27	448	272	290	230	5,680	390	283	586	340	272	210	206
28	480	272	275	230	5,820	364	305	740	294	272	197	210
29	377	283	245	235	.....	352	328	586	272	272	190	210
30	352	283	235	230	.....	340	352	497	294	261	208	210
31	352	.....	235	230	.....	340	.....	433	.....	234	210	.....

NOTE.—Stage-discharge relation affected by ice Dec. 13 to Feb. 20.

Monthly discharge of Pecatonica River at Dill, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 959 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	480	283	322	0.336	0.39
November	340	272	301	.314	.35
December	400	226	276	.288	.33
January	245	225	236	.246	.28
February	5,820	215	1,580	1.65	1.72
March	5,400	340	2,450	2.55	2.94
April	364	283	323	.337	.38
May	3,080	261	571	.595	.69
June	404	240	297	.310	.35
July	364	234	274	.286	.33
August	550	186	248	.259	.30
September	242	182	211	.220	.25
The year	5,820	182	586	.611	8.31

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 10, 1914, to September 30, 1918.

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 about 16.0 feet part of the flow passes over left bank and through East Freeport.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.4 feet at 4 p. m. February 15 (discharge, 6,880 second-feet); minimum stage, 3.0 feet at 6 p. m. September 7 (discharge, 208 second-feet).

1914–1918: Maximum stage recorded, 19.4 feet March 28, 1916 (discharge, 17,000 second-feet); minimum stage, 3.0 feet September 7, 1918 (discharge, 208 second-feet).

REGULATION.—A dam and power plant three-quarters of a mile upstream regulate flow past gage. Only slight diurnal fluctuation is noticeable.

ACCURACY.—Stage-discharge relation changed during year; seriously affected by ice during winter. Rating curves well defined between 620 and 6,260 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 tables, except for periods when stage-discharge relation was affected by ice, for which it was ascertained by means of occasional gage heights, observer's notes, weather records, and flow of Pecatonica River at Dill, Wis. Open-water records for medium and high stages good; for low stages fair; winter records poor.

Discharge measurements of Pecatonica River at Freeport, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Nov. 8	3.97	305
May 7	4.80	527
July 31	4.10	395

Daily discharge, in second-feet, of Pecatonica River at Freeport, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	324	461	340			5,970	514	572	652	533	332	290
2	324	442	324			6,140	552	533	652	496	332	276
3	308	500	308			5,970	514	514	632	478	276	318
4	324	540	308			5,380	496	478	612	478	290	361
5	324	500	324	335		5,000	496	425	592	392	290	318
6	340	480	278		350	5,120	496	392	572	442	290	218
7	340	442	221			5,380	514	478	552	442	304	256
8	340	406	248			5,000	552	478	533	408	318	256
9	324	372	278			4,000	572	514	514	376	304	243
10	324	372	293			3,750	514	572	442	408	361	330
11	324	372	293			2,670	478	632	693	408	392	345
12	324	372	278			2,520	478	533	735	460	376	315
13	340	372	263		3,060	2,880	442	496	612	425	552	300
14	356	372	210		4,360	5,520	442	460	442	376	496	345
15	340	356	221		6,490	5,660	442	442	442	318	425	315
16	340	340		320	6,310	5,380	442	425	408	262	442	285
17	372	340			5,520	4,770	442	392	425	376	572	300
18	406	372			4,880	4,090	514	408	425	376	514	270
19	406	372			4,270	3,120	533	533	392	361	442	270
20	389	356			3,670	2,220	552	693	376	361	392	270
21	372	340				1,470	514	714	392	346	304	270
22	372	340				1,140	552	1,440	392	332	276	270
23	406	308	400			1,060	592	2,570	392	290	361	270
24	406	308				801	592	2,220	376	376	332	270
25	424	308			3,200	735	552	1,920	376	361	304	256
26	500	293		305		693	496	1,740	361	361	304	256
27	424	293				672	460	1,860	460	361	304	270
28	480	308				632	425	1,650	572	361	304	270
29	600	340			.....	592	425	1,340	496	460	290	256
30	620	340			.....	572	552	801	392	376	290	270
31	500	.....			.....	572	.....	714	.....	376	304	.....

NOTE.—Discharge estimated Dec. 16 to Feb. 12 and Feb. 21–28, because of ice, from gage heights, observer's notes, weather records, and flow of Pecatonica River at Dill, Wis. Braced figures show mean daily discharge for periods indicated.

Monthly discharge of Pecatonica River at Freeport, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 1,330 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	620	308	386	0.290	0.33
November	540	293	377	.283	.32
December	.....	210	342	.257	.30
January	.....	.....	320	.241	.28
February	6,490	.....	2,440	1.83	1.91
March	6,140	572	3,210	2.41	2.78
April	592	425	505	.380	.42
May	2,570	392	869	.653	.75
June	735	361	497	.374	.42
July	533	262	393	.295	.34
August	572	276	357	.268	.31
September	361	218	285	.214	.24
The year	6,490	210	823	.619	8.40

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, 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, 1918.

GAGE.—Chain gage attached to downstream side of bridge; read by Arthur Christensen.

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

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Control not well defined. Right bank of medium height; rarely overflowed; left bank at gage overflows at stage of approximately 7 feet on the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.9 feet March 14 (discharge, 4,350 second-feet); minimum stage recorded, 0.7 foot at 5 p. m. September 8 (discharge, approximately 54 second-feet).

1914–1918: Maximum stage recorded, 11.4 feet September 13, 1915 (discharge, about 13,000 second-feet); minimum stage recorded, 0.7 foot at 5 a. m., September 8, 1918 (water was undoubtedly being held at the dam); discharge determined from extension of rating curve, about 54 second-feet.

ACCURACY.—Stage-discharge relation fairly permanent throughout the year. Control changes somewhat with floods, but not seriously affected during 1918. Rating curve fairly well defined between 108 and 4,500 second-feet. Gage read daily to quarter-tenths. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods when stage-discharge relation is affected by ice, for which it was 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. Open-water records fair; winter records roughly approximate.

Discharge measurements of Sugar River near Brodhead, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 9	R. B. Kilgore	1.62	246	May 27	T. G. Bedford	2.08	368
Jan. 4[a]	W. G. Hoyt	2.24	145	Aug. 18[b]	W. G. Hoyt	1.06	121
Feb. 7[a]	T. G. Bedford	2.90	182				

[a] Made through complete ice cover, 600 feet downstream from gage.
[b] Made by wading upstream from bridge.

Daily discharge, in second-feet, of Sugar River near Brodhead, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	235	306	248	150	140	2,280	322	354	370	306	222	118
2	222	291	197	150	120	2,160	338	354	338	291	197	150
3	235	291	248	145	110	2,100	322	306	322	291	222	173
4	235	262	248	145	150	3,070	276	262	306	210	173	185
5	210	291	248	165	140	3,180	291	235	291	262	235	197
6	197	276	222	140	175	2,490	291	276	291	222	248	150
7	210	276	222	140	185	1,810	370	388	306	197	262	139
8	248	276	222	130	155	1,440	338	388	306	235	235	81
9	248	276	173	125	175	1,190	291	458	276	276	210	150
10	248	276	195	120	130	785	306	458	306	248	197	173
11	262	235	190	130	195	740	291	405	322	235	139	235
12	248	276	190	120	225	965	276	306	338	210	185	197
13	235	276	185	110	195	3,070	262	306	262	222	248	197
14	185	276	185	130	305	4,350	222	291	276	185	235	173
15	235	276	185	120	440	2,880	276	291	248	235	235	150
16	248	262	185	100	660	1,810	262	276	210	235	235	197
17	262	248	190	100	830	1,540	276	262	210	291	235	235
18	322	210	195	160	965	1,290	338	354	248	210	210	162
19	306	248	210	195	1,010	2,160	354	370	248	210	235	185
20	291	248	220	70	965	1,810	262	322	248	210	210	185
21	197	248	235	85	875	1,640	276	291	210	173	210	210
22	276	248	250	85	785	965	354	1,010	248	210	235	162
23	291	248	250	105	660	545	354	875	197	262	210	173
24	306	222	235	95	785	440	306	1,100	276	210	197	197
25	322	173	210	95	1,060	458	276	660	291	197	139	210
26	370	222	195	145	1,340	405	262	475	306	235	222	173
27	528	222	185	130	2,490	388	262	440	291	210	222	185
28	580	222	175	160	2,420	322	262	510	262	128	248	185
29	620	222	175	165	.....	354	370	458	235	210	222	150
30	545	248	160	145	.....	322	370	405	210	197	186	197
31	338	.....	150	130	.....	291	.....	370	.....	197	210	.....

NOTE.—Stage-discharge relation affected by ice Dec. 10 to Mar. 2.

Monthly discharge of Sugar River near Brodhead, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 529 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	620	185	299	0.565	0.65
November	306	173	255	.482	.54
December	250	150	206	.389	.45
January	195	70	129	.244	.28
February	2,490	110	632	1.19	1.24
March	4,350	291	1,520	2.87	3.31
April	370	222	302	.571	.64
May	1,100	235	428	.809	.93
June	370	197	275	.520	.58
July	306	128	226	.427	.49
August	262	139	215	.406	.47
September	235	81	176	.333	.37
The year	4,350	70	388	.733	9.95

IOWA RIVER AT MARSHALLTOWN, IOWA.

LOCATION.—In sec. 23, T. 84 N., R. 18 W., at Third Avenue highway bridge, 1 mile north of Marshalltown, Marshall County, and about 1 mile below site of old gaging station.

DRAINAGE AREA.—1,380 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 21, 1915, to September 30, 1918; February 23, 1903, to August 8, 1903, from old 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 downstream side of bridge, to which gage is attached.

CHANNEL AND CONTROL.—Bed of stream sandy and subject to change. Right bank not subject to overflow; left bank will be overflowed at stages about 13 feet.

EXTREMES OF DISCHARGE.—Maximum and minimum stages ever recorded occurred during 1918; maximum stage, 17.74 feet June 4 (discharge, 42,000 second-feet); minimum stage recorded, 1.86 feet November 24 (discharge, estimated 2 second-feet).

ICE.—Stage-discharge relation seriously affected by ice December 9 to March 4; observations discontinued during that period.

ACCURACY.—Stage-discharge relation not permanent. Three rating curves, none of them very well defined, used during 1918. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was not determined. Open-water records fair.

Discharge measurements of Iowa River at Marshalltown, Iowa, during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 25	Bolster and Gregg	3.35	479
June 7	A. Davis	15.36	18,700

Daily discharge, in second-feet, of Iowa River at Marshalltown, Iowa, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	94	97	87	.....	300	270	6,820	1,190	427	394
2	81	103	94	.....	300	256	6,970	1,060	410	410
3	91	110	100	.....	315	256	10,100	977	346	316
4	94	113	68	.....	285	241	39,400	852	346	301
5	97	113	65	496	285	241	35,200	1,190	362	272
6	100	113	62	514	270	227	24,600	1,020	362	258
7	12	113	56	532	270	213	6,240	1,280	316	244
8	16	129	5	532	270	227	6,110	1,920	286	230
9	33	113	.....	569	256	569	15,100	1,870	258	230
10	44	113	.....	496	256	461	9,140	1,620	230	216
11	97	113	.....	532	241	362	6,820	1,330	216	230
12	62	129	.....	496	241	444	5,270	1,150	202	230
13	72	146	.....	645	241	723	3,210	935	202	244
14	44	100	.....	684	227	885	2,670	893	202	230
15	36	84	.....	803	227	763	2,130	770	202	316
16	36	87	.....	763	256	763	1,820	770	176	331
17	47	97	.....	885	270	461	1,570	1,020	189	301
18	62	110	.....	1,060	315	1,960	1,280	690	189	272
19	69	113	.....	1,320	331	1,240	1,240	530	216	244
20	62	113	.....	1,010	300	803	2,870	566	286	230
21	97	97	.....	927	315	2,030	4,000	530	461	216
22	129	8	.....	885	362	2,670	5,060	461	612	202
23	110	33	.....	645	346	3,210	1,970	530	690	202
24	100	2	.....	569	362	6,380	2,740	495	690	216
25	78	42	.....	478	300	6,520	2,080	427	730	189
26	146	65	.....	444	285	1,970	1,710	410	770	189
27	129	62	.....	394	270	1,710	1,470	410	770	163
28	113	56	.....	362	107	1,620	1,470	495	690	150
29	110	110	.....	346	256	1,420	1,330	495	566	163
30	103	97	.....	315	270	5,860	1,330	530	461	258
31	110	.....	.....	315	.....	8,580	.....	495	427	.....

NOTE.—Discharge Nov. 22 and 24, and Dec. 8 affected by storage above Marshalltown. Daily discharge for these dates estimated. Stage-discharge relation affected by ice Dec. 9 to Mar. 4; daily discharge not determined.

Monthly discharge of Iowa River at Marshalltown, Iowa, for the year ending Sept. 30, 1918.

[Drainage area, 1,380 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	146	12	79.7	0.058	0.07
November	146	2	92.7	.067	.07
April	362	107	278	.201	.22
May	8,580	213	1,720	1.24	1.43
June	39,400	1,240	7,060	5.11	5.70
July	1,920	410	868	.628	.72
August	770	176	396	.287	.33
September	410	150	248	.179	.21

IOWA RIVER AT IOWA CITY, IOWA.

LOCATION.—In sec. 15, T. 79 N., R. 6 W., at highway bridge 500 feet below Chicago, Rock Island & Pacific Railway main-line bridge; three-quarters of a mile below Iowa State University's power plant, three-quarters of a mile downstream from old gaging station, which was at county highway bridge a short distance above dam.

DRAINAGE AREA.—3,140 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 30, 1913, to September 30, 1918, at present site; June 11, 1903, to July 21, 1906, at old gaging station.

GAGE.—Chain gage, attached to upstream handrail of bridge about 40 feet from left-hand end of first span from left bank; read by A. Kostal.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached, or from a boat about 1,000 feet below highway bridge.

CHANNEL AND CONTROL.—Bed composed of sand; subject to change. Right bank high and will not be overflowed; left bank will be overflowed at high stage under a pile trestle approach to the bridge and beyond left end of the approach at extremely high stage.

EXTREMES OF DISCHARGE.—Maximum stage ever recorded occurred this year; gage height 19.45 feet, June 7 (discharge, 36,200 second-feet); minimum stage during this year, 0.15 foot May 10 (discharge, 190 second-feet); minimum discharge of record, 10 second-feet December 26, 1916.

ICE.—Stage-discharge relation affected by ice during winter period; observations discontinued.

REGULATION.—Considerable diurnal fluctuation at low stages, owing to operation of power plant above station.

ACCURACY.—Stage-discharge relation shifting. Three rating curves used during 1918; the 1917 curve was used to December 5, and is well defined during the period used; curves used March 10 to June 5, and June 6 to September 30, are not well defined. Gage read once daily to half-tenths. Daily discharge ascertained by applying daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which the daily discharge was not determined. All records for 1918 at this station are unsatisfactory on account of persistent shifting of the channel both before and after the record-breaking flood of June.

Discharge measurements of Iowa River at Iowa City, Iowa, during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 25	Bolster and Gregg	2.12	1,170
June 6	A. Davis	16.38	26,200

Daily discharge, in second-feet, of Iowa River at Iowa City, Iowa, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	218	200	142	.....	710	685	7,840	2,700	775	1,410
2	200	200	262	.....	710	660	4,780	2,440	950	1,080
3	158	207	152	.....	765	398	5,000	2,180	890	890
4	136	218	190	.....	710	535	9,030	1,780	890	775
5	158	236	200	.....	685	442	12,100	1,860	890	365
6	225	225	.....	.....	660	635	24,400	1,860	830	610
7	300	218	.....	.....	635	585	33,300	7,220	830	665
8	262	225	.....	.....	685	442	35,300	5,750	890	775
9	262	200	.....	.....	610	535	30,700	5,490	775	460
10	184	190	.....	1,340	710	190	25,700	6,010	665	410
11	190	184	.....	1,280	610	635	20,900	5,620	775	775
12	174	207	.....	1,340	560	635	16,900	3,550	775	775
13	184	225	.....	1,220	585	635	14,800	3,060	890	560
14	190	243	.....	1,160	310	635	11,600	2,180	775	560
15	174	262	.....	1,100	352	585	9,180	2,350	665	775
16	190	280	.....	1,280	442	610	7,660	2,350	830	460
17	184	225	.....	1,100	610	930	6,800	2,020	1,080	560
18	158	236	.....	1,220	635	3,060	4,760	2,020	950	460
19	152	190	.....	1,220	710	1,880	3,550	1,700	775	460
20	136	168	.....	1,280	685	2,160	3,850	1,630	665	460
21	136	174	.....	1,220	820	2,380	4,400	1,410	775	460
22	152	190	.....	1,280	765	2,300	4,400	1,410	775	460
23	158	200	.....	1,340	765	2,300	4,640	1,270	775	460
24	158	225	.....	1,220	738	6,430	3,960	2,020	775	410
25	152	262	.....	1,160	738	7,120	4,520	1,270	890	410
26	158	236	.....	1,100	738	8,560	4,520	1,200	610	365
27	168	207	.....	1,040	710	14,200	4,640	665	665	365
28	136	207	.....	875	685	13,500	4,290	1,140	560	365
29	152	190	.....	875	738	12,800	3,550	1,080	560	342
30	168	168	.....	765	685	11,900	3,160	1,010	3,850	365
31	184	.....	.....	765	.....	11,300	.....	950	2,790	.....

NOTE.—Daily discharge at low and medium stages, unsatisfactory; at high stages they are considered reliable; should be used with caution on account of persistent shifting of the channel during the year. Stage-discharge relation affected by ice Dec. 6 to Mar. 9; daily discharge not determined.

Monthly discharge of Iowa River at Iowa City, Iowa, for the year ending Sept. 30, 1918.

[Drainage area, 3,140 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	300	136	179	0.057	0.07
November	280	168	213	.068	.08
April	820	310	659	.209	.23
May	14,200	190	3,540	1.13	1.30
June	35,300	3,160	11,000	3.50	3.90
July	7,220	665	2,490	.793	.91
August	3,850	560	955	.304	.35
September	1,410	342	576	.183	.20

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 Iowa River. No large 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 to 500,000).

RECORDS AVAILABLE.—February 26, 1915, to September 30, 1918.

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; shifts slightly. Right bank high and will not be overflowed. Levee along left bank broke, causing considerable flooding of cultivated land in June, 1918.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.94 feet, 6 p. m. June 8 (discharge, 63,100 second-feet); minimum stage recorded, 0 foot December 11 (discharge affected by ice). The flood of June, 1892, was probably much higher than the flood of 1918.

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

ACCURACY.—Stage-discharge relation nearly permanent. Two rating curves used during 1918; well defined throughout. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table, except for the period February 21–25, when stage-discharge relation was affected by ice, for which it was ascertained from occasional gage readings and temperature records; stage-discharge relation was also affected by ice from December 6 to February 12, but daily discharges were not determined. Open-water records good; winter records fair.

The following discharge measurement was made by Bolster and Gregg:
March 28: Gage height, 3.16 feet; discharge, 7,090 second-feet.

Daily discharge, in second-feet, of Iowa River, at Wapello, Iowa, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,770	1,630	1,560	.....	7,790	4,190	2,360	23,400	11,000	7,020	7,880
2	1,770	1,630	1,500	.....	7,790	3,990	2,360	22,100	10,700	5,690	6,470
3	1,700	1,770	1,500	.....	8,660	3,790	2,280	20,500	11,700	5,440	5,690
4	1,630	1,770	1,440	.....	9,260	3,590	2,210	22,100	11,700	4,970	4,520
5	1,630	1,700	1,310	.....	8,960	3,590	2,210	28,300	12,100	4,740	4,300
6	1,630	1,700	.....	.....	7,790	3,400	2,210	37,400	16,100	4,520	4,090
7	1,630	1,700	.....	.....	7,510	3,400	2,280	55,800	16,900	4,300	3,880
8	1,770	1,630	.....	.....	6,470	3,400	2,280	59,600	19,200	3,880	3,670
9	1,630	1,630	.....	.....	5,980	3,210	2,280	60,300	17,700	3,470	3,670
10	1,560	1,630	.....	.....	5,280	3,030	2,360	58,300	15,700	3,280	3,670
11	1,560	1,630	.....	.....	5,060	2,850	2,360	53,900	15,400	3,280	3,670
12	1,560	1,700	.....	.....	4,840	2,680	2,680	46,500	13,900	3,280	3,670
13	1,630	1,630	.....	16,900	5,060	2,680	3,210	39,000	11,000	3,280	3,470
14	1,630	1,630	.....	22,100	5,060	2,520	4,190	32,200	9,410	3,470	3,470
15	1,630	1,630	.....	21,300	5,060	2,520	4,400	24,200	8,480	3,470	3,470
16	1,500	1,630	.....	19,200	5,060	2,520	4,620	19,600	8,180	3,470	3,670
17	1,500	1,630	.....	13,200	5,280	2,520	4,840	16,500	7,300	3,470	3,670
18	1,560	1,630	.....	11,800	5,510	2,520	5,060	14,600	6,740	4,090	3,470
19	1,560	1,630	.....	10,200	5,980	2,680	9,570	13,200	6,470	5,940	3,470
20	1,630	1,500	.....	7,510	6,470	2,680	7,510	11,700	6,740	6,740	3,280
21	1,560	1,500	.....	4,500	7,240	2,680	7,510	11,400	6,470	7,300	3,090
22	1,500	1,500	.....	4,000	7,510	2,680	8,660	11,000	6,200	7,590	2,070
23	1,440	1,500	.....	5,000	8,660	2,680	8,360	11,000	6,200	8,480	2,730
24	1,440	1,500	.....	7,000	8,360	2,680	21,700	11,000	6,470	9,410	2,730
25	1,440	1,500	.....	10,000	8,360	2,680	23,800	11,400	6,740	9,410	2,730
26	1,560	1,500	.....	9,260	8,360	2,680	26,500	11,700	5,440	9,730	2,560
27	1,630	1,500	.....	8,070	7,510	2,680	30,700	11,700	4,740	9,410	2,560
28	1,770	1,560	.....	7,790	6,470	2,520	31,200	15,400	4,740	9,100	2,560
29	1,770	1,560	.....	.....	5,980	2,520	32,700	12,400	5,200	9,100	2,560
30	1,700	1,560	.....	.....	5,060	2,360	29,200	11,000	5,440	9,100	2,560
31	1,630	.....	.....	.....	4,620	.....	26,500	.....	5,690	10,000	.....

NOTE.—Stage-discharge relation affected by ice Dec. 6 to Feb. 12 and Feb. 21–25; daily discharge for latter period determined from gage heights corrected for ice effect by means of temperature records.

Monthly discharge of Iowa River at Wapello, Iowa, for the year ending Sept. 30, 1918.

[Drainage area, 12,480 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,770	1,440	1,610	0.129	0.15
November	1,770	1,500	1,610	.129	.14
March	9,260	4,620	6,680	.535	.62
April	4,190	2,360	2,930	.235	.26
May	32,700	2,210	10,300	.825	.95
June	60,300	11,000	25,900	2.07	2.31
July	19,200	4,740	9,670	.775	.89
August	10,000	3,280	6,010	.481	.55
September	7,880	2,070	3,640	.292	.33

CEDAR RIVER AT JANESVILLE, IOWA.

LOCATION.—In sec. 35, T. 91 N., R. 14 W., at Illinois Central Railroad bridge a quarter of a mile below highway bridge 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 to 500,000).

RECORDS AVAILABLE.—April 26, 1905, to September 30, 1906; May 28, 1915, to September 30, 1918.

GAGE.—Chain gage attached to upstream guardrail of bridge about center of left span; read by James Townsend.

DISCHARGE MEASUREMENTS.—Made from upstream side of railroad bridge.

CHANNEL AND CONTROL.—Bed composed of gravel; shifting. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.9 feet, March 20 (discharge, 7,220 second-feet); minimum stage recorded, 0.72 foot October 17 (discharge, 165 second-feet).

1905–6 and 1915–1917: Maximum discharge occurred March 28, 1906 (discharge, 22,600 second-feet); minimum stage recorded, 0.72 foot, October 17, 1917 (discharge, 165 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

REGULATION.—May be slight diurnal fluctuation of water level owing to operation of power plant at Waverly, 9 miles above station.

ACCURACY.—Stage-discharge relation nearly permanent. Rating curve used October 1 to July 29, well defined throughout; from July 30 to September 30, a series of transition curves were used to allow for backwater caused by construction of 4 new piers in the gaging section. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage heights to rating table, except July 30 to September 30. Stage-discharge relation affected by ice December 6 to March 16; daily discharges not determined. Records excellent October to July and fair August and September.

The following discharge measurement was made by Bolster and Gregg:

March 23: Gage height, 4.48 feet; discharge, 2,090 second-feet.

Daily discharge, in second-feet, of Cedar River at Janesville, Iowa, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	537	302	211	.....	471	430	2,400	537	720	490
2	410	288	223	.....	583	316	2,320	606	720	510
3	352	371	214	.....	559	334	3,620	537	580	640
4	352	271	220	.....	559	316	4,170	493	580	560
5	410	281	232	.....	493	316	2,480	537	580	490
6	514	267	.....	.....	493	281	2,240	752	580	400
7	371	261	.....	.....	430	274	1,750	802	510	350
8	267	248	.....	.....	352	312	1,390	630	460	370
9	390	410	.....	.....	334	1,570	1,170	559	440	420
10	352	267	.....	.....	430	752	1,120	559	420	330
11	309	271	.....	.....	430	903	1,010	537	380	670
12	242	217	.....	.....	410	1,390	903	430	380	890
13	275	236	.....	.....	410	1,120	703	430	380	670
14	281	255	.....	.....	410	852	703	430	400	640
15	242	232	.....	.....	334	703	679	430	400	540
16	179	267	.....	.....	390	559	654	451	700	690
17	165	239	.....	2,830	430	630	559	703	3,840	630
18	217	255	.....	3,840	410	606	606	728	2,830	560
19	248	236	.....	5,130	390	1,170	728	654	4,060	500
20	205	275	.....	7,220	390	3,210	852	606	4,060	440
21	239	288	.....	5,520	371	3,110	1,010	583	3,020	370
22	242	309	.....	3,110	334	3,940	1,280	537	1,950	310
23	245	232	.....	2,020	390	1,570	955	493	1,690	290
24	226	236	.....	1,750	371	1,750	728	493	1,200	290
25	242	236	.....	1,230	352	1,340	752	537	1,140	310
26	236	248	.....	1,060	352	1,060	752	852	1,020	550
27	261	255	.....	1,010	352	900	679	3,720	850	580
28	255	248	.....	903	352	1,400	703	2,560	620	530
29	223	214	.....	802	371	2,240	654	1,750	850	500
30	371	217	.....	583	390	3,210	703	720	620	450
31	334	.....	.....	630	.....	3,210	.....	780	590	.....

NOTE.—Discharge May 26 and 27 and Sept. 29 and 30, estimated from Clarksville discharge. Discharge Sept. 17–21 interpolated. Stage-discharge relation affected by ice Dec. 6 to Mar. 16; daily discharge not determined.

Monthly discharge of Cedar River at Janesville, Iowa, for the year ending Sept. 30, 1918.

[Drainage area, 1,660 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	537	165	296	0.178	0.20
November	410	214	264	.159	.18
April	583	334	411	.248	.28
May	3,940	274	1,280	.771	.89
June	4,170	559	1,280	.771	.86
July	3,720	430	788	.475	.55
August	4,060	380	1,180	.711	.82
September	890	290	499	.301	.34

CEDAR RIVER AT CEDAR RAPIDS, IOWA.

LOCATION.—In sec. 28, T. 83 N., R. 7 W., in central part of Cedar Rapids, Linn County, half a mile below dam, between electric-railroad bridge and Eighth Avenue bridge.

DRAINAGE AREA.—At gaging 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 to 500,000).

RECORDS AVAILABLE.—October 26, 1902, to September 30, 1918.

GAGE.—Inclined staff gage fastened to posts driven in right bank of river in rear of plant of Iowa Windmill & Pump Co. plant; read by R. S. Toogood. Elevation of zero of gage from Northwestern Railroad levels, 723.03 feet above sea level.

DISCHARGE MEASUREMENTS.—Made from different bridges in the vicinity of gage, according to the stage.

CHANNEL AND CONTROL.—Bed composed of rock and gravel; free from vegetation; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.9 feet, June 7 (discharge, 27,800 second-feet); minimum stage recorded during year, 2.65 feet, various dates (discharge, 460 second-feet).

1902–1918: Maximum stage recorded, 17.2 feet April 1, 1912, and March 26, 1917 (discharge, 54,200 second-feet); minimum stage recorded, 2.65 feet, July 24–28, 1911 (discharge, 410 second-feet). Greatest known flood probably occurred in June, 1851, when the maximum stage was about 20 feet, and the discharge about 65,000 second-feet.

ICE.—Stage-discharge relation affected by ice, except in very mild winters, when the swift current and the proximity to power plant keep the measuring section open.

REGULATION.—Power dam above gaging station since 1917 produces marked effect on gage readings. There is no dam below gage which might cause backwater.

ACCURACY.—Stage-discharge relation nearly permanent. Rating curve well defined. Gage read once daily, to tenths. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which discharges were not determined. Open-water records excellent.

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

The following discharge measurement was made by Bolster and Gregg:
March 24: Gage height, 5.86 feet; discharge, 8,300 second-feet.

Daily discharge, in second-feet, of Cedar River at Cedar Rapids, Iowa, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,100	680	805	.....	5,180	3,050	1,280	10,000	4,010	5,180	3,320
2	945	945	460	.....	5,180	2,550	1,280	14,800	4,010	3,590	2,800
3	945	680	680	.....	4,590	2,320	1,280	16,300	3,870	2,550	2,550
4	1,100	805	680	.....	4,590	2,080	1,280	17,100	3,590	2,550	2,550
5	1,100	680	680	.....	4,010	2,080	1,280	24,200	3,590	2,550	2,800
6	945	680	.....	.....	3,870	1,860	1,280	23,400	3,870	2,320	2,550
7	945	1,100	.....	.....	3,870	1,860	1,280	26,200	4,590	2,320	2,320
8	945	680	.....	.....	3,590	1,660	1,280	26,200	5,790	2,080	2,080
9	945	680	.....	.....	3,320	1,860	1,460	21,800	7,050	2,080	2,080
10	945	805	.....	.....	3,320	1,460	2,080	17,900	5,790	2,320	1,860
11	945	805	.....	.....	3,590	1,280	2,320	14,000	5,790	2,080	2,320
12	805	680	.....	.....	3,590	1,460	3,870	9,680	4,590	1,860	2,080
13	945	565	.....	.....	3,870	1 460	5,180	8,670	4,010	1,860	1,860
14	945	680	.....	.....	3,590	1,460	5,790	6,410	3,870	1,860	2,320
15	805	565	.....	.....	4,590	1,460	5,790	5.180	3,590	1,860	2,800
16	945	565	.....	.....	4,010	1,460	5,180	4,590	3,050	2,080	2,550
17	680	680	.....	.....	4,010	1,460	4,010	4,010	3,050	2,080	2,550
18	945	680	.....	.....	5,790	1,280	5,180	4,010	3,590	2,080	2,320
19	680	680	.....	.....	6,410	1,460	5,790	3,870	3.870	4,590	2,320
20	680	945	.....	.....	7,050	1,660	5,180	3,590	3,590	7,050	2,080
21	680	680	.....	.....	7,690	1,460	5,790	3,590	3,320	8,340	2,080
22	945	565	.....	.....	8,340	1,460	7,690	3,870	3,050	8,340	1,860
23	680	680	.....	.....	10,400	1,460	9,340	4,590	3,050	8,340	1,860
24	680	680	.....	.....	9,000	1,280	11,400	5,180	2,800	7,690	1,860
25	680	680	.....	.....	7,050	1,280	12,500	5,180	2,500	6,410	1,860
26	680	680	.....	5,790	6,410	1,280	11,100	4,590	2,320	5,790	1,860
27	1,260	565	.....	6,410	4,590	1,280	8,340	4,010	2,800	3,590	1,660
28	1,100	680	.....	5,790	3,870	1,280	9,680	4,010	3,050	4,010	1,660
29	680	805	.....	.....	3,590	1,280	7,690	4,590	5,790	4,010	1,660
30	680	805	.....	.....	3,320	1,280	6,410	4,590	6,410	5,180	1,660
31	805	.....	.....	.....	3,050	.....	7,690	.....	5,180	3,590	.....

NOTE.—Stage-discharge relation affected by ice Dec. 6 to Feb. 25; daily discharge not determined.

Monthly discharge of Cedar River at Cedar Rapids, Iowa, for the year ending Sept. 30, 1918.

[Drainage area, 6,640 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,260	680	876	0.132	0.15
November	1,100	565	713	.107	.12
March	10,400	3,050	5,010	.755	.87
April	3,050	1,280	1,620	.244	.27
May	12,500	1,280	5,150	.775	.89
June	26,200	3,590	10,200	1.54	1.72
July	7,050	2,320	4,050	.610	.70
August	8,340	1,860	3,880	.584	.67
September	3,320	1,660	2,200	.331	.37

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 tributaries enter for several miles up and down stream.

DRAINAGE AREA.—1,660 square miles at station and 2,680 square miles at junction with Cedar River (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 28, 1915, to September 30, 1918.

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 downstream side of bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of rock and sand; probably permanent. Right bank high and will not be overflowed; left bank will probably be overflowed during extreme high stage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.4 feet, August 17 (discharge, 9,380 second-feet); minimum stage, 1.2 feet November 28 (discharge, 135 second-feet).

1915–1918: Maximum stage recorded, 14.7 feet, March 22, 1917 (probably affected by ice); minimum stage recorded, 1.15 feet October 23, 1916 (discharge, 125 second-feet). In April, 1907, a stage of approximately 16.5 feet was reached (discharge, about 19,000 second-feet).

ICE.—Stage-discharge relation affected by ice and observations discontinued during winter.

ACCURACY.—Stage-discharge relation practically permanent; rating curve well defined between 200 and 10,000 second-feet; not well defined outside these limits. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table, except for the following periods; July 28–29, estimated from Janesville, October 1–8, November 7, 8, 10, 12, 14, and 15, discharge interpolated; December 4 to March 18, discharge not determined because of ice effect. Records excellent, except for extremely low and high stages, which are fair.

The following discharge measurement was made by Bolster and Gregg:
March 24: Gage height, 3.42 feet; discharge, 1,290 second-feet.

Daily discharge, in second-feet, of Shellrock River near Clarksville, Iowa, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	203	188	155	.....	485	255	2,730	410	460	592
2	197	212	155	.....	460	240	2,630	410	410	565
3	191	212	155	.....	435	240	2,530	410	365	538
4	185	200	.....	.....	410	225	3,580	365	345	538
5	179	240	.....	.....	410	200	2,730	410	325	510
6	173	225	.....	.....	388	188	2,530	592	308	460
7	167	220	.....	.....	365	188	2,060	650	308	435
8	161	216	.....	.....	325	200	1,490	538	290	410
9	155	212	.....	.....	325	772	1,280	460	290	365
10	155	206	.....	.....	325	4,040	1,000	435	290	365
11	175	200	.....	.....	308	3,360	870	365	272	620
12	155	200	.....	.....	290	1,980	710	345	272	935
13	155	200	.....	.....	272	1,340	650	325	272	740
14	155	192	.....	.....	272	1,000	510	325	272	592
15	175	183	.....	.....	272	805	485	565	272	538
16	165	175	.....	.....	272	680	435	620	2,880	510
17	155	175	.....	.....	290	538	410	538	9,090	485
18	188	175	.....	.....	388	680	388	460	6,570	435
19	188	175	.....	3,360	308	935	388	410	4,400	410
20	188	175	.....	3,700	308	650	565	365	3,360	410
21	188	175	.....	2,340	308	592	435	325	2,440	365
22	188	175	.....	1,810	308	592	388	325	2,060	345
23	175	165	.....	1,500	290	565	388	290	1,900	345
24	175	165	.....	1,280	255	565	388	290	1,730	325
25	175	155	.....	1,000	240	510	365	290	1,420	325
26	200	155	.....	870	240	460	365	2,240	1,200	308
27	200	145	.....	740	225	435	410	2,440	1,000	308
28	240	135	.....	650	240	1,980	620	2,000	805	290
29	225	145	.....	592	272	3,930	485	1,000	710	272
30	212	165	.....	565	255	4,880	388	538	620	272
31	188	.....	.....	510	.....	3,140	.....	485	592	.....

NOTE.—Discharge July 28 and 29 estimated from Janesville discharge. Discharge Oct. 1 to 8, Nov. 7, 8, 10, 12, 14, and 15 interpolated. Stage-discharge relation affected by ice Dec. 4 to Mar. 19; daily discharge not determined.

Monthly discharge of Shellrock River near Clarksville, Iowa, for the year ending Sept. 30, 1918.

[Drainage area, 1,660 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	240	155	182	0.109	0.12
November	240	135	185	.111	.13
April	485	225	318	.192	.22
May	4,880	188	1,170	.704	.81
June	3,580	365	1,070	.645	.74
July	2,440	290	620	.373	.43
August	9,090	272	1,470	.886	1.02
September	935	272	454	.273	.31

SKUNK RIVER AT COPPOCK, IOWA.

LOCATION.—In sec. 36, T. 74 N., R. 8 W., at highway bridge one-eighth of a mile above Chicago, Burlington & Quincy Railroad bridge and a quarter of a mile above junction with Crooked Creek.

DRAINAGE AREA.—2,890 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 21, 1913, to September 30, 1918.

GAGE.—Chain gage attached to downstream side of bridge; read by J. W. Ricks.

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

CHANNEL AND CONTROL.—Bed composed of gravel and sand; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 19.7 feet, 7.30 p. m. June 9 (discharge, 19,600 second-feet); minimum discharge recorded, 78 second-feet October 13.

1913–1918: Maximum stage recorded, approximately 24 feet, May, 1903 (discharge, 30,000 second-feet); minimum discharge, 52 second-feet, October 17, 1917.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

ACCURACY.—Stage-discharge relation changed during high water of February and again during high water of June, requiring use of two rating curves, one applicable October 1 to December 5 and June 11 to September 30, and the other applicable February 14 to June 10; both are fairly well defined. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table, except for periods when stage-discharge relation was affected by ice, for which daily discharges were not determined. Daily discharge interpolated June 23 and August 15. Open-water records good.

The following discharge measurement was made by Bolster and Gregg:

March 28: Gage height, 3.20 feet; discharge, 348 second-feet.

Daily discharge, in second-feet, of Skunk River at Coppock, Iowa, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	104	114	104	.....	1,160	317	317	4,480	2,960	310	520
2	95	114	104	.....	1,280	302	302	3,920	1,760	295	835
3	104	114	104	.....	1,780	288	288	3,830	1,300	280	835
4	114	114	104	.....	1,780	260	274	3,400	995	265	645
5	104	114	104	.....	1,340	260	260	5,700	940	265	405
6	95	104	.....	.....	1,160	317	260	8,540	885	250	340
7	95	104	.....	.....	1,000	317	348	10,700	1,420	238	265
8	95	114	.....	.....	890	317	288	14,000	2,180	226	226
9	95	104	.....	.....	840	288	288	18,000	1,490	214	214
10	95	104	.....	.....	645	288	430	18,800	1,680	202	202
11	95	114	.....	.....	600	274	274	16,200	2,100	202	202
12	86	104	.....	.....	600	274	246	13,500	1,760	190	190
13	78	104	.....	.....	560	260	220	11,300	1,300	179	179
14	95	104	.....	2,840	560	260	233	9,810	1,060	179	168
15	104	124	.....	3,660	520	246	233	8,670	885	179	179
16	95	104	.....	3,570	520	317	233	7,100	835	179	168
17	104	104	.....	3,230	520	348	220	6,020	735	226	157
18	157	104	.....	2,770	520	348	317	4,840	690	340	157
19	124	114	.....	1,650	501	332	1,060	3,830	645	310	146
20	104	104	.....	.....	464	317	690	2,260	600	310	135
21	104	104	.....	.....	447	348	740	1,680	520	1,620	135
22	95	104	.....	.....	430	364	1,160	1,560	520	885	124
23	95	104	.....	.....	430	364	840	1,430	480	600	114
24	86	104	.....	.....	430	348	2,120	1,300	690	1,060	114
25	86	104	.....	890	396	348	4,200	1,760	560	480	124
26	114	95	.....	690	380	348	3,480	1,820	440	440	114
27	208	114	.....	740	364	348	3,830	2,330	405	340	114
28	124	104	.....	840	364	348	5,170	2,960	388	280	114
29	124	104	.....	.....	348	348	7,100	3,290	370	250	104
30	114	114	.....	.....	332	332	7,100	2,480	355	355	114
31	114	.....	.....	.....	332	.....	6,620	.....	340	370	.....

NOTE.—Daily discharge interpolated June 23 and Aug. 15. Stage-discharge relation affected by ice Dec. 6 to Feb. 13 and Feb. 20-24; daily discharge not determined.

Monthly discharge of Skunk River at Coppock, Iowa, for the year ending Sept. 30, 1918.

[Drainage area, 2,890 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	208	78	107	0.037	0.04
November	124	95	108	.037	.04
March	1,780	332	693	.240	.28
April	364	246	314	.109	.12
May	7,100	220	1,580	.547	.63
June	18,800	1,300	6,520	2.25	2.51
July	2,960	340	1,010	.349	.40
August	1,620	179	372	.129	.15
September	835	104	245	.085	.09

SKUNK RIVER AT AUGUSTA, IOWA.

LOCATION.—In sec. 26, T. 69 N., R. 4 W., at highway bridge one-third of a mile from Augusta post office, Des Moines County, and 12.2 miles from mouth of Skunk River, where it empties into pond of Mississippi River Power Co., 32.2 miles above dam at Keokuk, Iowa.

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 to 500,000).

RECORDS AVAILABLE.—September 30, to November 15, 1913; May 27, 1915, to September 30, 1918.

GAGE.—Chain gage attached to downstream handrail of bridge about 95 feet from left abutment; read once daily by L. E. Williamson. Staff gage attached to downstream left side of middle pier, used by engineers of the Hydraulic Engineering Co. of Maine during 1913. Datum of staff gage approximately 0.73 feet higher than datum of chain gage. Staff gage taken out by ice in spring of 1914.

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 only be overflowed at extremely high stage. Remains of old mill dam 600 feet below gage will probably make stage-discharge relation fairly permanent. The riffle at the dam causes a drop of 3 feet at medium low stage. Backwater from the Mississippi may occur once in about 50 years.

EXTREMES OF DISCHARGE.—Prior to 1918: Maximum stage recorded approximately 21 feet about June 1, 1903 (discharge, nearly 45,000 second-feet); minimum discharge recorded, 63 second-feet November 10, 1913; absolute minimum discharge at this station probably 25 second-feet or less.

ICE.—Stage-discharge relation affected by ice December 5 to February 25.

Gage height records withheld from publication until further information can be obtained with which to correct them.

Discharge measurements of Skunk River at Augusta, Iowa, during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 9	Davis and Gregg	3.03	1,020	June 11	A. Davis	16.32	24,400
May 25	do	7.02	7,710	13	Bolster and Hodge	13.51	17,100
30	do	12.06	14,500	Sept. 25	A. Davis	1.60	105

NOTE.—Gage heights liable to ±0.1 foot error.

DES MOINES RIVER AT KALO, IOWA.

LOCATION.—In sec. 17, T. 88 N., R. 28 W., at highway bridge 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 to 500,000).

RECORDS AVAILABLE.—October 18, 1913, to September 30, 1918, except October, 1914, to March 21, 1915, when the station was temporarily discontinued.

GAGE.—Chain gage attached to downstream side of bridge in middle of right span; read by S. C. Fuller.

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

CHANNEL AND CONTROL.—No well-defined control. Bed composed of gravel and is fairly permanent. Point of zero flow estimated to be at gage height −1.0 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.8 feet June 4 (discharge, 11,400 second-feet); minimum stage recorded, 0.5 foot for various days in October, November, and December (discharge, 128 second-feet).

1913–1918: Maximum stage recorded, 14.0 feet, May 30, 1915 (discharge, 18,500 second-feet); minimum stage, 0.2 foot October 5, 1917 (discharge, 57 second-feet).

ICE.—Stage-discharge relation affected by ice and observations discontinued during winter.

ACCURACY.—Stage-discharge relation permanent throughout year. Rating curve well defined between 200 and 12,000 second-feet; extended below 200 second-feet and only roughly approximate. Gage read once daily to quarter-tenths. Daily discharge ascertained by applying daily gage height to rating table, except for the following periods; June 9, July 4, and September 15, for which discharge was interpolated; December 6 to March 16 when stage-discharge relation was affected by ice for which daily discharges were not determined. Records excellent except below 200 second-feet, which are roughly approximate.

The following discharge measurement was made by Bolster and Gregg:
March 23: Gage height, 4.05; discharge, 2,740 second-feet.

Daily discharge, in second-feet, of Des Moines River at Kalo, Iowa, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	236	160	128	.....	840	525	3,720	645	677	1,640
2	196	160	128	.....	775	370	3,740	615	555	1,320
3	178	160	128	.....	872	280	2,980	585	498	1,110
4	216	160	128	.....	710	525	11,400	664	470	905
5	57	160	128	.....	645	420	7,650	742	498	905
6	128	160	.....	.....	615	370	8,130	525	347	872
7	178	144	.....	.....	645	302	9,310	775	347	872
8	160	160	.....	.....	615	280	8,290	1,040	280	775
9	160	178	.....	.....	585	325	6,470	1,040	325	645
10	160	100	.....	.....	525	370	4,650	1,180	420	585
11	144	128	.....	.....	420	585	3,590	1,040	370	840
12	178	160	.....	.....	302	615	2,860	970	370	525
13	196	128	.....	.....	470	970	2,300	872	395	585
14	128	144	.....	.....	470	970	2,000	710	420	710
15	128	128	.....	.....	420	1,040	1,730	645	280	632
16	128	128	.....	.....	645	808	1,560	710	555	555
17	160	144	.....	1,640	525	585	1,400	445	280	585
18	144	128	.....	1,640	585	585	1,180	585	370	710
19	160	114	.....	1,730	555	585	1,180	525	710	555
20	160	114	.....	2,100	585	615	1,110	710	1,320	585
21	160	114	.....	2,520	585	677	1,040	710	1,480	585
22	160	128	.....	2,740	645	710	1,040	872	1,730	555
23	144	128	.....	2,740	585	710	905	445	1,910	525
24	160	160	.....	2,000	585	905	872	555	2,410	470
25	160	100	.....	1,560	585	1,320	840	280	2,630	470
26	160	114	.....	1,320	555	1,480	808	420	2,860	420
27	144	196	.....	1,180	525	2,000	710	470	2,860	258
28	160	196	.....	1,110	445	2,100	775	905	2,740	280
29	160	128	.....	1,040	395	3,220	775	970	2,520	258
30	160	128	.....	905	585	3,590	525	872	2,200	236
31	160	.....	.....	905	.....	3,980	.....	840	1,910	.....

NOTE.—Discharge June 9, July 4, and Sept. 15 interpolated. Stage-discharge relation affected by ice Dec. 6 to Mar. 16; discharge not determined.

Monthly discharge of Des Moines River at Kalo, Iowa, for the year ending Sept. 30, 1918.
[Drainage area, 4,170 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	236	57	159	0.038	0.04
November	196	100	142	.034	.04
April	872	302	576	.138	.15
May	3,980	280	1,030	.247	.28
June	11,400	525	3,080	.739	.82
July	1,180	280	721	.173	.20
August	2,860	280	1,120	.268	.31
September	1,640	236	666	.160	.18

DES MOINES RIVER AT DES MOINES, IOWA.

LOCATION.—In T. 78 N., R. 24 W., at Walnut Street Bridge at Des Moines, Polk County, one-third of a mile above mouth of Raccoon River and 205 miles above mouth of Des Moines River.

DRAINAGE AREA.—6,180 square miles. Effective area at high stages, including Raccoon River, 9,770 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 2, 1902, to August 3, 1903; October 1, 1914, to September 30, 1918, at Walnut Street Bridge. From May 26, 1905, to July 20, 1906, records were collected at Interurban Bridge near Highland Park, about 5 miles above present station. The United States Weather Bureau has maintained a gage at Locust Street Bridge from July 1, 1897, to January, 1912, and at Walnut Street Bridge from January, 1912, to September 30, 1918.

GAGE.—The original Weather Bureau gage is a staff gage at Locust Street Bridge, one block above Walnut Street Bridge. In January, 1912, a Friez water-stage recorder was installed by the United States Weather Bureau near south end of the second pier from east abutment of Walnut Street Bridge. This gage is set to read the same as Locust Street gage. A copper float in a 9-inch pipe connects with the register at top, which is graduated to record graphically stages from 0 to 33 feet. Gage zero is 774.74 feet above sea level.

DISCHARGE MEASUREMENTS.—Made at any one of several bridges below power dam, according to the stage. Channel satisfactory for accurate measurements.

CHANNEL AND CONTROL.—A sheet-piling dam was constructed about 300 feet above the old mouth of Raccoon River about September, 1913. This dam, called a "beauty dam," is for the purpose of raising low-water stage of river a few feet, thus improving the appearance of the river through the park along the bank. The pooled water from this dam extends past gage to power dam at low water. The dam thus forms a fairly permanent control at low stages. It is drowned out at stages of 8 to 10 feet, depending on the stage in Raccoon River. Dam is now in poor repair, and the stage-discharge relation has been affected thereby.

EXTREMES OF STAGE.—Maximum stage recorded during year, 16.5 feet 1.30 a. m. June 7; minimum stage recorded, 2.6 feet September 29.

1897–1918: Maximum stage recorded, 22.6 feet May 31, 1903; minimum stage recorded, 0.8 foot at various times.

ICE.—The effect of the power dam above station is to improve the conditions of winter flow, but severe winters and occasional ice jams below gage seriously affect stage-discharge relation.

REGULATION.—Edison Power & Light Co.'s dam, about one-quarter of a mile above gage, causes slight diurnal fluctuation of stage. This dam is practically drowned out at a stage of 18 feet, although there is a perceptible ripple with a stage of 21 or 22 feet.

COOPERATION.—The gage-height records are furnished by the United States Weather Bureau. They are the readings shown by the graphic records at 8 a. m. Determinations of discharge withheld until additional data are collected.

The following discharge measurement was made by Bolster and Gregg:

March 21: Gage height, 4.72 feet; discharge, 2,300 second-feet.

Daily gage height, in feet, of Des Moines River at Des Moines, Iowa, for the year ending Sept. 30, 1918.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	3.50	3.20	8.10	3.60	3.40	4.30
2	.....	3.40	3.20	7.80	3.50	3.30	4.10
3	.....	3.20	3.20	7.50	3.40	3.00	3.90
4	.....	3.10	3.10	9.00	3.40	3.00	3.70
5	.....	3.10	3.10	10.90	3.50	3.00	3.50
6	.....	3.00	3.10	14.90	3.40	3.00	3.40
7	.....	3.00	2.90	16.30	3.40	2.90	3.20
8	.....	2.90	2.90	16.00	3.50	2.80	3.10
9	.....	2.80	2.90	15.40	3.40	2.80	3.00
10	.....	2.70	2.80	13.40	3.20	2.90	2.90
11	.....	2.70	2.80	10.60	2.80	2.80	2.80
12	.....	2.70	2.80	9.00	3.20	2.90	2.80
13	3.80	2.70	3.50	8.20	3.20	2.70	2.80
14	3.80	2.60	3.90	6.60	3.40	2.70	2.80
15	4.00	2.60	4.00	6.10	3.50	2.90	2.80
16	3.80	3.30	3.90	5.70	3.40	3.00	2.90
17	3.70	3.30	3.90	5.40	3.30	2.90	3.00
18	3.70	3.30	3.80	5.00	3.20	2.80	2.90
19	3.90	3.30	3.60	4.80	3.20	2.80	2.90
20	4.20	3.30	3.50	4.50	3.20	2.80	2.80
21	4.60	3.30	3.40	4.30	3.20	2.90	2.80
22	4.90	3.40	3.40	4.50	3.20	3.40	2.80
23	5.10	3.30	3.50	4.50	3.10	3.70	2.80
24	5.20	3.30	4.50	4.40	3.10	3.90	2.80
25	5.00	3.30	5.20	4.00	3.10	4.20	2.80
26	4.60	3.20	4.50	4.00	2.90	4.50	2.70
27	4.30	3.20	4.90	3.90	2.90	5.00	2.70
28	4.00	3.20	5.20	3.80	2.90	4.80	2.70
29	3.80	3.20	5.10	3.70	3.00	4.70	2.60
30	3.70	3.30	5.90	3.60	2.90	4.60	2.70
31	3.60	.....	7.60	.....	3.10	4.40	.....

NOTE.—Water-stage recorder not in operation Oct. 1 to Mar. 13.

DES MOINES RIVER AT OTTUMWA, IOWA.

LOCATION.—At Market Street Bridge, Ottumwa, Wapello County, Iowa. No large tributary within several miles up or down stream.

DRAINAGE AREA.—13,200 square miles (measured from map issued by the United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—Fragmentary high-water observations 1902–1916; daily records March 29, 1917, to September 30, 1918.

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 about 1,500 feet below gage and by wading.

CHANNEL AND CONTROL.—Channel probably fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 13.9 feet, June 10 (discharge, 41,400 second-feet). Minimum stage recorded 1.3 feet various dates, October and November (discharge, 435 second-feet).

1917–18: Maximum stage recorded, 16.5 feet June 11, 1917 (discharge, 58,700 second-feet; minimum stage, 1.3 feet various days in October and November, 1918. Maximum stage since 1850 and probably in the last century occurred May 31, 1903, and exceeded 100,000 second-feet.

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

ACCURACY.—Stage-discharge relation probably permanent, except as affected by ice. Rating curve fairly well-defined. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for periods when stage-discharge relation was affected by ice, for which daily discharges were not determined. Open-water records good except for July, 1917.

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

The following discharge measurement was made by Bolster and Gregg:

March 21: Gage height, 2.62 feet; discharge, 2,210 second-feet.

Daily discharge, in second-feet, of Des Moines River at Ottumwa, Iowa, for the period Mar. 28, 1917, to Sept. 30, 1918.

Day.	Mar.	Apr.	May.	June.	Aug.	Sept.
1917.						
1	.....	17,100	14,900	6,600	2,080	845
2	.....	13,300	14,500	11,500	2,060	735
3	.....	11,500	11,500	19,200	1,900	735
4	.....	10,400	14,900	17,500	1,900	735
5	.....	10,100	17,100	25,800	1,600	735
6	.....	9,540	14,500	30,000	1,600	2,740
7	.....	8,180	15,200	38,000	1,600	7,380
8	.....	8,180	12,700	40,800	1,460	6,860
9	.....	8,180	10,700	41,400	1,460	4,390
10	.....	8,180	8,990	55,100	1,460	2,390
11	.....	7,910	8,720	58,700	1,460	1,750
12	.....	7,910	8,180	52,300	1,330	1,600
13	.....	7,640	7,910	56,500	1,330	1,600
14	.....	7,640	7,640	52,300	1,330	1,600
15	.....	7,640	7,380	45,700	1,330	1,460
16	.....	7,640	7,120	39,100	1,330	1,330
17	.....	7,640	6,860	33,800	1,330	1,330
18	.....	7,380	6,600	17,800	1,200	1,330
19	.....	7,120	6,340	17,100	960	1,200
20	.....	6,860	6,080	13,300	960	1,200
21	.....	6,860	5,830	12,100	960	960
22	.....	6,600	6,340	10,900	960	960
23	.....	6,600	6,600	9,820	960	735
24	.....	7,120	6,080	8,990	960	735
25	.....	7,380	6,600	8,180	960	625
26	.....	7,120	6,860	7,640	960	625
27	.....	7,120	6,860	7,120	845	625
28	22,700	7,120	6,600	8,720	845	625
29	24,200	7,380	6,600	8,180	845	625
30	23,500	9,540	6,600	8,180	845	625
31	20,600	.....	6,600	.....	845	.....

Day.	Oct.	Nov.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1917-18.										
1	625	625	.....	2,220	1,750	1,080	8,990	3,320	1,080	2,740
2	625	625	.....	2,390	1,750	960	10,700	2,740	1,080	2,930
3	525	435	.....	3,950	1,750	960	11,500	2,220	1,080	4,170
4	525	525	.....	3,950	1,460	845	13,300	2,220	1,330	2,930
5	525	525	.....	3,520	1,460	845	17,800	2,390	1,200	2,390
6	435	435	.....	4,170	1,460	845	21,300	2,390	1,200	1,750
7	525	525	.....	4,170	1,460	845	25,400	2,220	1,200	1,600
8	525	525	.....	3,120	1,330	845	27,000	2,060	1,200	1,600
9	435	435	.....	2,740	1,330	735	33,300	2,060	1,080	1,460
10	525	525	.....	2,740	1,460	735	41,400	2,060	1,080	1,460
11	525	525	.....	2,740	1,330	735	39,700	2,060	1,080	1,200
12	435	435	5,830	2,220	1,200	735	36,900	2,060	960	1,200
13	435	525	7,910	1,900	1,200	735	27,000	2,390	960	1,200
14	435	525	7,380	2,220	1,080	625	22,000	2,220	845	1,200
15	435	435	6,600	2,220	1,080	625	14,200	2,220	845	1,080
16	435	525	3,730	2,060	1,080	625	12,100	2,060	845	1,080
17	435	525	2,220	2,060	1,080	845	8,720	2,060	960	845
18	435	435	.....	2,220	1,080	2,740	7,120	1,750	1,080	845
19	525	525	.....	2,220	1,080	2,740	6,340	1,600	1,330	960
20	525	525	.....	1,900	1,080	1,750	5,580	1,750	1,750	960
21	435	435	.....	2,060	1,080	1,330	4,850	1,750	2,560	960
22	525	525	.....	2,060	1,200	2,560	3,950	1,600	1,900	960
23	525	525	.....	2,220	1,200	2,220	3,730	1,600	2,560	845
24	435	435	.....	2,740	1,200	2,740	15,800	1,330	3,320	845
25	525	525	.....	3,120	1,200	3,320	30,400	1,330	2,220	845
26	625	525	2,560	3,320	1,080	7,640	12,100	1,330	2,560	845
27	525	435	1,750	3,320	1,080	6,340	7,120	1,330	2,560	735
28	625	525	1,600	2,560	1,080	6,340	5,330	1,200	2,560	735
29	625	435	.....	2,390	1,080	13,900	3,950	1,200	2,740	735
30	525	435	.....	2,060	1,080	12,700	3,320	1,200	2,930	735
31	625	.....	.....	2,060	.....	9,540	.....	1,080	2,930	.....

NOTE.—Regular daily gage readings began Mar. 28, 1917. Daily discharge for July, 1917, doubtful, hence not published. Stage-discharge relation affected by ice Dec. 1 to Feb. 11 and Feb. 18–25, 1918: discharge not determined.

Monthly discharge of Des Moines River at Ottumwa, Iowa, for the period Apr. 1, 1917, to Sept. 30, 1918.

[Drainage area, 13,200 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
1917.					
April	17,100	6,600	8,430	0.638	0.71
May	17,100	5,830	9,010	.683	.79
June	58,700	6,600	25,400	1.92	2.14
July					
August	2,060	845	1,280	.097	.11
September	7,380	625	1,640	.124	.14
1917-18.					
October	625	435	512	0.039	.04
November	625	435	499	.038	.04
March	4,170	1,900	2,670	.202	.23
April	1,750	1,080	1,260	.095	.11
May	13,900	625	2,890	.219	.25
June	41,400	3,320	16,000	1.21	1.35
July	3,320	1,080	1,900	.144	.17
August	3,320	845	1,650	.125	.14
September	4,170	735	1,390	.105	.12

DES MOINES RIVER AT KEOSAUQUA, IOWA.

LOCATION.—In sec. 36, T. 69 N., R. 10 W., at county bridge in Keosauqua, Van Buren County, a quarter of a mile above old dam site and Government locks. No large 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 to 500,000).

RECORDS AVAILABLE.—May 30, 1903, to July 21, 1906; April 5 to December 31, 1910 (United States Engineer Corps); August 3, 1911, to September 30, 1918.

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 about a quarter of a mile below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.95 feet June 25 (discharge, 39,800 second-feet); minimum stage recorded 0.20 foot, several days in November and December (discharge, 760 second-feet).

1903–1918: Maximum stage recorded, 27.9 feet June 1, 1903 (discharge, 97,000 second-feet); minimum stage recorded, zero August 28 to September 6, 1911 (discharge, 160 second-feet). On June 1, 1851, a stage of 24 feet was reached (discharge, 80,000 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Observations discontinued during winter.

ACCURACY.—Stage-discharge relation fairly permanent for low and medium stages, except as affected by ice. Three fairly well defined rating curves were used. Gage read once daily to half-tenths. Daily discharge ascertained by applying daily gage height to rating tables except for period when stage-discharge relation was affected by ice, for which daily discharge was not determined; daily discharge usually interpolated on Sundays, when no gage reading was taken. Open water records good.

The following discharge measurement was made by Bolster and Gregg:

March 20: Gage height, 1.14 feet; discharge, 2,150 second-feet.

Daily discharge, in second-feet, of Des Moines River at Keosauqua, Iowa, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,030	890	760	.....	1,970	1,150	9,720	3,700	1,140	3,240
2	1,030	825	760	.....	1,880	1,080	11,200	2,800	1,140	6,600
3	1,030	890	760	.....	1,880	945	12,700	2,600	1,370	5,770
4	1,030	860	760	.....	1,700	1,010	14,600	2,300	1,300	3,460
5	960	825	760	.....	1,620	1,200	20,200	2,120	1,220	2,400
6	960	890	.....	.....	1,540	1,380	22,900	2,120	1,220	2,120
7	960	825	.....	.....	1,500	1,220	25,300	2,080	1,140	1,680
8	960	825	.....	.....	1,460	1,150	28,400	2,030	1,060	1,520
9	890	825	.....	.....	1,380	856	33,500	2,030	1,060	1,370
10	890	825	.....	.....	1,380	856	39,300	1,940	1,060	1,290
11	890	825	.....	.....	1,300	856	39,300	1,940	925	1,290
12	890	825	.....	.....	1,220	856	36,700	2,030	790	1,290
13	825	825	.....	.....	1,220	856	28,800	2,120	995	1,220
14	860	825	.....	.....	1,190	945	19,800	2,080	790	1,140
15	890	825	.....	.....	1,150	856	15,600	2,030	790	1,140
16	890	825	.....	.....	1,220	856	12,400	2,030	790	1,140
17	960	890	.....	.....	1,220	1,460	9,400	1,860	925	995
18	1,500	890	.....	.....	1,220	1,790	7,720	1,770	1,060	995
19	1,030	890	.....	.....	1,220	1,750	6,610	1,680	1,370	995
20	960	825	.....	2,050	1,220	1,700	5,800	1,600	1,370	995
21	890	825	.....	2,100	1,220	2,990	5,000	1,530	2,400	995
22	825	825	.....	2,160	1,220	3,720	4,480	1,450	1,940	960
23	825	825	.....	2,360	1,220	2,360	4,200	1,450	1,770	925
24	890	760	.....	2,560	1,300	3,720	10,300	2,030	4,190	925
25	825	760	.....	2,770	1,220	2,990	40,000	1,450	3,020	858
26	960	760	.....	2,770	1,540	4,800	13,800	1,450	2,030	858
27	960	825	.....	2,990	1,150	6,610	8,000	1,370	2,300	858
28	960	760	.....	2,770	1,190	14,900	4,970	1,500	2,400	858
29	960	760	.....	2,460	1,220	25,600	4,450	2,400	2,400	824
30	960	760	.....	2,360	1,150	15,900	4,080	1,220	2,600	790
31	890	.....	.....	2,160	.....	10,900	.....	1,140	2,800	.....

NOTE.—Gage readings usually omitted on Sundays and discharge interpolated, except June 23, July 28 Aug. 18, and Sept. 1, which were estimated on the basis of climatological data. Stage-discharge relation affected by ice Dec. 6 to Mar. 19; daily discharge not determined.

Monthly discharge of Des Moines River at Keosauqua, Iowa, for the year ending Sept. 30, 1918.

[Drainage area, 13,900 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,500	825	948	0.068	0.08
November	890	760	826	.059	.07
April	1,970	1,150	1,360	.098	.11
May	25,600	856	3,780	.272	.31
June	39,300	4,080	16,600	1.19	1.33
July	3,700	1,140	1,930	.139	.16
August	4,190	790	1,590	.114	.13
September	6,600	790	1,650	.119	.13

RACCOON RIVER AT VAN METER, IOWA.

LOCATION.—In SW. ¼ sec. 22, T. 78 N., R. 27 W., at highway bridge one-third of a mile from railroad station, 1 mile below South Raccoon River, and 30 miles above junction of Raccoon River with Des Moines River.

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 to 500,000).

RECORDS AVAILABLE.—April 25, 1915, to September 30, 1918.

GAGE.—Chain gage attached to downstream handrail of bridge about 25 feet from right end of bridge; read by Fred Vreeland.

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

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 with the water surface slightly higher in the left channel than in the right at extreme low water. Right bank high and not subject to overflow; left bank subject to overflow at a stage of about 13 feet; at extreme high stage this overflow will extend for several thousand feet beyond left end of bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.59 feet June 8 (discharge, 14,600 second-feet); minimum stage, 1.61 feet, September 30 (discharge, 37 second-feet).

1915–1918: Maximum stage recorded, 17.5 feet June 7, 1917 (discharge, 31,800 second-feet); minimum stage recorded, 1.61 feet September 30 (discharge, 37 second-feet).

ICE.—Stage-discharge relation affected by ice December 6 to March 12. Observations discontinued December 13 to February 9.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined throughout. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which daily discharges were not determined. Open-water records excellent, except for extremely low stages, for which they are fair.

The following discharge measurement was made by Bolster and Gregg:

March 22: Gage height, 2.86 feet; discharge, 431 second-feet.

Daily discharge, in second-feet, of Raccoon River at Van Meter, Iowa, for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	188	198	156	.....	243	123	3,120	543	204	86
2	179	170	185	.....	243	116	3,330	459	194	75
3	210	204	173	.....	188	126	3,970	459	201	84
4	188	173	164	.....	226	110	7,590	434	164	82
5	185	134	150	.....	243	120	7,730	408	150	75
6	194	179	.....	.....	243	118	14,300	384	123	60
7	150	210	.....	.....	194	110	13,000	361	116	46
8	108	188	.....	.....	210	116	14,600	361	103	50
9	123	162	.....	.....	204	123	13,000	361	86	54
10	118	210	.....	.....	194	98	11,200	361	75	71
11	123	167	.....	.....	179	96	9,840	361	91	77
12	116	179	.....	.....	173	91	10,900	318	98	91
13	134	185	.....	633	167	98	8,160	298	91	67
14	136	198	.....	697	131	108	4,190	318	86	54
15	93	204	.....	665	170	110	3,430	318	89	136
16	110	204	.....	602	204	98	2,430	261	98	123
17	120	201	.....	514	173	100	2,140	279	108	116
18	159	167	.....	514	156	110	1,760	298	3,220	108
19	156	123	.....	486	173	123	1,670	261	459	91
20	164	162	.....	459	182	194	1,310	243	210	64
21	167	179	.....	434	194	486	1,230	210	194	46
22	179	194	.....	459	210	434	1,060	210	173	56
23	194	164	.....	361	194	834	907	226	159	52
24	170	136	.....	340	179	3,640	764	170	150	54
25	150	131	.....	361	150	2,330	697	136	142	58
26	145	136	.....	318	118	1,670	633	134	136	48
27	150	164	.....	279	116	5,860	602	123	150	46
28	134	156	.....	279	136	3,750	633	150	145	44
29	164	173	.....	279	123	2,430	602	179	139	41
30	188	179	.....	261	118	2,720	572	210	136	37
31	243	.....	.....	279	.....	2,920	.....	210	145	.....

NOTE.—Stage-discharge relation affected by ice Dec. 6 to Mar. 12; daily discharge not determined.

Monthly discharge of Raccoon River at Van Meter, Iowa, for the year ending Sept. 30, 1918.

[Drainage area, 3,410 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	243	93	156	0.046	0.05
November	210	123	174	.051	.06
April	243	116	181	.053	.06
May	5,860	91	947	.278	.32
June	14,600	572	4,850	1.42	1.58
July	543	123	292	.086	.10
August	3,220	75	246	.072	.08
September	136	37	69.7	.020	.02

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, 1918; also March 10, 1903, to July 21, 1906, for station at Peoria and Pekin Union Railroad bridge.

GAGE.—Vertical staff gage attached to wooden pile; read by employee of United States Army Engineers.

DISCHARGE MEASUREMENTS.—Made from downstream side of Lower Free bridge, about 2 miles below gage.

CHANNEL AND CONTROL.—Bed of river, which forms control for medium and high stages, composed of mud, and may shift. Dam at Copperas Creek probably forms control for lowest stages; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 19.8 feet February 20 and 21 (discharge, 41,800 second-feet); minimum stage, 10.0 feet September 28 (discharge, 10,000 second-feet).

1910–1918: Maximum stage recorded, 23.2 feet January 25, 1916 (discharge not determined because of backwater from ice); maximum stage recorded during open-water periods, 22.4 feet March 30 to April 2, 1913 (discharge, 55,000 second-feet); minimum stage, 8.0 feet December 14, 1910 (discharge, 7,250 second-feet).

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; seriously affected by ice during winter. Rating curve well defined between 11,000 and 40,000 second-feet and fairly well defined beyond these limits. Gage read to half-tenths once daily. Daily discharge ascertained by applying 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 daily gage heights corrected for ice effect by means of observer's notes and weather records, and by comparison with flow of adjacent streams. Open-water records good; winter records poor.

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

Discharge measurements of Illinois River at Peoria, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Oct. 16	10.68	10,600
June 12	13.28	16,700
Aug. 23	10.60	10,800

Daily discharge, in second-feet, of Illinois River at Peoria, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	11,300	12,100	11,900			35,800	20,800	16,900	18,400	13,000	12,500	10,600
2	11,100	12,100	11,900			34,800	20,200	17,200	19,000	13,600	12,300	10,600
3	10,900	11,900	12,300			34,800	20,500	17,500	18,700	13,800	12,300	10,800
4	10,900	12,300	11,900			34,800	19,600	17,500	18,400	14,000	11,900	10,900
5	10,800	12,300	11,900			34,800	18,700	17,500	18,100	14,200	11,600	10,900
6	10,800	12,500	11,900	9,860		34,800	18,400	17,500	17,800	15,000	11,600	10,600
7	10,900	12,700	11,800			34,800	18,100	17,200	17,800	15,200	11,300	10,600
8	10,900	12,700	11,900		11,400	33,900	18,100	17,200	17,200	15,800	11,600	10,400
9	10,900	12,700	11,600			33,900	18,400	16,600	16,400	16,400	11,400	10,600
10	10,900	12,700	11,600			33,400	17,800	17,200	16,400	15,600	11,300	10,800
11	10,800	12,700				31,600	16,900	16,900	16,000	15,600	11,300	10,600
12	10,900	13,000				30,800	16,600	16,900	15,800	15,800	11,300	10,900
13	10,900	12,700				30,800	16,200	16,600	15,400	15,800	10,900	10,800
14	10,900	12,700				29,800	16,000	16,600	15,200	15,600	11,300	10,900
15	11,100	12,500				29,400	15,800	16,400	15,000	15,200	11,600	10,900
16	11,100	12,700	11,100		27,300	29,000	15,400	16,400	14,200	15,000	11,300	10,900
17	11,300	12,700			33,900	29,000	15,400	16,400	14,400	15,000	11,300	10,600
18	11,300	12,700			38,800	28,500	15,200	16,400	14,000	14,800	11,300	10,400
19	11,400	12,700			40,800	28,500	15,400	16,000	13,800	14,600	11,300	10,600
20	11,400	12,300			41,800	28,100	15,400	16,600	14,400	14,200	11,300	10,600
21	11,600	12,300		9,440	41,800	27,700	14,600	16,600	13,400	14,000	10,900	10,600
22	11,400	13,000			41,300	27,700	14,600	16,600	13,400	13,600	10,900	10,300
23	11,600	12,700			39,800	26,900	15,000	16,900	13,000	13,400	10,900	10,300
24	11,600	12,300			38,800	26,100	15,400	17,200	12,500	13,000	10,900	10,300
25	11,600	12,300			38,300	25,300	15,800	17,200	13,000	13,000	10,900	10,400
26	11,100	12,300	10,300		37,800	24,500	16,200	17,200	12,700	13,000	10,800	10,600
27	11,600	12,100			37,300	24,100	16,200	17,800	12,700	13,000	10,800	10,300
28	11,600	11,900			36,800	22,900	16,200	18,400	12,800	12,700	10,400	10,000
29	12,300	12,300			.....	22,500	15,400	18,400	13,000	12,800	10,600	10,200
30	11,900	11,900			.....	21,700	16,600	18,400	13,000	12,800	10,600	10,300
31	11,900	.....			.....	20,800	.....	18,400	.....	12,700	10,800	.....

NOTE.—Stage-discharge relation affected by ice Dec. 11 to Feb. 15; daily discharge determined from gage heights corrected for ice effect by means of weather records and comparisons with flow at other stations up stream. Braced figures show mean daily discharge for periods included.

Monthly discharge, in second-feet, of Illinois River at Peoria, Ill., for the year ending Sept. 30, 1918.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October	12,300	10,800	11,200	May	18,400	16,000	17,100
November	13,000	11,900	12,500	June	19,000	12,500	15,200
December	12,300	.....	11,100	July	16,400	12,700	14,300
January	.....	.....	9,580	August	12,500	10,400	11,300
February	41,800	.....	23,800	September	10,900	10,000	10,600
March	35,800	20,800	29,400				
April	20,800	14,600	16,800	The year.	41,800	.....	15,200

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 22, 1905, to July 20, 1906; December 3, 1914, to September 30, 1918.

GAGE.—Chain gage attached to bridge, over left channel; read by Oscar Conrad.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge across the two channels during medium and high stages, and by wading during low stages.

CHANNEL AND CONTROL.—Bed composed of coarse gravel; may shift. River at gage divided into two channels by an island. Aquatic plants sometimes grow in bed of river during summer.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.6 feet February 14–18 (discharge not determined because of backwater from ice); maximum

stage recorded during open-water period, 4.2 feet at 1 p. m. February 25 (discharge, 6,300 second-feet); minimum stage, 1.44 feet at 11 a. m. August 29 (discharge, 442 second-feet).

1905–6 and 1915–18: Maximum stage recorded, 7.5 feet January 21, 1916 (discharge not determined because of backwater from ice); maximum open-water stage, 6.4 feet January 22, 1916 (discharge estimated from extension of rating curve, 12,600 second-feet); minimum discharge, 360 second-feet, July 13–20, 1906.

ACCURACY.—Stage-discharge relation changed during year; seriously affected by ice during winter. Rating curve used to February 20 well defined; curve used after that date well defined between 550 and 3,100 second-feet, and fairly well defined beyond those limits. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating daily gage heights corrected for ice effect by means of observer's notes and weather records. Open-water records good; winter records approximate.

Discharge measurements of Kankakee River at Momence, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Apr. 20	2.30	1,410
July 23	1.67	621
Aug. 31	1.62	573

Daily discharge, in second-feet, of Kankakee River at Momence, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	534	1,420	915			5,740	2,570	1,480	1,580	792	592	592
2	534	1,420	945			5,460	2,460	1,480	1,480	792	550	592
3	498	1,420	945			5,460	2,340	1,480	1,390	792	550	592
4	486	1,420	945			5,180	2,220	1,480	1,390	792	550	592
5	486	1,420	945			5,180	2,220	1,480	1,300	792	550	550
				500	390							
6	474	1,420				4,910	2,110	1,480	1,220	792	550	550
7	474	1,420				4,910	2,000	1,480	1,060	792	512	550
8	462	1,420				4,910	2,000	1,480	1,060	792	512	550
9	462	1,330				4,910	1,890	1,480	980	792	512	550
10	462	1,330				4,640	1,780	1,480	980	735	475	550
			640									
11	510	1,330				4,640	1,780	1,480	980	735	475	550
12	558	1,330				4,640	1,780	1,480	915	735	475	550
13	570	1,240				4,640	1,680	1,580	915	735	512	550
14	609	1,150				4,910	1,680	1,580	850	792	475	592
15	622	1,150				4,910	1,580	1,580	850	792	475	592
				390	4,670							
16	622	1,070				4,910	1,580	1,680	792	792	475	592
17	648	1,070				4,640	1,580	1,780	735	792	475	635
18	648	1,070				4,370	1,480	1,780	735	792	550	592
19	674	1,070				4,100	1,480	1,780	685	792	475	592
20	714	1,070				4,100	1,480	1,890	685	792	475	592
21	714	1,070				6,020	4,100	1,480	1,890	685	735	475	550
22	714	990				6,020	3,830	1,480	1,890	685	735	475	550
23	770	990				5,740	3,830	1,480	2,110	685	735	475	550
24	826	990	570			6,020	3,560	1,480	1,890	685	685	475	550
25	826	960				6,300	3,560	1,480	1,890	635	685	470	550
				330								
26	900	945				6,020	3,300	1,480	1,890	635	685	464	550
27	975	945				6,020	3,300	1,480	1,780	635	685	464	550
28	1,070	945				5,740	3,180	1,480	1,780	635	635	453	550
29	1,150	930				.....	2,930	1,480	1,780	685	592	442	550
30	1,240	930				.....	2,810	1,480	1,680	792	592	512	550
31	1,330	.....				.....	2,690	.....	1,680	.....	592	550	.....

NOTE.—Discharge Dec. 6 to Feb. 20 estimated, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Kankakee River at Momence, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 2,340 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,330	462	696	0.297	0.34
November	1,420	930	1,180	.504	.56
December	945	.....	652	.279	.32
January	.....	.....	404	.173	.20
February	6,300	.....	3,520	1.50	1.56
March	5,740	2,690	4,330	1.85	2.13
April	2,570	1,480	1,750	.748	.83
May	2,110	1,480	1,670	.714	.82
June	1,580	635	911	.389	.43
July	792	592	741	.317	.37
August	592	442	499	.213	.25
September	635	550	567	.242	.27
The year	6,300	.....	1,400	.598	8.08

KANKAKEE RIVER AT CUSTER PARK, ILL.

LOCATION.—In sec. 19, T. 32 N., R. 10 E., at 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, 1918.

GAGE.—Chain gage attached to bridge; read by J. H. Swords.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of solid rock strewn with boulders and gravel. Right half of channel deep with fissures in bed; left half shallow; may shift slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.0 feet at 1 and 6 p. m. February 14 (discharge not determined because of backwater from ice); maximum stage recorded during open-water periods, 13.0 feet at 9 a. m., February 16 (discharge, 22,700 second-feet); minimum stage, 4.95 feet October 4 and 5 and August 15 (discharge, 430 second-feet).

1915–1918: Maximum stage recorded, same as for 1918; minimum stage, 4.09 feet November 15, 1914 (discharge not determined; mean discharge for the day, estimated 250 second-feet).

REGULATION.—Operation of power plant at Kankakee causes slight fluctuation at gage.

ACCURACY.—Stage-discharge relation changed slightly during year; seriously affected by ice during winter. Rating curve well defined above and fairly well defined below 1,820 second-feet. Gage read to hundredths twice daily. Daily 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 estimated from occasional gage heights, observer's notes, and weather records. Open-water records good; winter records poor.

Discharge measurements of Kankakee River at Custer Park, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Oct. 17	5.07	509
July 16	5.59	1,030
Sept. 7	6.45	2,590

Daily discharge, in second-feet, of Kankakee River at Custer Park, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	657	2,060	1,000			9,100	2,690	4,630	4,630	5,640	680	940
2	546	2,320	1,070			8,790	2,600	4,390	4,150	4,630	634	758
3	546	2,410	1,000			8,480	2,600	3,680	3,270	3,910	588	784
4	546	2,320	940			7,880	2,690	3,270	2,600	3,070	546	810
5	518	2,150	1,000			7,580	2,690	2,880	2,230	2,410	588	875
				680								
6	527	2,150				7,290	2,880	2,600	1,900	2,060	565	1,440
7	657	2,060				7,000	2,690	2,410	2,060	1,900	536	2,500
8	611	1,980			4,260	6,720	2,600	2,320	1,980	1,900	565	2,500
9	680	1,980				6,440	2,410	2,410	2,410	2,060	565	1,980
10	565	1,900				6,170	2,320	3,070	2,320	2,500	600	1,510
			710									
11	657	1,740				5,380	2,150	2,880	1,900	2,410	470	1,280
12	565	1,820				5,380	2,150	3,270	1,660	2,060	536	1,210
13	680	1,660				5,130	1,980	3,680	1,360	1,660	498	1,070
14	758	1,580				5,380	1,900	3,910	1,280	1,360	498	1,000
15	634	1,440				6,170	1,580	4,150	1,210	1,280	462	940
				600								
16	588	1,510			21,300	5,900	1,740	3,680	1,210	1,140	480	940
17	706	1,440			18,400	5,640	1,820	3,270	1,000	1,070	565	940
18	784	1,360			15,000	5,130	1,980	2,690	940	1,000	565	940
19	771	1,360			13,000	4,880	2,150	2,880	810	940	518	940
20	1,000	1,280			13,600	4,390	2,410	2,880	810	940	498	875
21	1,000	1,210			13,600	4,150	3,070	3,070	771	810	480	810
22	1,000	1,360			11,600	3,910	4,150	3,270	693	784	536	784
23	1 070	1,070			10,400	3,910	5,130	3,270	668	810	576	758
24	1,070	1,210	680		9,410	3,910	4,630	3,270	693	668	556	706
25	1,070	1,210			8,790	3,680	3,910	4,150	657	680	470	745
				470								
26	1,210	1 210			8,180	3,680	3,470	4,150	622	810	611	758
27	1,140	1,070			8,480	3,470	3,270	3,910	646	940	565	732
28	1,210	1,070			8,480	3,270	3,270	3,470	1,000	758	527	634
29	1,360	1,070			.....	3,070	4,150	2,880	1,740	940	518	680
30	1,440	1,070			.....	2,880	4,630	3,070	3,680	940	745	634
31	1,740	.....			.....	2,690	.....	4,150	.....	745	680	.....

NOTE.—Discharge Dec. 6 to Feb. 15 estimated, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Kankakee River at Custer Park, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 4,870 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,740	518	849	0.174	0.20
November	2,410	1,000	1,600	.329	.37
December	1,070	.....	742	.152	.18
January	.....	.....	580	.119	.14
February	.....	.....	8,000	1.64	1.71
March	9,100	2,690	5,400	1.11	1.28
April	5,130	1,580	2,860	.587	.65
May	4,630	2,320	3,340	.686	.79
June	4,630	622	1,700	.349	.39
July	5,640	668	1,700	.349	.40
August	745	462	556	.114	.13
September	2,500	634	1,050	.216	.24
The year	.....	462	2,320	.476	6.48

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; 8 miles above junction of Des Plaines River and Chicago Drainage canal.

DRAINAGE AREA.—705 square miles.

RECORDS AVAILABLE.—November 4, 1914, to September 30, 1918.

GAGE.—Enamel staff gage attached to bridge; read by William Weck, jr.

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

CHANNEL AND CONTROL.—A concrete dam, forming a new control and changing the former stage-discharge relation, was built across the channel about 500 feet below the gage August 20, 1916; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.6 feet at 4 p. m. February 16 (discharge not determined because of backwater from ice); maximum stage recorded during open-water period, 5.4 feet March 2 (discharge, 2,700 second-feet); minimum stage, 2.44 feet August 12 and 28 (discharge, 6 second-feet).

1915–1918: Maximum stage recorded, 6.6 feet February 16, 1918 (discharge not determined because of backwater from ice); maximum stage recorded during open-water periods, 5.9 feet June 10, 1916 (discharge, 3,380 second-feet); minimum discharge, 3.9 second-feet (measured by current meter), November 26 1914.

ACCURACY.—Stage-discharge relation permanent; affected by ice February 14 to 28. Rating curve well defined between 120 and 2,220 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage heights to rating table, except for periods noted in footnote to daily-discharge table. Open-water records good for medium and high stages, fair for low stages; winter records fair.

The following discharge measurement was made by H. C. Beckman while river was frozen across but crest of dam was clear of ice:

January 29, 1918: Gage height, 2.54 feet; discharge, 21 second-feet.

Daily discharge, in second-feet, of Des Plaines River at Lemont, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	22	180	63	22	10	2,580	400	852	445	40	28	22
2	10	150	63	20	10	2,700	357	760	400	33	31	22
3	9	150	52	17	10	2,580	301	715	280	33	28	17
4	22	150	52	17	10	2,460	245	625	232	33	28	22
5	17	138	70	17	14	2,460	245	492	212	33	15	28
6	22	138	63	17	17	2,460	180	476	174	44	9	33
7	22	120	63	17	17	2,340	150	415	180	40	9	22
8	22	110	63	17	17	1,980	193	385	156	31	7	10
9	17	110	22	17	17	1,860	238	357	132	24	9	9
10	22	95	22	17	17	1,740	206	385	132	28	9	10
11	28	95	22	17	17	1,570	180	422	120	28	7	9
12	33	85	22	17	1,050	1,410	193	385	100	31	6	22
13	28	85	22	17	1,740	1,460	168	415	80	19	7	33
14	22	70	20	17		1,860	144	422	70	15	24	28
15	22	95	17	17		2,460	120	408	110	17	15	22
16	22	95	20	17		2,580	80	329	70	48	15	17
17	33	95	22	17		2,340	132	245	63	55	48	17
18	95	70	25	17		2,220	174	232	48	33	31	10
19	85	52	28	17		1,860	212	174	44	28	15	22
20	70	52	40	14		1,740	219	174	31	28	10	22
21	63	44	52	10	2,300	1,460	301	193	22	19	19	6
22	52	70	58	10		1,250	430	212	31	22	19	6
23	52	63	63	10		1,100	625	371	24	22	19	9
24	63	52	66	10		900	670	805	24	19	15	17
25	52	52	70	10		805	540	805	40	31	9	22
26	52	52	61	10		670	500	715	31	40	9	10
27	95	52	52	10		540	492	625	24	66	9	6
28	95	44	42	10		524	445	540	33	110	6	9
29	120	63	33	10	.....	492	625	500	40	66	7	10
30	120	52	28	10	.....	460	805	524	28	40	9	9
31	138	.....	22	10	.....	460	.....	476	.....	40	28	.....

NOTE.—No gage reading, every other day Nov. 10 to Jan. 24, Jan. 27, 29, 31, and Feb. 2, 3, 5, 7, 9, and 10; daily discharge interpolated. Mean daily discharge estimated Feb. 14-28, because of backwater from ice, from gage heights, observer's notes, and weather records.

Monthly discharge of Des Plaines River at Lemont, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 705 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	138	9	49.2	0.070	0.08
November	180	44	89.3	.127	.14
December	70	17	42.5	.060	.07
January	22	10	14.7	.021	.02
February	.....	10	1,340	1.90	1.98
March	2,700	460	1,660	2.35	2.71
April	805	80	319	.452	.50
May	852	174	466	.661	.76
June	445	22	113	.160	.18
July	110	15	36.0	.051	.06
August	48	6	16.1	.023	.03
September	33	6	16.7	.024	.03
The year	.....	6	340	.482	6.56

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.—Not measured.

RECORDS AVAILABLE.—December 3, 1914, to September 30, 1918; 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, 12,500 second-feet, February 15; minimum mean daily discharge, 6,960 second-feet, February 3.

1914–1918: Maximum mean daily discharge during days of record, 13,200 second-feet, June 10, 1916; minimum mean daily discharge, 5,420 second-feet, April 25, 1915.

DIVERSIONS.—Water is diverted to the Illinois & Michigan canal at dam No. 1, about 100 feet above the gage.

REGULATION.—Flow past the gage is largely regulated by the operation of the power plant of the Chicago sanitary district at Lockport, which utilizes the flow of the Chicago Drainage canal and, to a lesser extent, by the operation of Economy Light & Power Co.'s plant, about 100 feet above gage.

ACCURACY.—Stage-discharge relation permanent; not affected by ice during winter. Rating curve well defined. Operation of the water-stage recorder satisfactory except as noted in the table of daily discharge. Daily discharge ascertained by use of discharge integrator. Records excellent.

Discharge measurements of Des Plaines River at Joliet, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Mar. 19 [a]	5.02	9,180	July 23 [b]	.....	348
19 [b]	.....	379	Sept. 14 [b]	.....	348
Nov. 23 [b]	.....	526			

[a] Made in Des Plaines River. [b] Made in Illinois & Michigan canal.

Daily discharge, in second-feet, of Des Plaines River at Joliet, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8,800	8,740	8,730	7,080	7,730	10,300	8,230	9,060	9,470	9,160	9,270	7,110
2	8,500	8,760	8,280	7,830	7,450	9,960	8,480	8,680	8,900	8,540	8,720	7,470
3	8,370	8,540	8,680	7,890	6,960	10,700	8,680	[a]8,850	8,980	9,780	8,580	8,270
4	[a]8,700	8,040	8,560	7,600	7,370	11,100	8,300	[a]9,090	8,960	8,620	8,640	[b]
5	9,070	8,270	8,800	7,480	7,840	11,100	8,170	[a]8,620	9,460	9,510	8,340	[b]
6	9,250	8,450	8,750	8,130	7,740	11,700	8,120	8,520	9,820	[a]8,710	8,940	[b]
7	7,810	8,670	8,700	7,860	7,830	11,200	7,650	8,520	9,920	8,860	9,300	[b]
8	9,070	8,540	9,100	8,060	8,420	10,200	8,090	8,540	9,010	9,720	9,360	7,390
9	8,950	8,400	7,280	7,900	8,320	9,840	8,450	8,400	8,590	9,600	8,920	7,380
10	8,960	8,630	8,470	8,140	7,800	10,100	8,610	8,740	8,980	9,710	8,680	7,660
11	8,860	7,880	8,280	8,230	7,730	9,340	8,400	8,450	8,490	9,820	8,700	7,500
12	8,780	8,620	8,470	6,560	10,200	9,180	7,960	8,440	[a]8,370	9,840	9,780	7,470
13	9,070	8,570	7,910	6,670	9,900	9,570	7,920	8,620	[a]8,320	9,500	8,580	8,300
14	7,530	8,950	8,060	6,480	10,700	10,700	7,830	8,380	8,740	9,680	8,800	[a]8,560
15	8,710	8,660	7,880	[b]	12,500	11,200	7,920	8,470	9,100	9,390	9,390	[a]8,200
16	8,500	8,820	7,030	[b]	11,600	10,400	8,030	8,460	8,840	9,360	8,610	[a]8,300
17	8,700	[b]	8,060	7,160	11,000	10,400	8,190	8,200	9,510	9,230	8,860	[a]8,150
18	8,700	[b]	8,090	[a]7,060	10,300	10,300	8,400	9,440	9,870	8,280	8,800	[a]8,150
19	8,740	[b]	8,000	[a]7,660	10,600	10,100	8,350	8,690	8,910	8,180	8,620	[a]8,240
20	8,530	[b]	8,070	6,970	10,400	9,950	8,650	8,370	8,780	8,000	8,520	[a]8,430
21	8,100	[b]	8,220	7,510	10,200	9,480	8,370	8,560	8,700	8,140	8,300	[a]8,530
22	8,190	[b]	8,110	7,190	10,200	9,680	8,050	8,510	9,110	9,420	8,860	[a]7,580
23	8,700	[b]	6,970	7,790	9,900	9,120	[a]8,520	8,580	8,790	9,540	8,970	[a]7,830
24	9,160	[b]	7,740	7,490	9,640	9,400	[a]8,700	9,000	9,550	8,840	8,180	[a]8,170
25	8,900	8,180	7,260	7,860	9,960	8,810	[a]8,900	9,000	9,620	8,590	8,1 0	[a]8,220
26	8,880	9,000	8,050	7,610	9,870	8,940	9,060	8,670	9,920	8,440	8,470	[a]8,200
27	9,210	8,980	7,870	7,630	9,870	8,720	8,660	9,120	9,360	8,700	8,630	[b]
28	7,830	9,250	7,820	7,610	10,200	8,540	[a]9,000	9,520	9,600	8,820	8,200	8,180
29	8,640	7,650	8,080	7,610	.....	8,340	[a]8,720	9,440	9,220	9,540	8,180	8,020
30	8,840	8,980	7,030	7,640	.....	8,040	[a]9,300	9,210	8,590	9,450	8,080	8,360
31	8,910	.....	8,170	7,760	.....	7,540	.....	10,300	.....	8,780	7,980	.....

[a] Discharge partly estimated because of incomplete gage record. [b] No record.

NOTE.—Daily discharge in the above table does not include the flow in the Illinois & Michigan canal. (See "Diversions" in the station description.)

Monthly discharge, in second-feet, of Des Plaines River at Joliet, Ill., for the year ending Sept. 30, 1918.

Month.	Maximum.	Minimum.	Mean.
October	9,250	7,530	8,680
December	9,100	6,970	8,080
February	12,500	6,960	9,370
March	11,700	7,540	9,800
April	9,300	7,650	8,390
May	10,300	8,200	8,790
June	9,920	8,320	9,120
July	9,840	8,000	9,090
August	9,780	7,980	8,690

NOTE.—Discharge in the above table does not include flow of the Illinois & Michigan canal, which diverts water around the gage. See "Diversions" in station description and measurements of flow in the canal.

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 500 feet above Crystal Lake outlet.

RECORDS AVAILABLE.—October 1, 1915, to September 30, 1918.

DRAINAGE AREA.—1,340 square miles (measured on map of United States Geological Survey; scale, 1 to 500,000).

GAGE.—Enamel staff gage attached to concrete abutment of bridge; read by Edward Pederson.

CHANNEL AND CONTROL.—Control is a concrete dam about 100 feet below gage; appears to be cracking, and may settle.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading below dam.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.4 feet at 7 a. m. and 6 p. m. March 14 (discharge, 5,600 second-feet); minimum stage, 0.59 foot at 7 a. m. and 6 p. m. August 31 (discharge, 67 second-feet).

1916–1918: 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).

DIVERSIONS.—Water is diverted to operate grist mill at dam, which 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. If total used for each day were uniformly distributed, it would probably average less than 5 second-feet and never exceed 8 second-feet.

ACCURACY.—Stage-discharge relation changed during year; not affected by ice during winter. Rating curve used to March 5 fairly well defined; curve used after that date well defined above and fairly well defined below 750 second-feet. Gage read to hundredths twice daily. Storage pond is large, so the small amount of water used by grist mill does not noticeably affect the gage heights. Daily discharge ascertained by applying mean daily gage height to rating tables. Records good.

Discharge measurements of Fox River at Algonquin, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Mar. 15	4.03	4,790	Apr. 8	2.08	1,440	July 5	0.95	268
15	4.08	5,010	15	1.68	970	5	.94	259

Daily discharge, in second-feet, of Fox River at Algonquin, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	423	1,200	664	312	255	1,760	2,560	1,080	702	288	185	72
2	423	1,200	620	312	255	2,090	2,390	1,080	702	280	178	72
3	423	1,260	567	305	255	2,600	2,230	1,020	702	265	172	77
4	430	1,260	525	305	255	3,300	2,070	960	702	250	162	82
5	430	1,260	461	298	255	4,250	1,840	960	653	272	151	82
6	423	1,200	401	292	250	5,400	1,610	905	625	272	141	86
7	415	1,200	344	292	250	5,200	1,540	905	588	265	130	91
8	415	1,200	292	286	250	5,000	1,470	905	551	265	120	96
9	415	1,200	255	286	250	5,000	1,400	905	525	265	120	101
10	415	1,200	220	286	255	4,800	1,330	905	507	250	110	106
11	415	1,200	188	279	267	4,600	1,260	905	490	250	110	110
12	423	1,140	188	279	279	4,600	1,200	905	472	250	106	120
13	423	1,140	194	279	292	4,010	1,080	905	455	242	101	130
14	423	1,080	199	279	305	5,600	1,020	850	439	235	101	141
15	430	1,020	204	279	318	5,000	905	800	422	235	106	151
16	430	1,020	209	273	331	5,000	850	750	406	229	110	162
17	446	967	215	273	344	4,800	800	702	389	222	110	172
18	461	914	220	273	358	4,800	850	653	373	222	110	185
19	477	860	226	273	372	4,800	850	634	357	216	106	191
20	500	810	244	273	387	4,800	905	625	242	210	106	197
21	534	810	267	273	401	4,600	905	625	326	204	101	197
22	567	759	292	273	415	4,600	960	702	310	197	101	204
23	620	712	318	267	430	4,400	960	960	310	197	91	210
24	712	712	344	267	509	4,200	905	905	310	197	91	210
25	759	712	358	267	664	4,010	905	850	302	191	82	210
26	914	712	365	267	810	3,820	850	800	302	191	82	204
27	1,020	712	358	261	967	3,630	850	750	295	185	77	197
28	1,080	712	351	261	1,400	3,450	905	750	295	185	77	197
29	1,140	664	344	261	.....	3,270	960	750	295	185	72	191
30	1,140	664	331	261	.....	2,910	1,080	750	288	185	72	185
31	1,200	.....	318	261	.....	2,730	.....	750	.....	191	67	.....

NOTE.—The above table does not include small amount of water used to operate grist mill. (See "Diversions" in station description.)

Monthly discharge of Fox River at Algonquin, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 1,340 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,200	415	591	0.441	0.51
November	1,260	664	983	.734	.82
December	664	188	325	.243	.28
January	312	261	279	.208	.24
February	1,400	250	406	.303	.32
March	5,600	1,760	4,160	3.10	3.57
April	2,560	800	1,250	.933	1.04
May	1,080	625	837	.625	.72
June	702	288	448	.334	.37
July	288	185	229	.171	.20
August	185	67	111	.083	.10
September	210	72	148	.110	.12
The year	5,600	67	818	.610	8.29

FOX RIVER AT WEDRON, ILL.

LOCATION.—In sec. 9, T. 34 N., R. 4 E., at highway bridge at Wedron, LaSalle County, 1,000 feet above Buck Creek.

DRAINAGE AREA.—2,500 square miles.

RECORDS AVAILABLE.—November 5, 1914, to September 30, 1918.

GAGE.—Chain gage attached to bridge; read by Nels Mathias to January 31 and by T. W. Server after that date.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed or river at measuring section is soft and probably shifts. Control about 1,000 feet downstream composed of coarse gravel and large boulders; seldom shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.4 feet at 8 a. m. February 15 (discharge, 15,500 second-feet); minimum stage, 5.40 feet at 6 a. m. and 6 p. m. September 4 (discharge, 145 second-feet).

1915–1918: Maximum stage recorded, 15.4 feet February 3, 1916 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 13.8 feet March 28, 1916 (discharge, 16,700 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 Montgomery.

ACCURACY.—Stage-discharge relation changed during high water in February; seriously affected by ice during winter. Rating curve used to February 12 well defined above and fairly well defined below 1,130 second-feet; curve used after that date well defined between 275 and 11,300 second-feet. Gage read to hundredths twice daily. Diurnal fluctuation only slight. Daily discharge ascertained by applying mean daily gage height to rating tables, except for period when stage-discharge relation was affected by ice, for which it was estimated from occasional gage heights, observer's notes, and weather records. Open-water records good for medium and high stages, and fair for low stages; winter record poor.

Discharge measurements of Fox River at Wedron, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 18	6.76	853	July 8	5.86	371
Nov. 16	7.01	1,170	Aug. 21	5.78	318
Nov. 16	7.02	1,150			

Daily discharge, in second-feet, of Fox River at Wedron, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	384	1,550	940			3,680	2,870	1,610	1,310	428	301	185
2	580	1,670	852			4,660	2,720	1,710	997	317	349	228
3	652	1,670	852			5,750	2,570	1,660	830	405	285	194
4	544	1,610	852			8,270	2,570	1,560	997	405	296	145
5	510	1,610	810			7,230	2,170	1,460	871	388	306	194
				400								
6	580	1,670				7,230	3,500	1,460	922	285	228	185
7	510	1,790			680	6,710	1,930	1,410	997	440	502	296
8	372	1,670				5,980	1,820	1,260	997	376	247	296
9	510	1,610				5,980	1,710	1,310	790	394	301	280
10	615	1,670				6,220	1,710	1,360	712	405	296	224
11	580	1,440				4,660	1,660	1,310	871	417	247	275
12	544	1,330				5,520	1,560	1,220	922	440	206	376
13	544	1,380	550		11,300	5,520	1,460	1,220	712	371	194	360
14	510	1,330			13,100	7,750	1,310	1,360	535	382	202	322
15	372	1,230			15,200	7,230	1,260	1,180	502	285	202	371
				370								
16	580	1,180			8,010	6,220	1,310	1,080	751	280	285	338
17	896	1,130			4,660	5,980	1,220	997	471	382	411	238
18	940	985			3,860	5,750	1,310	954	568	388	638	228
19	940	940			5,080	5,520	1,260	922	535	388	417	354
20	852	1,180			5,980	5,750	1,310	871	471	388	301	317
21	690	1,080			3,860	5,750	1,610	997	471	382	285	256
22	652	1,030			3,500	5,300	1,820	1,260	423	311	285	296
23	1,030	1,030			3,500	5,520	1,930	1,410	376	228	285	306
24	1,030	1,030			4,050	5,080	1,660	1,610	275	266	266	206
25	1,130	896			4,660	4,870	1,510	1,610	266	354	270	266
26	1,230	769	450	330	4,660	4,450	1,560	1,560	405	502	252	327
27	1,330	940			4,450	4,250	1,560	1,360	535	502	177	399
28	1,330	896			4,050	4,050	1,510	1,360	922	394	198	332
29	1,440	769			.....	3,680	1,660	1,360	603	327	185	322
30	1,550	730			.....	3,500	1,820	1,360	471	237	252	285
31	1,550	.....			.....	3,170	.....	1,310	.....	311	228	.....

NOTE.—Discharge Dec. 6 to Feb. 12 estimated, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean daily discharge for periods included.

Monthly discharge of Fox River at Wedron, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 2,500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,550	372	806	0.322	0.37
November	1,790	730	1,260	.504	.56
December	940	.....	565	.226	.26
January	.....	.....	365	.146	.17
February	15,200	.....	3,860	1.54	1.60
March	8,270	3,170	5,520	2.21	2.55
April	3,500	1,220	1,800	.720	.80
May	1,710	871	1,330	.532	.61
June	1,310	266	684	.274	.31
July	502	228	367	.147	.17
August	638	177	287	.115	.13
September	399	145	280	.112	.12
The year	15,200	145	1,410	.564	7.66

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, La Salle County, and 100 feet below Santa Fe Railway bridge.

DRAINAGE AREA.—1,080 square miles.

RECORDS AVAILABLE.—July 27, 1914, to September 30, 1918.

GAGE.—Chain gage attached to highway bridge; read by Mathew Reid until March 31, and by Floyd Leslie after that date.

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

CHANNEL AND CONTROL.—Gravel and rocks; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.0 feet at 4 p. m. February 15 (discharge, 5,080 second-feet); minimum stage, 0.53 foot at 4 p. m. June 27 (discharge, 1.4 second-feet).

1914–1918: Maximum stage recorded, 22.4 feet January 21, 1916 (discharge estimated from extension of rating curve, 16,000 second-feet); minimum stage 0.45 foot August 16 and 17, 1914 (discharge, 0.7 second-foot).

ACCURACY.—Stage-discharge relation permanent; seriously affected by ice during winter. Rating curve well defined between 300 and 2,500 second-feet, and fairly well defined between 10 and 300 second-feet and above 2,500 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which it was estimated from occasional gage heights, observer's notes, and weather records. Records good, except for periods of extreme low stages and period of ice effect, for which they are poor.

Discharge measurements of Vermilion River near Streator, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
July 9	6.23	1,790	Aug. 21	0.80	8.5
Aug. 21	.80	8.2			

Daily discharge, in second-feet, of Vermilion River near Streator, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	19	15	12			684	146	1,500	783	970	39	75
2	18	31	12			495	127	1,050	588	716	34	68
3	18	39	17			557	291	818	464	620	15	39
4	3.8	34	12			652	557	716	360	495	21	34
5	3.8	30	9			652	620	620	291	404	30	83
6	5.2	24			2	652	652	557	228	252	26	39
7	3.8	28				557	557	526	216	652	15	39
8	3.0	23				495	526	464	346	1,750	12	26
9	2.4	23				495	464	557	526	1,700	15	127
10	1.8	20				375	419	588	419	1,700	9.4	119
11	1.8	17				346	375	684	318	1,450	12	113
12	1.9	17			4,200	346	332	749	265	818	81	44
13	1.8	16	3		4,680	332	304	588	228	854	21	78
14	1.8	21			5,000	404	240	684	156	818	18	59
15	3.3	18			5,080	360	216	684	127	495	3.8	109
16	2.4	15		2	3,200	346	204	620	53	434	15	167
17	19	12			2,150	332	228	557	80	291	14	49
18	22	20			1,700	291	304	557	59	216	14	74
19	30	13			1,600	265	464	495	48	169	13	34
20	28	9.4			1,400	265	620	2,450	47	146	6.0	30
21	24	9.4			1,170	216	1,350	1,050	42	131	6.9	26
22	16	10			930	216	1,800	818	74	91	10	21
23	14	8.6			818	216	1,650	684	30	39	10	23
24	9.4	9.4			818	240	1,650	1,350	33	15	8.6	18
25	9.4	12			620	193	1,010	1,700	14	49	6.0	24
26	17	12	12		557	204	930	1,300	2.2	9.4	5.2	18
27	15	9.4			495	193	930	818	1.4	434	9.4	21
28	13	13			526	204	1,090	783	131	216	6.9	21
29	13	12			.....	193	818	652	652	193	3.6	21
30	15	9.4			.....	165	1,250	588	970	150	193	21
31	12	.....			.....	156	.....	818	.....	51	167	.....

NOTE.—Discharge for Dec. 6 to Feb. 11 estimated, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Vermilion River near Streator, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 1,080 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	30	1.8	11.2	0.010	0.01
November	39	8.6	17.7	.016	.02
December	.....	.....	7.71	.0071	.008
January	.....	.....	2.00	.0019	.002
February	5,080	.....	1,250	1.16	1.21
March	684	156	358	.331	.38
April	1,800	127	671	.621	.69
May	2,450	464	840	.778	.90
June	970	1.4	252	.233	.26
July	1,750	9.4	527	.488	.56
August	193	3.6	27.1	.025	.03
September	167	18	54.0	.050	.06
The year	5,080	.....	328	.304	4.13

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, 1918.

GAGE.—Chain gage attached to bridge; read by C. D. Bartlett until July 1 and by R. M. Boales after that date.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge; low-water measurements are made by wading below dam at railroad station.

CHANNEL AND CONTROL.—Control is a loose rock dam, about 2 miles downstream from gage, used to create a reservoir for the pumping station of Toledo, Peoria & Western Railway.

EXTREMES OF STAGE.—Maximum stage recorded during year, 15.3 feet at 9 a. m. February 16; minimum stage, 2.55 feet at 7 a. m. January 25.

1914–1918: Maximum stage recorded, 26.0 feet January 23, 1916; minimum stage, 1.35 feet July 31 and August 28 and 29, 1914.

ICE.—Stage-discharge relation affected by ice during winter.

Data inadequate for determination of discharge.

Discharge measurements of Spoon River at Seville, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 15	2.73	74	July 10	15.02	6,270
15	2.73	76	Aug. 22	4.27	492
June 11	3.68	317			

Daily gage height, in feet, of Spoon River at Seville, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3.1	5.7	2.95	2.7	.....	6.8	3.6	5.9	6.0	6.4	4.4	7.5
2	3.0	5.7	2.95	.....	.....	6.8	3.6	5.8	5.7	.....	3.8	5.8
3	2.9	5.6	2.95	2.7	.....	.....	6.6	5.8	5.5	.....	3.7	4.5
4	2.9	5.4	2.95	.....	.....	8.8	3.6	5.8	5.5	.....	3.5	5.4
5	3.4	5.4	.....	2.7	.....	6.7	3.6	4.1	5.5	.....	3.5	5.1
6	3.3	5.3	2.85	.....	.....	6.7	3.6	4.1	6.9	.....	3.4	4.8
7	3.3	5.3	2.95	2.6	.....	5.5	4.8	3.8	6.7	.....	3.3	4.6
8	4.4	5.1	.....	.....	3.3	5.4	5.0	3.8	5.9	.....	3.2	4.2
9	4.1	4.2	.....	2.6	3.8	5.4	5.2	3.8	5.9	.....	3.2	4.0
10	3.6	4.0	.....	.....	.....	5.4	4.8	3.8	.....	14.7	3.2	3.9
11	3.3	3.8	2.7	2.6	7.3	4.3	4.8	3.8	3.7	10.6	3.6	3.8
12	3.1	3.8	.....	.....	13.4	4.3	4.8	3.8	4.0	7.7	3.4	4.0
13	2.7	3.7	2.7	.....	14.0	4.2	4.6	3.8	4.2	6.4	3.3	4.4
14	2.8	3.6	.....	2.6	.....	4.2	5.1	3.8	3.9	5.8	3.1	4.2
15	2.7	3.6	2.7	.....	14.8	4.2	5.6	3.8	2.4	5.4	4.0	4.0
16	7.2	3.5	.....	2.6	15.3	4.2	6.1	4.2	3.1	5.2	6.8	3.8
17	8.4	3.4	2.7	.....	5.5	4.3	6.1	4.4	3.3	5.4	5.6	3.7
18	7.2	3.4	.....	2.6	5.5	4.3	6.1	4.5	2.2	4.8	6.4	3.6
19	7.2	3.3	2.7	.....	5.4	4.3	6.1	4.6	3.2	4.6	9.7	3.5
20	7.2	3.3	.....	.....	5.3	4.2	6.1	4.8	3.2	4.4	8.0	3.5
21	7.0	3.2	.....	2.6	5.3	4.2	6.0	5.4	3.0	4.2	5.1	3.4
22	6.9	3.1	3.1	.....	5.1	4.2	5.9	6.8	3.0	4.1	4.4	3.4
23	6.9	3.1	.....	2.6	5.1	4.2	5.9	7.2	3.0	4.0	4.0	3.3
24	6.7	2.9	.....	.....	5.1	3.7	5.9	8.1	3.3	3.9	3.8	3.3
25	6.5	2.8	4.3	2.55	4.8	3.8	5.8	10.4	5.7	3.8	3.7	3.3
26	6.5	2.8	.....	.....	4.8	3.6	5.8	9.8	6.8	3.8	3.6	3.3
27	6.4	2.8	.....	.....	4.6	3.6	5.8	9.1	10.1	3.8	3.6	3.2
28	6.4	2.8	.....	.....	6.8	3.6	6.0	8.1	12.4	3.8	3.4	3.2
29	6.3	2.8	3.6	.....	.....	3.6	5.2	8.2	12.7	3.8	3.3	3.1
30	6.0	2.9	.....	.....	.....	3.6	5.9	7.6	11.3	6.6	3.5	3.1
31	5.9	.....	3.6	.....	.....	3.6	.....	8.8	.....	6.2	6.3	.....

NOTE.—Stage-discharge relation probably affected by ice about Dec. 5 to Feb. 25. Sudden drop in stage Feb. 16 probably caused by breaking of ice jam.

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, 1918.

GAGE.—Chain gage attached to downstream side of bridge; read by David Coay.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge and wooden trestle approach during medium and high stages, and by wading during low stages.

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, 14.4 feet at 8 a. m., February 14 (discharge, 6,180 second-feet); minimum stage, 1.85 feet October 10–12 and December 12 and 14 (discharge, 11 second-feet).

1908–1912 and 1914–1918: Maximum stage recorded 15.2 feet May 14, 1908 (discharge, 9,280 second-feet); maximum stage during flood of March to April, 1913, 17.7 feet March 25 (discharge not known); minimum stage recorded, 1.5 feet July 31, August 1 and 3, 1914 (discharge, 1 second-foot).

ACCURACY.—Stage-discharge relation changed slightly several times during year; seriously affected by ice during winter. Rating curve fairly well defined below 4,000 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice for which it was estimated from occasional gage heights, observer's reports, and weather records and except for days noted in table of daily discharge. Open-water records good for low and medium stages, fair for very high stages; winter records poor.

Discharge measurements of Sangamon River at Monticello, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*			
Oct. 10	1.86	11.1	June 25	10.56	1,910	Aug. 26	3.03	108
10	1.86	10.7	July 15	5.16	324	30	2.42	41
Feb. 16	10.95	2,090						

Daily discharge, in second-feet, of Sangamon River at Monticello, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	12	59	19			226	114	1,320	508	675	42	a 72
2	12	59	a 19			a 211	114	1,100	a 375	637	36	a 86
3	12	56	19			a 196	258	891	242	473	34	100
4	12	a 44	19			181	490	758	194	a 382	a 32	354
5	a 12	32	19			181	354	a 660	159	290	29	490
6	12	29		15	300	170	290	562	159	226	25	675
7	a 12	27				170	a 274	a 628	128	a 708	21	862
8	12	25				159	258	695	148	1,190	21	a 778
9	12	25				210	226	675	a 171	1,440	17	695
10	11	25				a 218	194	675	194	1,440	17	599
11	11	a 24			1,810	226	181	675	148	1,320	a 19	338
12	11	23			3,100	194	170	a 716	114	920	21	290
13	a 11	23	12		4,270	181	159	758	100	618	17	226
14	a 12	23			6,180	170	a 141	1,040	87	a 494	17	148
15	12	21			4,270	148	123	1,040	71	371	21	a 138
16	12	21		8	3,100	148	114	862	a 64	322	21	128
17	12	21			a 2,070	a 138	170	715	56	258	21	128
18	12	a 20			1,040	128	258	580	48	226	a 28	114
19	14	19			715	109	422	a 571	45	194	34	100
20	16	19			618	100	695	562	45	170	36	100
21	a 16	19			562	96	a 1,090	599	45	a 144	32	100
22	16	19			526	96	1,480	526	45	118	21	a 92
23	16	19			490	96	1,610	456	a 40	104	21	83
24	16	19			a 430	a 102	1,480	388	34	96	25	71
25	15	a 19			371	109	862	338	1,360	87	a 35	71
26	16	19	30	5	322	118	1,190	a 293	2,270	75	45	67
27	17	19			274	138	1,440	253	1,260	75	71	56
28	a 22	19			226	128	a 1,500	226	1,040	a 71	45	48
29	27	19			.....	114	1,560	194	1,010	67	a 40	a 46
30	32	19			.....	100	1,440	a 266	a 842	48	36	45
31	59	.....			.....	a 107	.....	338	.....	42	59	.....

a Discharge interpolated because of no gage-height record.

NOTE.—Discharge estimated for Dec. 6 to Feb. 10, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean daily discharge for periods included.

Monthly discharge of Sangamon River at Monticello, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 550 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	59	11	15.9	0.029	0.03
November	59	19	26.2	.048	.05
December	.....	.....	19.5	.035	.04
January	.....	.....	9.19	.017	.02
February	6,180	.....	1,190	2.16	2.25
March	226	96	151	.275	.32
April	1,610	114	622	1.13	1.26
May	1,320	194	625	1.14	1.31
June	2,270	34	367	.667	.74
July	1,440	42	428	.778	.90
August	71	17	30.3	.055	.06
September	862	45	237	.431	.48
The year	6,180	.....	303	.551	7.46

SANGAMON RIVER AT RIVERTON, ILL.

LOCATION.—In southeast corner of SW. ¼ sec. 9, T. 16 N., R. 4 W. third principal meridan, at Wabash Railroad bridge 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, 1918.

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, 22.8 feet at 4 p. m. May 11 (discharge, 9,980 second-feet); minimum stage, 7.19 feet February 2, 3, and 6 (discharge estimated, 16 second-feet).

1908–1912 and 1914–1918: Maximum stage recorded, 27.8 feet February 3, 1916 (discharge, 20,800 second-feet;) high water of 1883 reached a height of approximately 32 feet on present gage, and that of 1875 is said to have been one-half foot lower (discharge not estimated;) minimum stage recorded, 6.9 feet October 3–15, 1915 (discharge, 3 second-feet).

ACCURACY.—Stage-discharge relation changed slightly during year; affected by ice during winter. Rating curve well defined between 94 and 4,350 second-feet, and fairly well defined beyond these limits. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which it was estimated from occasional gage heights, observer's notes, and weather records. Open-water records good; winter records poor.

Discharge measurements of Sangamon River at Riverton, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 11	7.56	36	June 14	9.26	343
11	7.56	36	Aug. 24	8.46	190

Daily discharge, in second-feet, of Sangamon River at Riverton, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	64	102	75			862	368	4,630	1,100	1,570	262	227
2	55	105	69			736	416	4,910	736	1,530	205	250
3	55	115	62			706	465	4,000	736	1,530	184	284
4	52	129	45			706	416	3,300	736	1,370	168	1,100
5	51	136	48			706	862	2,880	736	1,170	162	1,490
				50	800							
6	43	127				706	1,210	2,280	798	862	147	1,450
7	51	122				619	1,370	1,930	798	1,210	140	1,330
8	43	112				566	1,100	1,650	556	3,240	113	1,250
9	41	102				515	1,060	4,910	440	3,790	92	1,170
10	39	82				515	1,030	9,280	416	3,360	85	1,170
11	37	86			5,700	465	767	9,980	416	3,720	84	862
12	40	85			7,320	440	647	9,100	392	3,600	84	767
13	41	90	30		9,800	392	566	9,440	344	3,420	80	592
14	43	88			9,620	392	566	8,300	320	3,180	79	490
15	43	82			8,160	416	540	7,580	296	2,830	79	404
				25								
16	50	80			6,120	416	515	8,160	284	1,610	79	416
17	52	76			6,560	416	676	6,930	238	1,330	76	592
18	53	75			7,860	416	566	5,240	227	927	75	619
19	51	71			8,010	404	995	4,490	216	894	380	676
20	50	73			7,320	368	1,250	4,280	164	1,060	392	619
21	174	69			4,070	356	1,780	3,240	154	619	182	706
22	320	66			2,430	344	2,330	2,940	151	566	90	465
23	490	68			1,830	344	2,880	1,980	151	465	80	416
24	184	65			1,410	332	3,000	1,370	145	440	178	368
25	122	57			1,290	490	3,540	1,210	296	404	154	320
26	102	51	85	15	1,250	490	3,930	1,490	440	368	140	296
27	86	50			960	465	4,700	1,250	1,100	356	113	238
28	84	52			960	392	4,770	1,060	862	273	105	227
29	75	58			.....	344	4,910	995	1,450	174	94	216
30	96	76			.....	344	4,910	894	1,780	205	113	184
31	113	.....			.....	320	.....	767	.....	250	238	.....

NOTE.—Discharge estimated for Dec. 6 to Feb. 10, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean daily discharge for period indicated.

Monthly discharge of Sangamon River at Riverton, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 2,560 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	490	37	90.3	0.035	0.04
November	136	50	85.0	.033	.04
December	.....	.....	54.3	.021	.02
January	.....	.....	29.5	.012	.01
February	9,800	.....	3,520	1.38	1.44
March	862	320	483	.189	.22
April	4,910	368	1,740	.680	.76
May	9,980	767	4,210	1.64	1.89
June	1,780	145	549	.214	.24
July	3,860	174	1,510	.590	.68
August	392	75	144	.056	.06
September	1,490	184	640	.250	.28
The year	9,980	.....	1,070	.418	5.68

SANGAMON RIVER NEAR OAKFORD, ILL.

LOCATION.—In sec. 6, T 19 N., R. 7 W. third principal meridian, at highway bridge 3 miles northeast of Oakford, Menard County, 2½ miles above Chicago, Peoria & St. Louis Railroad bridge, and 1¼ miles above mouth of Crane Creek.

DRAINAGE AREA.—5,000 square miles.

RECORDS AVAILABLE.—October 26, 1909, to June 30, 1911; December 10, 1911, to March 31, 1912; and August 25, 1914, to September 30, 1918.

GAGE.—Chain gage attached to bridge; read by R. W. Schnell from October 1 to December 31, by Henry Chesser from January 1 to June 30, and by Frank Dick from July 1 to September 30.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and fine gravel; shifting. The river for some distance above and below station has been dredged and straightened, thus increasing the slope considerably and disturbing the regimen of flow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.2 feet February 15 and 17 (discharge, 10,500 second-feet); minimum stage, 1.28 feet October 19–22 (discharge, 183 second-feet).

1914–1918: Maximum stage recorded, 19.9 feet June 8 and 9, 1917 (discharge determined from extension of rating curve, 33,300 second-feet); minimum stage recorded, 0.65 foot September 27, 1916 (discharge, 128 second-feet). Minimum discharge recorded, 85 second-feet August 30–31. November 27, and December 2, 1914. Maximum and minimum discharges recorded during periods of record, same as above.

ACCURACY.—Stage-discharge relation practically permanent; seriously affected by ice during winter. Rating curve fairly-well defined. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which it was estimated from occasional gage heights, observer's notes, and weather records; discharge interpolated, because of no gage-height record July 7, August 10–23 and 25, and September 8. Open-water records good; winter records poor.

Discharge measurements of Sangamon River near Oakford, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 13	1.32	185	June 13	3.12	1,040
13	1.32	190	Aug. 24	2.31	644
Nov. 17	1.42	248			

Daily discharge, in second-feet, of Sangamon River near Oakford, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	294	315	214			1,810	851	6,400	2,980	2,100	696	452
2	294	315	210			1,810	746	6,040	1,810	1,810	647	524
3	272	315	210			1,600	851	5,080	1,670	1,950	598	549
4	259	294	210			1,530	851	4,940	1,670	2,100	574	696
5	243	294	206			1,530	1,200	3,770	1,670	2,260	524	2,260
6	230	315		130	1,000	1,390	1,530	3,770	1,600	2,420	500	2,740
7	230	315				1,390	1,950	3,460	1,810	4,120	452	2,580
8	222	315				1,390	1,670	3,590	1,600	5,820	428	2,420
9	210	294				1,390	1,670	6,040	1,390	6,880	405	2,260
10	202	294				1,320	1,600	6,040	1,320	7,000		1,810
11	190	272	155		6,280	1,390	1,460	7,390	1,260	7,000		1,670
12	190	272			6,400	1,200	1,320	7,650	1,140	6,640		1,600
13	198	264			9,080	1,140	1,320	9,920	1,200	5,710		1,390
14	202	255			10,100	1,140	1,200	10,300	1,020	4,940		1,200
15	198	251			10,500	1,140	1,080	9,780	906	4,230		1,020
16	190	251		65	10,300	1,200	1,020	8,820	906	3,590	350	906
17	190	243			10,500	906	1,080	8,300	798	3,060		906
18	194	238			9,640	1,020	1,140	7,390	906	2,340		906
19	183	230			8,820	962	1,260	10,200	851	2,020		906
20	183	230			8,300	962	1,460	8,560	1,020	1,810		962
21	183	230			7,390	906	2,260	5,820	962	1,600		1,020
22	183	226			7,000	906	2,980	5,380	549	1,390		906
23	264	222			5,050	962	3,500	3,950	574	1,260		851
24	405	214	230		3,060	906	3,770	3,460	746	1,200	1,080	798
25	405	210			2,980	851	3,680	2,180	549	1,080	814	696
26	359	210		45	2,260	851	4,230	2,020	2,260	1,020	549	647
27	315	214			2,100	906	4,630	2,180	2,580	962	549	598
28	272	218			1,810	851	5,930	2,340	3,060	906	476	549
29	272	218			.....	851	6,520	2,740	3,500	851	428	500
30	405	214			.....	906	6,520	3,950	3,950	798	405	476
31	315	.....			.....	851	.....	3,460	.....	696	428	.....

NOTE.—Discharge interpolated for July 7, Aug. 10-23 and 25, and Sept. 8, because of no gage-height record; estimated for Dec. 6 to Feb. 10, because of ice, from gage heights, observer's notes, and weather records.

Monthly discharge of Sangamon River near Oakford, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 5,000 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	405	183	250	0.050	0.06
November	315	210	258	.052	.06
December	.....	.....	203	.041	.05
January	.....	.....	78.9	.016	.02
February	10,500	.....	4,700	.940	.98
March	1,810	851	1,160	.232	.27
April	6,520	746	2,310	.462	.52
May	10,300	2,020	5,640	1.13	1.30
June	3,950	549	1,540	.308	.34
July	7,000	696	2,890	.578	.67
August	.....	.....	466	.093	.11
September	2,740	452	1,160	.232	.26
The year	10,500	.....	1,700	.340	4.64

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. (Measured on map issued by the United States Geological Survey; scale, 1: 500,000.)

RECORDS AVAILABLE.—May 18, 1917, to September 30, 1918.

GAGE.—Chain gage attached to bridge; read by H. Hendricks.

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

CHANNEL AND CONTROL.—Soft mud; likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 18.0 feet at 8 a. m., May 11 (discharge, 2,960 second-feet); minimum discharge, 3.1 second-feet, October 9.

1917–18: Maximum stage recorded, 26.6 feet June 6, 1917 (discharge, 10,400 second-feet); minimum discharge, 3.1 second-feet, October 9. A stage of about 27.3 feet on the 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 the power plant.

ACCURACY.—Stage-discharge relation changed slightly during high water in February; seriously affected by ice during winter. Rating curves fairly well defined above 16 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage heights to rating tables, except for periods noted in footnote to daily-discharge table. Open-water records good for medium and high stages, fair for low stages; winter records poor.

Discharge measurements of South Fork of Sangamon River at power plant near Taylorville, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 12	3.72	4.0	June 15	4.33	24.5
12	3.72	4.1	Aug. 26	4.28	25.9

Daily discharge, in second-feet, of South Fork of Sangamon River at power plant near Taylorville, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	9.0	112	19			125	62	1,180	93	150	14	46
2	8.2	96	17			125	117	829	85	109	12	35
3	7.4	84	18			125	125	478	73	66	11	177
4	6.9	84	17			125	1,000	387	66	38	9.6	522
5	6.6	80	14		2	125	1,000	317	58	29	8.6	733
				3								
6	6.2	23				125	1,020	267	55	25	7.6	646
7	6.6	21				125	868	258	49	73	6.6	663
8	6.8	19			267	117	327	267	49	327	4.6	522
9	3.1	11			1,440	117	297	934	46	511	3.8	437
10	3.6	9			2,110	109	240	2,710	36	489	3.8	387
11	4.4	30			2,430	93	186	2,960	40	557	3.8	281
12	4.2	26			2,860	85	159	2,860	38	646	3.8	175
13	4.0	25	7		2,860	77	159	2,590	31	570	3.3	69
14	4.4	24			2,860	73	141	2,430	29	377	3.3	58
15	5.0	21			2,430	85	125	2,190	27	168	3.3	58
				2								
16	6.0	19			2,430	109	109	1,870	27	109	3.8	73
17	5.0	17			2,110	93	277	1,560	27	89	4.6	267
18	6.5	17			1,800	81	599	1,120	25	77	5.6	317
19	250	17			1,480	77	697	769	24	66	4.6	229
20	340	17			1,160	73	630	437	22	55	6.6	140
21	230	20			846	66	806	347	21	46	9.6	52
22	76	11			529	73	956	277	19	40	18	141
23	59	19			213	85	978	249	19	36	15	109
24	52	16			200	81	956	222	18	52	14	89
25	38	16			186	77	806	195	18	52	12	80
26	28	18	25	1	177	69	1,120	177	16	36	11	71
27	40	14			168	66	1,530	159	16	29	29	61
28	32	17			141	55	1,540	141	14	27	17	52
29	46	19			.....	49	1,560	125	73	24	10	43
30	52	21			.....	46	1,470	109	125	20	10	38
31	47	.....			.....	43	.....	97	.....	16	133	.....

NOTE.—Discharge interpolated, because of no gage-height record, for Feb. 17–22 and 24, Apr. 28, May 2, and Sept. 11, 12, 19, 20, and 25–28; estimated for Dec. 6 to Feb. 7, because of ice, from gage heights, observer's notes, and weather records.

Monthly discharge of South Fork of Sangamon River at power plant near Taylorville, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 510 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	340	3.1	45.0	0.088	0.10
November	112	9	30.8	.060	.07
December	.....	.....	15.0	.029	.03
January	.....	.....	1.97	.0039	.004
February	2,860	.....	1,020	2.00	2.08
March	125	43	89.5	.175	.20
April	1,560	62	662	1.30	1.45
May	2,960	97	920	1.80	2.08
June	125	14	41.3	.081	.09
July	646	16	158	.310	.36
August	133	3.3	18.0	.025	.03
September	733	38	221	.433	.48
The year	2,960	.....	263	.516	6.97

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, 1918.

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; likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 18.5 feet May 11 and 12 (discharge, 8,460 second-feet); minimum stage recorded, 0.91 foot at 1 p. m. October 17 (discharge, 38 second-feet).

1908–1912 and 1914–1918: Maximum stage recorded, 23.0 feet June 5, 1917 (discharge, 16,400 second-feet); minimum stage, 0.38 foot August 12, 1914 (discharge, 13 second-feet).

ACCURACY.—Stage-discharge relation changed during high water in February; seriously affected by ice during winter. Rating curves well defined above and fairly well defined below 368 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage heights to rating tables, except for period when stage-discharge relation was affected by ice, for which it was estimated from occasional gage heights, observer's notes, and weather records.

Discharge measurements of Kaskaskia River at Vandalia, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 9	1.09	50	Feb. 16	17.28	7,280	July 15	9.02	2,240
Nov. 19	2.10	162	June 17	3.10	386	Aug. 27	2.41	267

Daily discharge, in second-feet, of Kaskaskia River at Vandalia, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	67	770	120			991	332	5,490	933	2,280	297	609
2	67	685	114			1,050	332	4,710	818	2,200	263	585
3	67	657	108			904	314	4,090	790	2,080	246	1,020
4	62	552	102			818	407	3,390	710	1,820	229	1,500
5	62	458	102			818	736	2,920	684	1,820	213	4,140
6	58	413		65	1,320	790	585	2,360	634	1,750	213	5,140
7	54	369				736	515	1,820	585	1,540	198	5,350
8	46	307				684	585	1,540	818	1,890	184	4,890
9	43	307				634	538	1,860	585	3,740	177	2,640
10	42	268				538	538	5,070	492	4,530	164	1,920
11	42	249				492	515	8,460	470	4,710	157	1,680
12	41	231			6,270	448	492	8,460	427	4,650	144	1,470
13	41	222	55		7,320	515	448	7,800	387	3,740	138	1,230
14	40	204			8,060	609	427	7,210	368	2,520	138	991
15	39	196			7,800	585	427	4,770	332	1,750	150	846
16	38	180			6,770	561	407	4,830	332	1,750	132	710
17	38	172			6,010	515	2,320	3,740	368	1,440	184	962
18	38	165			5,350	492	3,840	3,120	314	1,170	126	1,080
19	46	151			4,290	448	2,720	2,800	280	962	121	1,890
20	222	151			3,240	427	2,480	3,080	263	818	116	1,960
21	481	151		45	2,440	407	4,830	2,960	246	736	110	1,640
22	391	144			1,780	368	5,140	2,560	229	634	157	1,360
23	327	138			1,400	350	4,040	2,160	198	470	121	1,140
24	222	138			1,330	350	3,290	1,750	213	538	121	991
25	204	132			1,200	368	3,440	1,500	246	470	157	875
26	196	132	150		1,110	368	5,420	1,330	448	448	184	763
27	180	132			1,050	368	7,440	1,200	2,000	407	263	684
28	172	126			962	350	7,100	1,080	2,040	368	164	684
29	222	126			.....	350	6,460	962	1,780	350	157	585
30	657	120			.....	332	6,270	933	2,120	332	138	538
31	713	.....			.....	332	.....	1,020	.....	297	634	.....

NOTE.—Discharge estimated for Dec. 6 to Feb. 11, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Kaskaskia River at Vandalia, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 1,980 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	713	38	159	0.080	0.09
November	770	120	268	.135	.15
December	.....	.....	97.5	.049	.06
January	.....	.....	51.5	.026	.03
February	8,060	.....	2,890	1.46	1.52
March	1,050	332	548	.277	.32
April	7,440	314	2,410	1.22	1.36
May	8,460	933	3,390	1.71	1.97
June	2,120	198	670	.338	.38
July	4,710	297	1,680	.848	.98
August	634	110	187	.094	.11
September	5,350	538	1,680	.848	.95
The year	8,460	38	1,150	.581	7.92

KASKASKIA RIVER AT NEW ATHENS, ILL.

LOCATION.—In W. ½ NE. ¼ sec. 28, T. 2 S., R. 7 W. third principal meridian, at Illinois Central Railroad bridge 600 feet north of railroad station at New Athens, St. Clair County, 1 mile below mouth of Silver Creek and 3 miles above mouth of Lively Creek.

DRAINAGE AREA.—5,220 square miles.

RECORDS AVAILABLE.—January 23, 1907, to December 31, 1912; June 22, 1914, to September 30, 1918. Gage height of river was taken on Wednesday and Thursday mornings from January 23, 1907, to October 28, 1909, by C. J. von Roth Roffy for the New Athens Journal, and by whom they were published. Record authentic. Gage heights have been reduced to the present datum; maximum error probably not more than 0.4 foot, decreasing with increase of stage.

GAGE.—Chain gage attached to bridge; read by Henry Hoffman.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge to which gage is attached, or from highway bridge about 500 feet downstream.

CHANNEL AND CONTROL.—Sand and gravel; may shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 24.5 feet at noon April 30 (discharge, 20,300 second-feet); minimum stage recorded, 2.47 feet at noon October 18 (discharge, 107 second-feet).

1907–1912 and 1914; 1918: Maximum stage recorded, 35.7 feet August 26, 1915 (discharge, 63,100 second-feet); minimum stage, 2.08 feet August 10, 1914 (discharge, 102 second-feet).

ACCURACY.—Stage-discharge relation changed during high water in February; seriously affected by ice during winter; also affected by backwater from Mississippi River about April 4–8 and June 1–20. Rating curves used during periods of no backwater from Mississippi River fairly well defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating tables, except for periods noted in footnote to table of daily discharge. Open-water records fair; winter records and records during period of backwater poor.

Published estimates of discharge for the following periods may be considerably too large, the excess depending on the amount of backwater produced at New Athens: January 21–28, June 14–18, July 19 to August 3, 1907; May 17 to July 23, 1908; March 14, April 21 to May 1, May 11–17, June 12 to July 27, 1909; May 10–13, June 12–15, 1910; March 22 to May 11, June 19–22, 1912.

Discharge measurements of Kaskaskia River at New Athens, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 8	2.71	145	June 18 [a]	5.98	557
Feb. 15	22.49	13,300	Aug. 28	4.52	606

[a] Made during backwater from Mississippi River.

Daily discharge, in second-feet, of Kaskaskia River at New Athens, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	187	1,060	295			2,190	556	18,900	1,300	2,240	609	456
2	178	910	316			2,190	556	17,000	1,230	2,440	556	748
3	178	880	316			2,420	582	15,500	1 240	2,490	505	1,450
4	170	850	274			2,640	348	14,100	1,150	2,490	480	1,410
5	170	790	244			2,440	444	13,200	1,060	2,440	456	2,240
6	161	730	224	180		2,090	464	12,200	906	2,290	432	4,670
7	153	700	215		3,000	1,990	500	11,500	1,160	2,140	409	7,100
8	145	612				1,840	742	10,800	2,860	1,990	365	6,700
9	145	530				1,610	1,130	10,100	1,920	1,940	365	6,780
10	137	478				1,410	950	8,910	1,360	1,840	344	6,620
11	137	429				1,250	834	6,700	1,060	2,390	323	5,720
12	129	405				1,130	834	9,820	952	3,300	323	5,030
13	129	360			12,600	1,040	776	13,000	911	3,740	323	4,190
14	129	338	160		13,700	1,010	748	13,900	794	3,960	323	2,970
15	129	316			13,900	950	692	14,100	693	4,070	283	2,400
16	122	316			13,900	892	664	14,100	649	4,070	283	1,840
17	114	295			13,700	863	2,640	13,900	596	3 630	304	1,650
18	107	295			12,700	863	7,340	13,300	561	2,860	324	1,370
19	122	295			11,800	834	8,810	13,000	460	2,240	344	2,490
20	114	295			10,900	834	10,300	13,000	422	1,790	530	3,080
21	122	274		125	10,100	776	11,000	12,800	664	1,490	556	4,550
22	129	234			9,340	748	11,800	12,600	609	1,230	530	5,030
23	137	234			8,910	720	11,800	12,700	556	1,100	409	4,790
24	145	234			8,610	664	12,000	12,700	505	1,010	323	3,580
25	234	224			8,310	664	13,200	12,700	480	892	387	2,390
26	360	224	350		7,260	636	15,200	11,800	456	834	530	1,740
27	360	234			4,250	636	17,000	10,700	456	805	582	1,410
28	338	234			2,640	609	18,100	7,600	480	748	505	1,250
29	382	254			.....	582	19,800	3,630	556	692	892	1,100
30	880	274			.....	582	20,300	2,440	1,330	636	748	1,010
31	1,400	.....			.....	556	.....	1,940	.....	609	556	.....

NOTE.—Discharge interpolated for Oct. 21, Mar. 3, Apr. 21, Aug. 17–18, and Sept. 15, for lack of gage-height record; estimated for Dec. 7 to Feb. 12, because of ice, from gage heights, observer's notes, and weather records; determined from daily gage heights at Chester and New Athens, by slope method described in Water Supply Paper 345, p. 35, for Apr. 4–8 and June 1–20, because of backwater from Mississippi River.

Monthly discharge of Kaskaskia River at New Athens, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 5,220 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
November	1,400	107	237	0.045	0.05
December	1,060	224	443	.085	.09
January	.....	.....	252	.048	.06
February	.....	.....	143	.027	.03
March	13,900	.....	7,090	1.36	1.42
April	2,640	556	1,210	.232	.27
May	20,300	348	6,340	1.21	1.35
June	18,900	1,940	11,600	2.22	2.56
July	2,860	422	913	.175	.20
August	4,070	609	2,080	.398	.46
September	892	283	448	.086	.10
The year	7,100	456	3,190	.611	.68
	20,300	107	2,790	.534	7.27

BIG MUDDY RIVER AT PLUMFIELD, ILL.

LOCATION.—In W. ½ sec. 20, T. 7 S., R. 2 E., at highway bridge at 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, 1918; June 16, 1908 to September 30, 1912, and November 1, to December 31, 1912, maintained 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.—Probably permanent. Control is about a quarter of a mile below gage. Point of zero flow is at a stage of about 0.6 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 24.3 feet at 6 a. m. and 6 p. m. May 15 (discharge, 9,330 second-feet); minimum stage, 0.84 foot at 6 a. m. October 12 (discharge, 2.4 second-feet).

1914–1918: Maximum stage recorded, 30.2 feet February 1, 1916 (discharge, 16,300 second-feet); minimum stage August 18 to 26, 1914, when there was no flow past the gage.

ACCURACY.—Stage-discharge relation practically permanent; seriously affected by ice during winter. Rating curve fairly well defined above 43 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage heights to rating table, except for periods noted in footnote to daily-discharge table. Open-water records good except for low stages, for which they are fair; winter records poor.

Discharge measurements of Big Muddy River at Plumfield, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 19	1.26	9.0
19	1.26	8.4

Daily discharge, in second-feet, of Big Muddy River at Plumfield, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	4.0	386	438			113	24	7,930	62	452	300	108
2	3.6	348	360			312	9	7,190	42	252	174	264
3	3.3	207	143			760	196	6,020	35	133	90	240
4	3.5	103	114			790	123	4,600	26	62	58	373
5	3.2	62	85			494	67	3,370	26	39	24	565
6	2.9	42	62	150	830	466	43	2,180	133	24	16	700
7	2.8	32	43			480	33	1,320	288	17	10	522
8	2.8	26				324	26	790	399	14	8.2	264
9	2.7	20				218	21	412	286	11	6.0	123
10	2.7	18				153	18	185	174	9.1	5.0	67
11	2.6	15				113	16	730	128	6.8	4.7	42
12	2.4	13				94	14	3,070	80	6.2	4.2	28
13	2.8	11			5,600	72	13	6,380	43	5.2	3.9	20
14	2.6	9.1	15		6,020	58	12	9,030	29	5.0	3.8	16
15	2.6	8.4		45	5,930	46	12	9,330	22	4.7	3.8	13
16	2.5	7.6			5,680	42	14	8,930	16	3.9	3.6	26
17	2.5	6.6			5,040	39	153	8,030	13	4.4	3.2	67
18	3.1	6.0			4,110	37	536	6,920	10	4.0	3.8	336
19	3.1	5.2			3,170	32	955	4,880	7.9	4.0	3.5	494
20	3.0	4.8			2,150	30	1,280	3,910	7.0	3.9	3.1	312
21	8.8	4.7			1,300	26	1,540	2,680	6.8	4.1	3.0	163
22	7.9	4.6			685	24	1,730	1,940	6.0	4.0	30	252
23	6.6	4.4			264	26	1,880	1,480	5.0	3.8	34	185
24	4.5	4.2			153	30	2,090	1,340	5.0	3.9	31	98
25	4.4	4.3			133	46	2,640	1,300	5.6	4.2	33	58
26	4.5	4.2	140	10	118	67	3,220	1,280	5.6	4.0	58	37
27	3.8	7.0			118	54	4,460	1,060	6.6	3.8	300	24
28	3.2	12			113	50	6,470	480	6.4	3.9	264	19
29	4.2	46			.....	38	7,460	240	12	3.7	229	14
30	15	324			.....	32	8,030	153	580	3.6	196	11
31	62	.....			.....	28	.....	94	.....	3.0	143	.....

NOTE.—Discharge interpolated for Nov. 13 and 15, Dec. 4, June 9, and Aug. 8; estimated for Dec. 8 to Feb. 12, because of ice, from gage heights, observer's notes, and weather records.

Monthly discharge of Big Muddy River at Plumfield, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 753 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	62	2.4	5.92	0.008	0.009
November	386	4.2	58.2	.077	.09
December	438	.....	96.1	.128	.15
January	.....	.....	66.5	.088	.10
February	6,020	.....	1,800	2.39	2.49
March	790	24	164	.218	.25
April	8,030	9	1,440	1.91	2.13
May	9,330	94	3,460	4.59	5.29
June	580	5.0	82.2	.109	.12
July	452	3.0	35.6	.047	.05
August	300	3.0	66.1	.088	.10
September	700	11	181	.240	.27
The year	9,330	2.4	614	.815	11.05

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, a quarter of a mile below mouth of Louis Creek at Mobile & Ohio Railway bridge.

RECORDS AVAILABLE.—December 6, 1916, to September 30, 1918.

DRAINAGE AREA.—2,170 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

GAGE.—Chain gage attached to bridge; read by E. W. 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, 33.9 feet at 8 p. m. May 16 (discharge not determined because of backwater from Mississippi River); maximum stage recorded during periods not affected by backwater, 27.7 feet at 5 p. m. February 16 (discharge, 10,000 second-feet); minimum stage recorded during year, 1.64 feet at 1 p. m. October 11 (discharge, 3.9 second-feet).

1917–1918: Maximum discharge, estimated 15,600 second-feet January 10, 1917; minimum discharge, 3.9 second-feet, October 11, 1917. About February 2, 1916, the river reached a height of 39.6 feet—the highest known stage—on the present gage (discharge ascertained from extension of rating curve, 28,000 second-feet).

ACCURACY.—Stage-discharge relation changed during year; seriously affected by ice during winter; also affected by backwater from Mississippi River whenever height on gage of United States Weather Bureau at Chester, Ill., is above about 10.0 feet. Rating curve used until March 4 fairly well defined between 45 and 9,000 second-feet; curve used after that date fairly well defined above 68 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage heights to rating tables, except for periods noted in footnote to table of daily discharge. Open-water records good for medium stages, fair for very low and high stages; winter records poor.

Discharge measurements of Big Muddy River at Murphysboro, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Oct. 8	1.87	7.2
8	1.87	7.4
Aug. 28	9.40	1,770

Daily gage height, in feet, of Big Muddy River at Murphysboro, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	5.3	5.1	.....	.....	3.8	5.2	30.9	7.9	.....	1.85	.....
2	.....	5.8	.....	3.25	4.4	.....	6.8	31.2	.....	8.6	2.22	4.8
3	2.15	5.8	5.1	.....	.....	.....	7.4	30.6	10.0	8.4	2.75	6.1
4	2.04	4.0	4.8	3.2	.....	8.2	8.6	28.5	9.6	8.0	.....	8.8
5	1.96	3.6	4.2	3.55	4.9	.....	8.6	.....	9.1	7.6	2.85	9.2
6	1.94	3.5	3.6	3.55	.....	7.4	8.5	26.2	8.8	7.0	2.9	9.6
7	.....	3.0	3.15	.....	5.6	.....	.....	24.9	8.5	.....	2.85	9.9
8	1.84	2.90	2.92	6.2	.....	6.4	8.4	23.2	8.2	6.0	2.5	8.4
9	1.70	2.80	.....	6.2	19.0	6.1	7.5	19.4	.....	5.2	1.96	7.1
10	1.66	2.72	2.80	6.4	21.0	4.6	6.7	16.8	8.0	5.3	2.04	5.7
11	1.64	.....	2.70	.....	.....	4.4	6.1	17.1	8.2	5.4	2.12	5.1
12	1.72	2.96	2.66	6.6	24.4	4.1	5.3	27.3	9.1	5.5	1.98	4.4
13	1.70	3.7	2.62	.....	.....	3.8	4.6	30.5	10.9	5.2	1.85	3.0
14	.....	3.05	2.59	.....	27.0	3.6	.....	32.2	10.6	.....	1.78	2.95
15	2.10	2.72	2.57	5.0	27.0	3.4	3.6	33.5	10.4	5.0	1.74	.....
16	2.05	2.54	.....	.....	27.7	3.25	4.4	33.9	.....	4.0	1.88	4.2
17	2.00	2.48	2.55	4.1	.....	.....	7.6	33.5	9.9	3.2	2.12	5.4
18	2.30	.....	2.52	.....	26.2	3.4	8.6	31.9	9.2	2.7	.....	5.9
19	2.20	2.40	2.65	3.7	24.6	3.5	10.6	.....	8.9	2.2	3.7	6.4
20	2.20	2.32	3.1	.....	.....	3.55	12.8	29.9	8.6	2.12	4.6	6.0
21	.....	2.22	3.4	.....	21.0	3.5	17.3	28.4	8.0	.....	4.0	5.2
22	2.60	2.14	3.55	3.45	.....	.....	17.8	26.5	7.7	2.06	3.4	4.6
23	2.70	2.08	.....	.....	14.9	3.1	18.2	24.4	.....	2.00	3.4	4.2
24	2.64	2.04	4.8	3.4	.....	.....	.....	22.3	6.4	1.92	4.0	3.8
25	2.60	.....	.....	.....	7.2	3.6	21.6	20.2	5.5	1.85	4.2	3.5
26	2.70	2.02	4.4	4.4	.....	3.45	24.5	.....	6.1	1.88	6.9	3.35
27	2.60	2.22	4.3	.....	4.3	3.5	26.4	18.2	7.1	1.92	9.2	3.05
28	.....	2.70	4.2	.....	.....	.....	29.2	15.1	7.7	1.98	.....	2.85
29	2.60	4.2	4.2	3.45	.....	3.8	30.2	11.5	8.1	1.92	.....	.....
30	2.80	5.0	.....	.....	.....	3.9	.....	8.1	.....	1.90	4.8	2.6
31	3.20	.....	3.7	4.0	.....	.....	.....	7.8	.....	1.88	4.2	.....

NOTE.—Stage-discharge relation affected by ice Dec. 11 to Feb. 8 and by backwater from Mississippi River Mar. 5 to July 21 and Sept. 5–10.

Daily discharge, in second-feet, of Big Muddy River at Murphysboro, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	July.	Aug.	Sept.
1	a 26	495	455			225	.....	18	a 404
2	a 22	598	a 455			.....	.....	43	469
3	18	598	455			.....	.....	94	797
4	13	255	395			1,170	.....	a 100	1,590
5	10	195	287	325	250	.....	.....	106	
6	9.2	180	195			.....	.....	112	
7	a 8.0	105	128			.....	.....	106	1,000
8	6.8	92	95			.....	.....	68	
9	4.5	79	a 87		5,650	.....	.....	25	
10	4.1	69	79		6,730	.....	.....	30	
11	3.9	a 84			7,680	.....	.....	35	539
12	4.8	100			8,640	.....	.....	26	381
13	4.5	210			a 9,420	.....	.....	18	125
14	a 10	112			10,200	.....	.....	14	118
15	15	69	40	310	a 10,200	.....	.....	12	a 229
16	13	49			10,700	.....	.....	20	340
17	11	43			10,200	.....	.....	35	612
18	27	a 39			9,720	.....	.....	a 140	743
19	20	35			8,760	.....	.....	244	880
20	20	29			a 7,740	.....	.....	424	770
21	a 38	21			6,730	.....	.....	300	563
22	56	17			a 5,200	.....	31	190	424
23	67	14			3,660	.....	27	190	340
24	60	13			a 2,290	.....	22	300	262
25	56	a 12			920	.....	18	340	208
26	67	12	260	30	a 612	.....	20	1,020	182
27	56	21			304	.....	22	1,710	132
28	a 56	67			a 264	.....	26	a 1,400	106
29	56	287			.....	.....	22	a 882	a 92
30	79	435			.....	.....	21	469	78
31	135	.....			.....	.....	20	340	.....

a Discharge interpolated.

NOTE.—Discharge estimated for Dec. 11 to Feb. 8 because of ice and for Sept. 5–10 because of backwater from Mississippi River. Discharge March 5 to July 21 not determined owing to backwater. Braced figures show mean discharge for periods indicated.

Monthly discharge of Big Muddy River at Murphysboro, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 2,170 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	135	3.9	31.5	0.015	0.02
November	598	12	144	.066	.07
December	455	.....	190	.088	.10
January	.....	.....	215	.099	.11
February	10,700	.....	4,560	2.10	2.19
August	1,710	12	284	.131	.15
September	.....	78	546	.252	.28

MISCELLANEOUS MEASUREMENTS.

Miscellaneous discharge measurements in Hudson Bay drainage basin during the year ending Sept. 30, 1918.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
June 16	Allen Creek	Swift Current Creek	Trail crossing on Many Glacier-Canyon Creek trail.	.....	17.6
July 14	.....do.....	.....do.....	.....do.....	0.29	[a] 8.0
Aug 11	.....do.....	.....do.....	.....do.....	.06	2.6
Sept. 6	.....do.....	.....do.....	.....do.....	.03	1.2

[a] Temporary gage set under foot log at trail crossing.

Miscellaneous discharge measurements in Upper Mississippi River drainage basin during the year ending Sept. 30, 1918.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
June 5	Iowa River	Mississippi River	Belle Plain, Iowa	.....	38,600

INDEX.

STREAM-GAGING STATIONS

AND

PUBLICATIONS RELATING TO WATER RESOURCES

PART V. HUDSON BAY AND UPPER MISSISSIPPI RIVER DRAINAGE BASINS

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.
II. South Atlantic slope and eastern Gulf of Mexico basins.
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 obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C. The edition printed for free distribution is, however, small and is soon exhausted.

2. 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.

3. Sets of the reports may be consulted in the libraries of the principal cities in the United States.

4. 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.
Harrisburg, Pa., Care of Water Supply Commission.
Asheville, N. C., 32–35 Broadway.
Chattanooga, Tenn., Temple Court Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Chicago, Ill., 1404 Kimball Building.
Ames, Iowa, care of State Highway Commission.
Helena, Mont., Montana National Bank Building.
Topeka, Kans., 23 Federal Building.
Austin, Tex., Capitol Building.
Denver, Colo., 403 New Post Office Building.
Salt Lake City, Utah, 313 Federal Building.
Boise, Idaho, 615 Idaho Building.
Idaho Falls, Idaho, 228 Federal Building.
Portland, Oreg., 606 Post Office Building.
Tacoma, Wash., 406 Federal Building.
San Francisco, Calif., 328 Customhouse.
Los Angeles, Calif., 619 Federal Building.
Honolulu, Hawaii, 14 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director of the United States Geological Survey, Washington, D. C.

STREAM-FLOW REPORTS.

Stream-flow records have been obtained at more than 4,510 points in the United States, and the data obtained have been published in the reports tabulated below:

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 Sept., 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. 2	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.
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.

Stream-flow data in reports of the United States Geological Survey—Continued.

Report.	Character of data.	Year.
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.

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 1918. The data for any particular station will in general be found in the reports covering the years during which the station was maintained. For example, data for Machias River at Whitneyville, Me., 1903 to 1917, are published in Water-Supply Papers 97, 124, 165, 201, 241, 261, 281, 301, 321, 351, 381, 401, 431, 451, and 471, which contain records for the New England streams from 1903 to 1918. Results of miscellaneous measurements are published by drainage basins.

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 III, and the records for large lakes are taken up in order of streams around the rim of the lake.

Numbers of water-supply papers containing results of stream measurements, 1899–1918.

Year.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
												North Pacific drainage basins.		
	North Atlantic slope basins (St. John River to York River).	South Atlantic slope and eastern Gulf of Mexico basins (James River to the Mississippi).	Ohio River basin.	St. Lawrence River and Great Lakes basins.	Hudson Bay and upper Mississippi River basins.	Missouri River basin.	Lower Mississippi River basin.	Western Gulf of Mexico basins.	Colorado River basin.	Great Basin.	Pacific slope basins in California.	Pacific slope basins in Washington and upper Columbia River basin.	Snake River basin.	Lower Columbia River basin and Pacific slope basins in Oregon.
1899 [a]	35	[b] 35, 36	36	36	36	[c] 36, 37	37	37	[d] 37, 38	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	332-A	332-B	332-C
1913	351	352	353	354	355	356	357	358	359	360	361	362-A	362-B	362-C
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

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39. Tables of 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 drainage 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. Tables of 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.

PART V.—HUDSON BAY AND UPPER MISSISSIPPI RIVER DRAINAGE BASINS.

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 p. XVII.)

GAGING STATIONS.

NOTE.—Dash after a date indicates that station was being maintained September 30, 1918. 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–
- U. S. Reclamation Service, St. Mary canal at intake, near Babb, Mont., 1918–
- U. S. Reclamation Service, St. Mary canal at St. Mary crossing, near Babb, Mont., 1918–
- U. S. Reclamation Service, 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 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.

UPPER MISSISSIPPI RIVER BASIN.

Mississippi River tributaries—Continued.
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., 1902–1905; 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–
Cannon River at Welch, Minn., 1909–1914.
Chippewa River at Bishops Bridge, near Winter, Wis., 1912–
Chippewa River near Bruce, Wis., 1913–
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–
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.
Wisconsin River near Rhinelander, Wis., 1905–1915.
Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., 1915–
Wisconsin River at Merrill, Wis., 1902–
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 Kelley, Wis., 1914–
Big Eau Pleine River near Stratford, Wis., 1914–
Plover River near Stevens Point, Wis., 1914–
Baraboo River near Baraboo, Wis., 1913–
Kickapoo River at Gays Mills, Wis., 1913–

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 are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked in this way may, however, be purchased (at prices quoted) from the SUPERINTENDENT OF DOCUMENTS, Washington, D. C. Omission of the price indicates that the report s not obtainable from Government sources. Water-supply papers are of octavo size.

*21. Wells of northern Indiana, by Frank Leverett. 1899. 82 pp., 2 pls.
Dicsusses, 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. 15c.
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. 5c.

*61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp. 5c.
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. 30c.
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. 25c.
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. 5c.
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. 10c.

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. 10c.

Cites 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. 25c

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. 15c.

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. 40c.

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. 10c.

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, Kaskakia, 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, occurence, 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.

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 are distributed free by the Geological Survey as long as its stocks lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers so marked, however, may be purchased, from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

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. $2.35. 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 Beavers 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 of quarto size. They are not distributed free, but may be obtained from the Geological Survey or from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C., at the prices indicated. An asterisk (*) indicates that the Survey's stock of the paper is exhausted.

25. The glacial Lake Agassiz, by Warren Upham. 1896. 658 pp., 38 pls. $1.70.

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. $1.60.

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 groundwater supplies.

PROFESSIONAL PAPERS.

Professional papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked with an asterisk may, however, be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. 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. $1.80.

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.

BULLETINS.

An asterisk (*) indicates that the Geological Survey's stock of the paper is exhausted. Many of the papers so marked may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

Discusses the imporance 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. 25c.

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, 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.

[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.

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. 5c.
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. 5c.
Discusses shallow, deep and artesian wells; head, pressure, power, volume, and character of the water, and gives a tabulated list of representative wells, 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.

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 Commission of Illinois, and the water-power report of the Tenth Census (vol. 17). The following reports deserve special mention:

Contributions to the physical geography of the United States, Part I. On the physical geography of the Mississippi Valley, with suggestions for the improvement 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 the 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 Isiah 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.

[2] Issued in two editions; specify which edition is wanted.

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.

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.

GEOLOGICAL SURVEY HYDROLOGIC REPORTS OF GENERAL INTEREST.

The following list comprises reports not readily classifiable by drainage basins and covering a wide range of hydrologic investigations:

WATER-SUPPLY PAPERS.

*1. Pumping water for irrigation, by H. M. Wilson. 1896. 57 pp., 9 pls.

Describes pumps and motive powers, windmills, water wheels, and various kinds of engines; also storage reservoirs to retain pumped water until needed for irrigation.

*3. Sewage irrigation, by G. W. Rafter. 1897. 100 pp., 4 pls. (See Water-Supply Paper 22.) 10c.

Discusses methods of sewage disposal by intermittent filtration and by irrigation; describes utilization of sewage in Germany, England, and France, and sewage purification in the United States.

*8. Windmills for irrigation, by E. C. Murphy. 1897. 49 pp., 8 pls. 10c.

Gives results of experimental tests of windmills during the summer of 1896 in the vicinity of Garden, Kansas; describes instruments and methods and draws conclusions.

*14. New tests of certain pumps and water lifts used in irrigation, by O. P. Hood. 1898. 91 pp., 1 pl.

Discusses efficiency of pumps and water lifts of various types.

*20. Experiments with windmills, by T. O. Perry. 1899. 97 pp., 12 pls. 15c.

Includes tables and descriptions of wind wheels, compares wheels of several types, and discusses results.

*22. Sewage irrigation, Part II, by G. W. Rafter. 1899. 100 pp., 7 pls. 15c.

Gives résumé of Water-Supply Paper 3; discusses pollution of certain streams, experiments on purification of factory wastes in Massachusetts, value of commercial fertilizers, and describes American sewage-disposal plants by States; contains bibliography of publications relating to sewage utilization and disposal.

*41. The windmill; its efficiency and economic use, Part I, by E. C. Murphy. 1901. 72 pp., 14 pls. 5c.

*42. The windmill; its efficiency and economic use, Part II, by E. C. Murphy. 1901. 75 pp. (73–147), 2 pls. (15–16). 10c.

Nos. 41 and 42 give details of results of experimental tests with windmills of various types.

*43. Conveyance of water in irrigation canals, flumes, and pipes, by Samuel Fortier. 1901. 86 pp., 15 pls. 15c.

*56. Methods of stream measurement. 1901. 51 pp., 12 pls. 15c.

Describes the methods used by the Survey in 1901–2. (See also Nos. 64, 94, and 95.)

*64. Accuracy of stream measurements, by E. C. Murphy. 1902. 99 pp., 4 pls. (See No. 95.) 10c.

Describes methods of measuring velocity of water and of measuring and computing stream flow, and compares results obtained with the different instruments and methods; describes also experiments and results at the Cornell University hydraulic laboratory. A second, enlarged, edition published as Water-Supply Paper 95.

*67. The motions of underground waters, by C. S. Slichter. 1902. 106 pp., 8 pls. 15c.

Discusses origin, depth, and amount of ground waters; permeability of rocks and porosity of soils; causes, rates, and laws of motions of ground waters; surface and deep zones of flow, and recovery of waters by open wells and artesian and deep wells; treats of the shape and position of the water table; gives simple methods of measuring yields of flowing wells; describes artesian wells at Savannah, Ga.

72. Sewage pollution in the metropolitan area near New York City and its effect on inland water resources, by M. O. Leighton. 1902. 75 pp., 8 pls. 10c.

Defines "normal" and "polluted" waters and discusses the damage resulting from pollution.

*80. The relation of rainfall to run-off, by G. W. Rafter. 1903. 104 pp. 10c.

Treats of measurements of rainfall and laws and measurements of streams flow; gives formulas for rainfall, run-off, and evaporation; discusses effects of forests on rainfall and run-off.

87. Irrigation in India (second edition), by H. M. Wilson. 1903. 238 pp., pls. 25c.

First edition was published in Part II of the Twelfth Annual Report.

93. Proceeding of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, Chief Engineer. 1904. 361 pp. 25c. [Requests for this report should be addressed to the U. S. Reclamation Service.]

Contains the following papers of more or less general interest:
Limits of an irrigation project, by D. W. Ross.
Relation of Federal and State laws to irrigation, by Morris Bien.
Electical transmission of power for pumping, by H. A. Storrs.
Correct design and stability of high masonry dams, by Geo. Y. Wisner.
Irrigation surveys and use of the planetable, by J. V. Lippincott.
The use of alkaline waters for irrigation, by Thomas H. Means.

*94. Hydrographic manual of the United States Geological Survey, prepared by E. C. Murphy, J. C. Hoyt, and G. B. Hollister. 1904. 76 pp., 3 pls. 10c.

Gives instruction for field and office work relating to measurements of stream flow by current meters. (See also No. 95.)

*95. Accuracy of stream measurements (second, enlarged edition), by E. C. Murphy. 1904. 169 pp., 6 pls.

Describes methods of measuring and computing stream flow and compares results derived from different instruments and methods. (See also No. 94.)

*103. A review of the laws forbidding pollution of inland water in the United States, by E. B. Goodell. 1904. 120 pp. (See No. 152.)

Explains the legal principles under which antipollution statutes become operative, quotes court decisions to show authority for various deductions, and classifies according to scope the statutes enacted in the different States.

*110. Contributions to the hydrology of Eastern United States; 1904, M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains the following reports of general interest. The scope of each paper is indicated by its title.

Description of under flow meter used in measuring the velocity and direction of underground water, by Charles S. Slichter.

The California or "stovepipe" method of well construction, by Charles S. Slichter.

Approximate methods of measuring the yield of flowing wells, by Charles S. Slichter.

Corrections necessary in accurate determinations of flow from verticals well casings, from notes furnished by A. N. Talbot.

113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls. 5c.

The first paper discusses the pollution of stream by sewage and by trade wastes, describes the manufacture of strawboard, and gives results of various experiments in disposing of the waste. The second paper describes briefly the topography, drainage, and geology of the region about Marion, Ind., and the contamination of rock wells and of streams by waste oil and brine

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains reports on "Occurrence of underground waters," by M. L. Fuller, discussing sources, amount, and temperature of waters, permeability and storage capacity of rocks, water bearing formations, recovery of water by springs, wells, and pumps, essential conditions of artesian flows, and general conditions affecting ground waters in eastern United States.

119. Index to the hydrographic progress reports of the United States Geological Survey, 1888 to 1903, by J. C. Hoyt and B. D. Wood. 1905. 253 pp. 15c.

120. Bibliographic review and index of papers relating to underground waters published by the United States Geological Survey, 1879–1904, by M. L. Fuller. 1905. 128 pp. 10c.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Defines and classifies underground waters, gives common-law rules relating to their use, and cites State legislative acts affecting them.

140. Field measurements of the rate of movement of underground waters, by C. S. Slichter. 1905. 122 pp., 15 pls. 15c.

Discusses the capacity of sand to transmit water, describes measurements of underflow in Rio Hondo, San Gabriel, and Mohave River Valleys, Cal., and on Long Island, N. Y., gives results of tests of wells and pumping plants, and describes stovepipe method of well construction.

143. Experiments on steel-concrete pipes on a working scale, by J. H. Quinton. 1905. 61 pp., 4 pls. 5c.

Scope indicated by title.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains brief reports of general interest, as follows:

Drainage of ponds into drilled wells, by Robert E. Horton. Discusses efficiency, cost, and capacity of drainage wells, and gives statistics of such well in Southern Michigan.

Construction of so-called fountain and geyser springs, by Myron L. Fuller

A convenient gage for determining low artesian heads, by Myron L. Fuller.

146. Proceedings of second conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, Chief Engineer. 1905. 267 pp. 15c. [Inquiries concerning this report should be addressed to the Reclamation Service.]

Contains brief account of the organization of the hydrographic [water-resources] branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of technical papers by members of the service. Of the papers read at the conference those listed below (scope indicated by title) are of more or less general interest.

Proposed State code of water laws, by Morris Bien.

Power engineering applied to irrigation problems, by O. H. Ensign.

Estimates on tunneling in irrigation projects, by A. L. Fellows.

Collection of steam-gaging data, by N. C. Grover.

Diamond-drill methods, G. A. Hammond

Mean-velocity and area curves, by F. W. Hanna.

Importance of general hydrographic data concerning basins of streams gaged, by R. E. Horton.

Effect of aquatic vegetation on stream flow, by R. E. Horton

Sanitary regulations governing construction camps, by M. O. Leighton.

Necessity of draining irrigated land, by Thos. H. Means.

Alkali soils, by Thos. H. Means.

Cost of stream gaging work, by E. C. Murphy.

Equipment of a cable gaging station, by E. C. Murphy.

Silting of reservoirs, by W. M. Reed

Farm-unit classification, by D. W. Ross.

Cost of power for pumping irrigated water, by H. A. Storrs.

Records of flow at current-meter gaging stations during the frozen season, by F. H. Tillinghast.

147. Destructive floods in United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c.

Contains a brief account of "A method of computing cross-section area of waterways," including formulas for maximum discharge and areas of cross section.

*150. Weir experiments, coefficients, and formulas, by R. E. Horton. 1906. 189 pp., 38 pls. (See Water-Supply Paper 200.) 15c.

Scope indicated by title.

151. Field assay of water, by M. O. Leighton. 1905. 77 pp., 4 pls.

Discusses methods, instruments, and reagents used in determining turbidity, color, iron, chlorides, and hardness in connection with the studies of the quality of water in various parts of the United States

*152. A review of the laws forbidding pollution of inland waters in the United States, second edition, by E. B. Goodell. 1905. 149 pp. 10c.

Scope indicated by title.

*155. Fluctuations of the water level in wells, with special reference to Long Island. N. Y., A. C. Veatch. 1906. 83 pp., 9 pls. 25c.

Includes general discussion of fluctuations due to rainfall and evaporation, barometric changes, temperature changes, changes in rivers, changes in lake level, tidal changes, effects of settlement, irrigation, dams, underground-water developments, and to indeterminate causes.

*160. Underground water papers. 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.

Gives account of work in 1905; lists publications relating to underground waters, and contains the following brief reports of general interest:

Significance of the term "artesian," by Myron L. Fuller.
Representation of wells and springs on maps, by Myron L. Fuller.
Total amount of free water in the earth's crust, by Myron L. Fuller.
Use of fluorescein in the study of underground waters, by R. B. Dole.
Problems of water contamination, by Isaiah Bowman.
Instances of improvement of water in wells, by Myron L. Fuller.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

*163. Bibliographic review and index of underground-water literature published in the United States in 1905, by M. L. Fuller, F. G. Clapp, and B. L. Johnson. 1906. 130 pp. 15c.

Scope indicated by title.

*179. Prevention of stream pollution by distillery refuse, based on investigations at Lynchburg, Ohio, by Herman Stabler. 1906. 34 pp., 1 pl. 10c.

Describes grain distillation, treatment of slop, sources, character, and effects of effluents on streams; discusses filtration, precipitation, fermentation, and evaporation methods of disposal of wastes without pollution.

*180. Turbine water-wheel tests and power tables, by R. E. Horton. 1906. 134 pp., 2 pls. 20c.

Scope indicated by title.

*185. Investigations on the purification of Boston sewage, * * * with a history of the sewage-disposal problem, by C.-E. A. Winslow and E. B. Phelps. 1906. 163 pp. 25c.

Discusses composition, disposal, purification, and treatment of sewages and tendencies in sewage-disposal practice in England, Germany, and the United States; describes character of crude sewage at Boston, removal of suspended matter, treatment in septic tanks, and purification by intermittent sand filtration and in beds of coarse material; gives bibliography.

*186. Stream pollution by acid-iron wastes, a report based on investigations made at Shelby, Ohio, by Herman Stabler. 1906. 36 pp., 1 pl.

Gives history of pollution by acid-iron wastes at Shelby, Ohio, and of resulting litigation; discusses effect of acid-iron liquors of sewage-purification processes, recovery of copperas from acid-iron wastes, and other processes for removal of pickling liquor.

*187. Determination of stream flow during the frozen season, by H. K. Barrows and R. E. Horton. 1907. 93 pp., 1 pl. 15c.

Scope indicated by title.

*189. The prevention of stream pollution by strawboard waste, by E. B. Phelps. 1906. 20 pp., 2 pls.

Describes manufacture of strawboard, present and proposed methods of disposal of waste liquors, laboratory investigations of precipitation and sedimentation, and field studies of amounts and character of water used, raw material and finished product, and mechanical filtration.

*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.

*200. Weir experiments, coefficients, and formulas (revision of paper No. 150), by R. E. Horton. 1907. 195 pp., 1 pl. 35c.

Scope indicated by title.

*226. The pollution of streams by sulphite-pulp waste, a study of possible remedies by E. B. Phelps. 1909. 37 pp., 1 pl. 10c.

Describes manufacture of sulphite pulp, the waste liquors, and the experimental work leading to suggestions as to methods of preventing stream pollution.

*229. The disinfection of sewage and sewage filter effluents, with a chapter on the putrescibility and stability of sewage effluents, by E. B. Phelps. 1909. 91 pp., 1 pl. 15c.

Scope indicated by title.

*234. Papers on the conversion of water resources. 1909. 96 pp., 2 pls. 15c.

Contains the following papers, whose scope is indicated by their titles: Distribution of fall, by Henry Gannett; Floods, by M. O. Leighton; Developed water powers, compiled under the direction of W. M. Steuart, with discussion by M. O. Leighton; Undeveloped water powers, by M. O. Leighton; Irrigation, by F. H. Newell; Underground waters, by W. C. Mendenhall; Denudation, by R. B. Dole and Herman Stabler; Control of catchment areas, by H. N. Parker.

*235. The purification of some textile and other factory wastes, by Herman Stabler, and G. H. Pratt. 1909. 76 pp. 10c.

Discusses waste waters from wool-scouring, bleaching, and dyeing cotton yarn, bleaching cotton piece goods, and manufacture of oleomargarine, fertilizer, and glue.

*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. 10c.

Describes collection of samples, methods of examination, preparation of solutions, accuracy of estimates, and expression of analytical results.

238. The public utility of water powers and their governmental regulation, by René Tavernier and M. O. Leighton. 1910. 161 pp. 15c.

Discusses hydraulic power and irrigation, French, Italian, and Swiss legislation relative to the development of water powers, and laws proposed in the French Parliament; reviews work of bureau of hydraulics and agricultural improvement of the French department of agriculture and gives résumé of Federal and State water-power legislation in the United States.

*255. Underground waters for farm use, by M. L. Fuller. 1910. 58 pp., 17 pls. 15c.

Discusses rocks as sources of water supply and the relative saftey of supplies from different materials; springs, and their protection; open or dug and deep wells, their location, yields, relative cost, protection, and safety; advantages and disadvantages of cisterns and combination wells and cisterns.

*257. Well-drilling methods, by Isaiah Bowman. 1911. 139 pp., 4 pls. 10c.

Discusses amount, distribution, and disposal of rainfall, water-bearing rocks, amount of ground water, artesian conditions, and oil and gas bearing formations; gives history of well drilling in Asia, Europe, and the United States; describes in detail the various methods and the machinery used; discusses loss of tools and geologic difficulties; contamination of well waters and methods of prevention; tests of capacity and measurement of depth; and costs of sinking wells.

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*258. Underground water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 123 pp., 2 pls. 15c.

Contains the following papers (scope indicated by titles) of general interest:
Drainage by wells, by M. L. Fuller.
Freezing of wells and related phenomena, by M. L. Fuller.
Pollution of underground waters in limestone, by G. C. Matson.
Protection of shallow wells in sandy deposits, by M. L. Fuller.
Magnetic wells, by M. L. Fuller.

274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pp. 15c.

Describes collection of samples, plan of analytical work, and methods of analyses; discusses soap-consuming power of waters, water softening, boiler waters, and water for irrigation.

*315. The purification of public water supplies, by G. A. Johnson. 1913. 84 pp., 8 pls. 10c.

Discusses ground, lake, and river waters as public supplies, development of waterworks systems in the United States, water consumption, and typhoid fever; describes methods of filtration and sterilization of water, and municipal water softening.

334. The Ohio Valley flood of March–April, 1913 (including comparisons with some earlier floods), by A. H. Horton and H. J. Jackson. 1913. 96 pp., 22 pls. 20c.

Although relating specifically to floods in the Ohio Valley, this report discusses also the causes of floods and the prevention of damage by floods.

*337. The effects of ice on stream flow, by William Glenn Hoyt. 1913. 77 pp., 7 pls. 15c.

Discusses methods of measuring the winter flow of streams.

*345. Contributions to the hydrology of the United States, 1914; N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c. Contains:

* (*e*) A method of determining the daily discharge of rivers of variable slope, by M. R. Hall, W. E. Hall, and C. H. Pierce, pp. 53–65.

*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 waters from rivers, lakes, wells, and springs in various parts of the United States, including analyses of the geyser water of Yellowstone National Park, hot springs in Montana, brines from Death Valley, water from the Gulf of Mexico, and mine waters from Tennessee, Michigan, Missouri and Oklahoma, Montana, Colorado, and Utah, Nevada and Arizona, and California.

371. Equipment for current-meter gaging stations, by G. J. Lyon. 1915. 64 pp., 37 pls. 20c.

Describes methods of installing automatic and other gages and of constructing gage wells, shelters, and structures for making discharge measurements and artificial controls.

*375. Contributions to the hydrology of the United States, 1915; N. C. Grover, chief hydraulic engineer. 1916. 181 pp., 9 pls. 15c.

Contains three papers presented at the conference of engineers of the water-resources branch in December, 1914.

* (*c*) The relation of stream gaging to the science of hydraulics, by C. H. Pierce and R. W. Davenport, pp. 77–84.

(*e*) A method for correcting river discharge for changing stage, by B. E. Jones, pp. 117–130.

(*f*) Conditions requiring the use of automatic gages in obtaining records of stream flow, by C. H. Pierce, pp. 131–139.

*400. Contributions to the hydrology of the United States, 1916; N. C. Grover, chief hydraulic engineer. 1917. 108 pp., 7 pls. Contains.

(*a*) The people's interest in water-power resources, by G. O. Smith, pp. 1–8.

* (*c*) The measurement of silt-laden streams, by R. C. Pierce, pp. 39–51.

(*d*) Accuracy of stream-flow data, by N. C. Grover and J. C. Hoyt, pp. 53–59.

416. The divining rod, a history of water witching, with a bibliography, by Arthur J. Ellis. 1917. 59 pp. 10c.

A brief paper published "merely to furnish a reply to the numerous inquiries that are continually being received from all parts of the country" as to the efficacy of the divining rod for locating underground water.

*425. Contributions to the hydrology of the United States, 1917; N. C. Grover, chief hydraulic engineer. 1918. Contains:

* (c) Hydraulic conversion tables and convenient equivalents, pp. 71–94. 1917.

427. Bibliography and index of the publications of the United States Geological Survey relating to ground water, by O. E. Meinzer. 1918. 169 pp., 1 pl.

Includes publications prepared, in whole or part, by the Geological Survey that treat any phase of the subject of ground water or any subject directly applicable to ground water. Illustrated by map showing reports that cover specific areas more or less thoroughly.

ANNUAL REPORTS.

*Fifth Annual Report of the United States Geological Survey, 1883–84, J. W. Powell, Director. 1885. xxxvi, 469 pp., 58 pls. $2.25. Contains:

*The requisite and qualifying conditions of artesian wells, by T. C. Chamberlin, pp. 125–173, pl. 21. Scope indicated by title.

*Twelfth Annual Report of the United States Geological Survey, 1890–91, J. W. Powell, Director. 1891. 2 parts. *Pt. II, Irrigation, xviii, 576 pp., 93 pls. $2. Contains:

*Irrigation in India, by H. M. Wilson, pp. 368–561, pls. 107 to 146. See Water-Supply Paper 87.

Thirteenth Annual Report of the United States Geological Survey, 1891–92, J. W. Powell, Director. 1892. (Pts. II and III, 1893.) 3 parts. *Pt. III, Irrigation, xi, 486 pp., 77 pls. $1.85. Contains:

*American irrigation engineering, by H. M. Wilson, pp. 101–349, pls. 111 to 145. Discusses the economic aspects of irrigation, alkaline drainage, silt and sedimentation; gives brief history of legislation; describes perennial canals in Idaho, California, Wyoming, and Arizona; discusses water storage at reservoirs of the California and other projects, subsurface sources of supply, pumping, and subirrigation.

Fourteenth Annual Report of the United States Geological Survey, 1892–93, J. W. Powell, Director. 1893. (Pt. II, 1894.) 2 parts. *Pt. II, Accompanying papers, xx, 597 pp., 73 pls. $2.10. Contains:

*Potable waters of the eastern United States, by W J McGee, pp. 1 to 47. Discusses cistern water, stream waters, and ground waters, including mineral springs and artesian wells.

*Natural mineral waters of the United States, by A. C. Peale, pp. 49–88, pls. 3 and 4. Discusses the origin and flow of mineral springs, the source of mineralization, thermal springs, the chemical composition and analysis of spring waters, geographic distribution, and the utilization of mineral waters; gives a list of American mineral spring resorts; contains also some analyses.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Parts II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. II.—Papers chiefly of a theoretic nature, v, 958 pp., 172 pls. $2.65. Contains:

*Principles and conditions of the movements of ground water, by F. H. King, pp. 59–294, pls. 6 to 16. Discusses the amount of water stored in sandstone, in soil, and in other rocks, the depth to which ground water penetrates; gravitational, thermal, and capillary movements of ground waters, and the configuration of the ground-water surface; gives the results of experimental investigations on the flow of air and water through a rigid, porous medium and through sands, sandstones, and silts; discusses results obtained by other investigators, and summarizes results of observations; discusses also rate of flow of water through sand and rock, the growth of rivers, rate of filtration through soil, interference of wells, etc.

*Theoretical investigation of the motion of ground waters, by C. S. Slichter, pp. 295–384, pl. 17. Scope indicated by title.

PROFESSIONAL PAPERS.

*72. Denudation and erosion in the southern Appalachian region and the Monongahela basin, by L. C. Glenn. 1911. 137 pp., 21 pls. 35c.

Describes the topography, geology, drainage, forests, climate and population, and transportation facilities of the region, the relation of agricultural lumbering, mining, and power development to erosion and denudation, and the nature, effects, and remedies of erosion; gives details of conditions in Holston, Nolichucky, French Broad, Little Tennessee, and Hiwassee river basins, along Tennessee River proper, and in the basins of the Coosa-Alabama system, Chattahoochee, Savannah, Saluda, Broad, Catawba, Yadkin, New, and Monongahela rivers.

*86. The transportation of débris by running water, by G. K. Gilbert, based on experiments made with the assistance of E. C. Murphy. 1914. 263 pp., 3 pls. 70c.

The results of an investigation which was carried on in a specially equipped laboratory at Berkeley, Calif., and was undertaken for the purpose of learning "the laws which control the movement of bed load and especially to determine how the quantity of load is related to the stream slope and discharge and to the degree of comminution of the débris."

105. Hydraulic-mining débris in the Sierra Nevada, by G. K. Gilbert. 154 pp. 34 pls. 1917. 50c.

Presents the results of an investigation undertaken by the United States Geological Survey in response to a memorial from the California Miners' Association asking that a particular study be made of portions of the Sacramento and San Joaquin valleys affected by detritus from torrential streams. The report deals largely with geologic and physiographic aspects of the subject, traces the physical effects, past and future, of the hydraulic mining of earlier decades, the similar effects which certain other industries induce through stimulation of the erosion of the soil, and the influence of the restriction of the area of inundation by the construction of levees. Suggests cooperation by several interests for the control of the streams now carrying heavy loads of débris.

BULLETINS.

*32. Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 1886. 235 pp.

Defines mineral waters, lists the springs by State, and gives table of analyses.

*319. Summary of the controlling factors of artesian flows, by Myron L. Fuller. 1908. 44 pp. 7 pls. 10c.

Describes underground reservoirs, the source of ground waters, the confining agents, the primary and modifying factors of artesian circulation, the essential and modifying factors of artesian flow, and typical artesian systems.

*479. The geochemical interpretation of water analyses, by Chase Palmer. 1911. 31 pp. 5c.

Discusses the expression of chemical analyses, the chemical character of water and the properties of natural waters; gives a classification of waters based on property values and reacting values, and discusses the character of the waters of certain rivers as interpreted directly from the results of analyses; discusses also the relation of water properties to geological formations, silica in river water, and the character of the water of the Mississippi and the Great Lakes and St. Lawrence River as indicated by chemical analyses.

*616. The data of geochemistry (third edition), by F. W. Clarke. 1916. 821 pp. 45c.

Earlier editions were published as Bulletins 330 and 491. Contains a discussion of the statement and interpretation of water analyses and a chapter on "Mineral wells and springs" (pp. 179–216). Discusses the definition and classification of mineral waters, changes in composition of water, deposits of calcareous, ocherous, and siliceous materials made by water, vadose and juvenile waters, and thermal springs in relation to volcanism. Describes the different kinds of ground water and gives typical analyses. Includes a brief bibliography of papers containing water analyses.

INDEX BY AREAS AND SUBJECTS.

[A=Annual Reports; M=Monograph; B=Bulletin; P=Progressional Paper; W=Water-Supply Paper; G F=Geologic folio.]

[1] Many of the reports contain brief subject bibliographies. See abstracts.

[2] Many analyses of river, spring, and well waters are scattered through publications, as noted in abstract.

INDEX OF STREAMS.