DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

Water-Supply Paper 455

SURFACE WATER SUPPLY OF THE UNITED STATES

1917

PART V. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS

NATHAN C. GROVER, Chief Hydraulic Engineer
W. G. HOYT, District Engineer

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, 1917.

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, 1917.

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, 1895–1918.

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 1918, inclusive	150,000

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 11.

Measurements of stream flow have been made at about 4,250 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1917, 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 pre-

cipitation, 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.

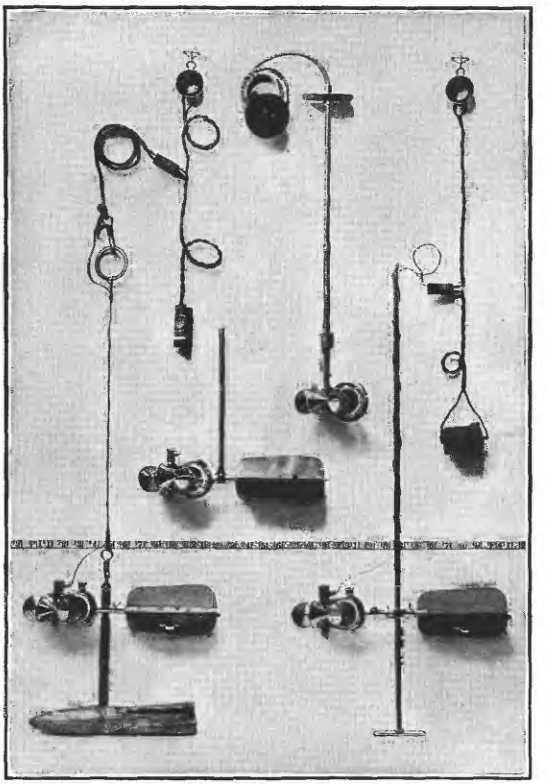
"Millions of cubic feet" is applied to quantities of water stored in reservoirs, most frequently in connection with studies of flood control.

The following terms not in common use are here defined:

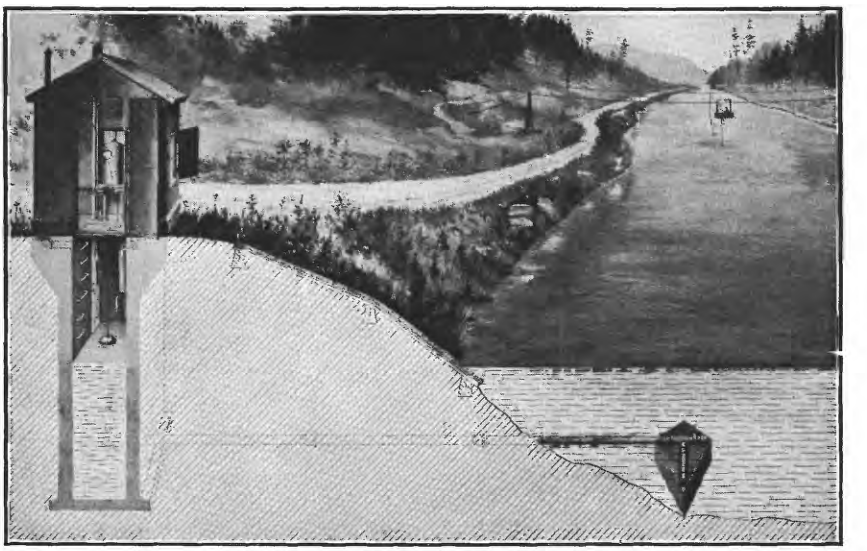
"Stage-discharge relation," an abbreviation for the term "relation of gage height to discharge."

"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.

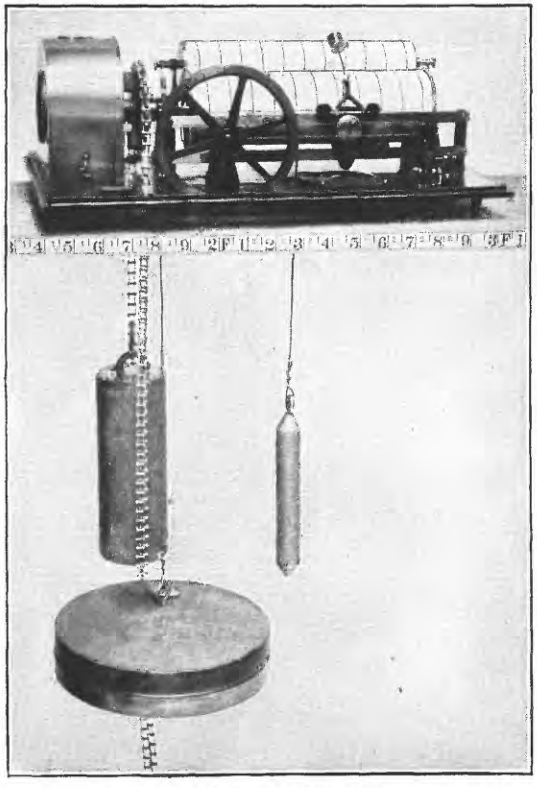
The "point of zero flow" for a gaging station is that point on the gage—the gage height—to which the surface of the river falls when the discharge is reduced to zero.



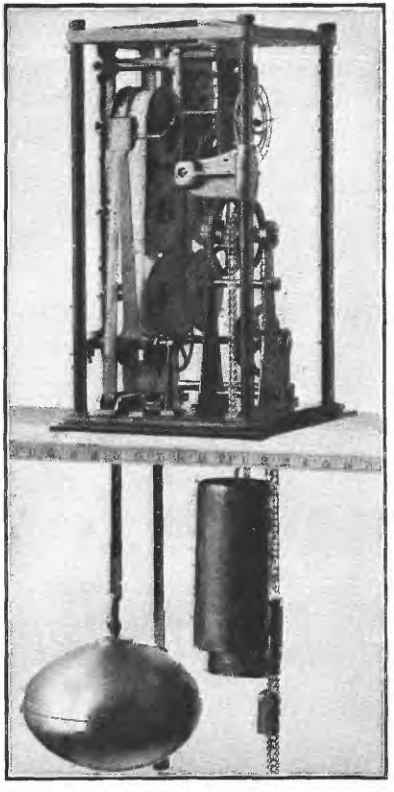
A. PRICE CURRENT METERS.



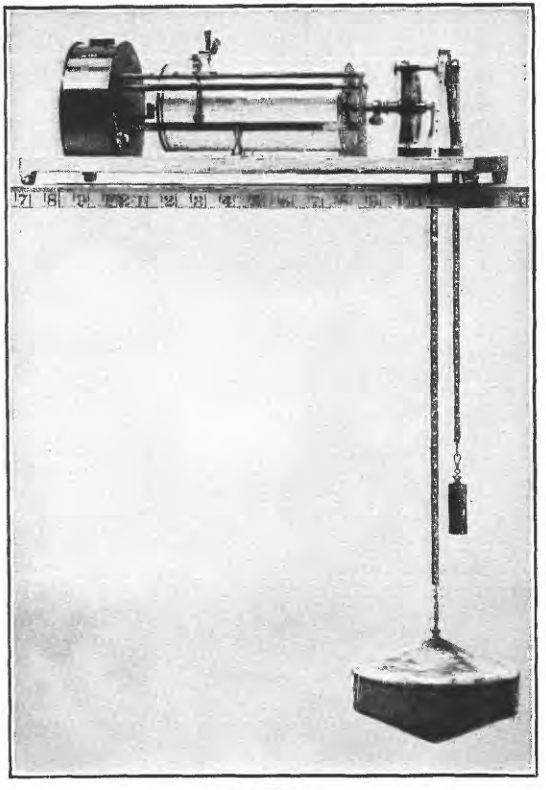
B. TYPICAL GAGING STATION.



A. STEVENS CONTINUOUS.



B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1916, and ending September 30, 1917. 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 average flow in cubic feet per second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 8, 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 RESULTS.

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

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

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

[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.

The monthly means for any station may represent with high accuracy the quantity of water flowing past the gage, but the figures showing discharge per square mile and depth of run-off in inches may be subject to gross errors caused by the inclusion of large 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 Chippewa River near Watson.

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 following organizations: 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), Chippewa & Flambeau Improvement Co. (Chippewa River at Bishops Bridge near Winter), Stoughton Municipal Electric Light System (Yahara River near Edgerton).

In Iowa the work was carried on in cooperation with the Iowa Geological Survey, George F. Kay, director, and the Mississippi River Power Co., of Keokuk, Iowa.

In Illinois work was carried on in cooperation with the State of Illinois, through the Rivers and Lakes Commission until June 30, and 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 A. H. Tuttle and 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 R. B. Kilgore, and by E. F. Chandler, assisted by T. M. Wardwell, L. B. Dale, 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 E. L. Williams, R. B. Kilgore, F. W. Huels, and J. P. Schwada.

For stations in the Mississippi River basin in Iowa the data were collected under the general direction of W. G. Hoyt and under the immediate direction of R. H. Bolster, assisted by C. Herlofson and A. Davis. The data for stations in the Mississippi River basin in Illinois were collected under the general direction of W. G. Hoyt and under the immediate direction of H. C. Beckman, assisted by G. J. Trinkaus. A. M. Wohl, H. S. Wohl, and Marcia Towle.

GAGING-STATION RECORDS.

HUDSON BAY DRAINAGE BASINS.

ST. MARY RIVER NEAR BABB, MONT.

[Including diversion from Swiftcurrent Creek.]

LOCATION.—About 1,040 feet above the headworks of St. Mary canal, one-fourth mile below outlet of Lower St. Mary Lake, 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, 1917. Records prior to October, 1915, do not include the flow of Swiftcurrent Creek.

GAGE.—Chain gage on right bank. During the winter months a temporary low-water gage opposite the chain gage was read. Gages read by employees of the United States Reclamation Service.

DISCHARGE MEASUREMENTS.—Made from cable 560 feet below gage, or by wading. Until September, 1909, the cable was at a point about 300 feet downstream from its present location.

CHANNEL AND CONTROL.—Bed of stream practically permanent. Banks high and not subject to overflow. 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 headgates. Stage-discharge relation is permanent when the flashboards in the sluice gates remain at the level of the crest of the dam.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.60 feet June 10 and 11 (discharge, 4,160 second-feet); minimum discharge, 66 second-feet April 1.

1902–1917: Maximum stage estimated at 9.4 feet June 5, 1908 (discharge, 7,980 second-feet); minimum discharge, 20 second-feet, April 3–7, 1904.

ICE.—Stage-discharge relation affected by ice for short periods.

DIVERSIONS.—None.

REGULATION.—Natural storage in St. Mary Lakes. The flow of Swiftcurrent Creek was diverted into lower St. Mary Lake on October 1, 1915. The flow of this stream will be regulated by Sherburne Lake reservoir.

ACCURACY.—Stage-discharge relation permanent when flashboards in sluice gates of dam are kept at level of crest of dam. Four rating curves have been developed and used for the periods noted: October 1–10, fairly well defined; October 11 to December 4 and April 11–19, and July 23 to September 9, well defined; April 20 to July 22 and September 13–30, well defined; January 6 to April 5, poorly defined. Gage read twice daily during the open season and once daily in winter. Daily discharge ascertained by applying daily gage height to rating table except for periods affected by ice or by shifting control. Discharge, December 5 to January 5 estimated from temperature records and notes by observer. 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 the St. Mary canal, which carries the water across the divide into the 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, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 23	0.65	256	June 30	4.45	2,980
Jan. 27	— .55	85	July 19	3.58	1,950
Apr. 13	— .43	116	Aug. 16	1.75	630
June 15	4.82	3,320	Sept. 14	1.69	363

Daily discharge, in second-feet, of St. Mary River near Babb, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	462	177	154	108	89	81	66	205	2,840	2,770	1,010	511
2	462	183	150	106	89	81	70	205	2,840	2,720	932	507
3	444	183	171	103	89	81	73	205	2,620	2,690	860	467
4	426	227	159	102	89	81	73	205	2,620	2,730	849	463
5	409	171	150	100	81	81	73	205	2,510	2,800	778	463
6	392	171	146	97	81	81	79	205	2,510	2,840	750	433
7	360	171	143	97	73	81	86	205	2,510	2,880	750	430
8	330	171	140	97	73	81	93	250	2,950	2,840	750	398
9	301	211	139	97	70	81	100	300	3,500	2,740	750	398
10	287	196	138	89	70	81	107	415	3,940	2,690	750	388
11	236	183	138	97	73	81	114	620	4,160	2,550	740	377
12	245	183	137	97	73	81	114	770	4,160	2,580	700	366
13	265	183	137	97	77	81	119	1,020	3,830	2,510	675	355
14	245	183	136	97	81	81	119	1,460	3,500	2,390	655	385
15	255	171	136	97	81	81	124	1,760	3,280	2,200	650	385
16	265	227	135	97	81	81	128	2,400	3,390	1,940	650	385
17	245	337	135	97	81	81	128	2,620	3,610	1,860	650	385
18	255	352	134	97	81	81	128	2,620	3,880	1,860	650	367
19	311	287	134	89	81	81	133	2,620	3,940	1,960	650	367
20	337	245	133	89	81	81	125	2,620	4,000	1,960	650	355
21	471	245	133	89	81	81	125	2,510	3,940	1,900	660	355
22	452	245	132	89	81	81	165	2,510	3,940	1,840	675	355
23	366	255	132	89	81	81	165	2,180	3,830	1,740	700	355
24	287	219	131	89	81	81	165	2,070	3,660	1,560	690	355
25	245	236	131	89	81	81	165	2,180	3,610	1,460	655	355
26	190	190	130	85	81	81	165	2,620	3,500	1,340	645	355
27	171	171	130	85	81	81	205	2,950	3,390	1,280	630	355
28	180	171	127	89	81	73	205	3,060	3,220	1,250	605	355
29	190	165	125	89	.....	73	205	3,280	3,060	1,250	563	355
30	177	154	122	89	.....	73	205	3,280	2,900	1,170	520	355
31	190	.....	110	89	.....	73	.....	3,170	.....	1,220	520	.....

NOTE.—No gage-height record Dec. 5 to Jan. 5; discharge estimated from temperature records and notes by observer. Discharge estimated because of ice for following periods: Jan. 21, 29–31, Feb. 1, 16–28, and Mar. 1–11. Discharge, Apr. 6–10, interpolated because of change in stage-discharge relation.

Monthly discharge of St. Mary River near Babb, Mont., for the year ending Sept. 30, 1917.

[Drainage area, 278[a] square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	471	171	305	1.10	1.27	18,800
November	352	154	209	.752	.84	12,400
December	171	110	137	.493	.57	8,420
January	108	89	94.2	.339	.39	5,790
February	89	70	80.1	.288	.30	4,450
March	81	73	80.1	.288	.33	4,920
April	205	66	127	.457	.51	7,560
May	3,280	205	1,640	5.90	6.80	101,000
June	4,160	2,510	3,390	12.2	13.61	202,000
July	2,880	1,170	2,110	7.59	8.75	130,000
August	1,010	520	700	2.52	2.90	43,300
September	511	355	391	1.41	1.57	23,300
The year	4,160	66	775	2.79	37.84	562,000

[a] Includes drainage area of Swiftcurrent Creek above point of diversion into St. Mary Lake.

ST. MARY RIVER NEAR KIMBALL, ALBERTA.

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

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

RECORDS AVAILABLE.—January 1, 1913, to September 30, 1917. From September 4, 1902, to December 31, 1912, records were obtained at a point one-fourth 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 about 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. A staff gage at cable from which discharge measurements were made was used October 1 to November 8. A chain gage attached to the highway bridge 2 miles below the station was used November 10 to May 5 when stage-discharge relation was affected by ice.

DISCHARGE MEASUREMENTS.—Made from a cable three-fourths of a mile below the gage; low-water measurements made by wading near the cable.

CHANNEL AND CONTROL.—Bed of stream at the gage and at the control is composed of boulders and sandstone ledges. The control is formed by an outcropping ledge of sandstone. Stage-discharge relation is affected by a large gravel bar which has formed on the right bank at the control.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 6.93 feet at 6 p. m. June 11 (discharge, 5,230 second-feet); minimum discharge, 100 second-feet January 30 and 31.

1902–1917: 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,[1] February 5, 1914.

ICE.—Stage discharge relation seriously affected by ice. Daily discharge computed from discharge measurements and temperature records.

DIVERSIONS.—The St. Mary canal, constructed by the United States Reclamation Service, diverts water from St. Mary River near Babb, Mont., to the North Fork of Milk River. During 1917, 33,600 acre-feet was diverted. The Alberta Railway & Irrigation Co. canal diverts from St. Mary River about a mile 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 changed during high water June 9–13; affected by ice November 10 to May 5. Rating curves used as follows: October 1 to November 8, fairly well defined; May 7 to June 8, well defined between 470 and 4,000 second-feet; June 14 to September 30 well defined between 200 and 5,000 second-feet. Staff gage read to hundredths twice daily October 1 to November 9; chain gage read November 10 to May 5. Gage heights May 7 to September 30 obtained from recorder graph by averaging the stage for hourly intervals. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by shifting control or ice. Records good.

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

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[1] 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, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 18	S. H. Frame[a]	[b] 3.23	342	May 24	A. W. P. Lowrie[a]	5.50	2,750
Nov. 17	do	4.25	440	26	do	5.96	3,290
18	W. A. Lamb	4.28	418	27	do	6.08	3,570
Dec. 11	H. W. Rowley[a]	3.95	210	28	do	6.20	3,730
Jan. 3	do	[c] 5.57	241	June 14	W. A. Lamb	6.15	4,070
22	do	[c] 5.38	118	18	A. W. P. Lowrie[a]	6.47	4,790
Feb. 20	G. S. Wendon[a]	[c] 5.76	140	19	do	6.44	4,750
Mar. 13	do	[c] 5.54	140	20	do	6.46	4,690
Apr. 2	A. W. P. Lowrie[a]	[c] 5.69	110	22	do	6.43	4,720
7	do	[c] 6.83	651	July 9	do	5.47	2,900
11	do	[c] 6.37	824	20	W. A. Lamb	4.85	1,870
12	do	[c] 5.98	597	26	A. W. P. Lowrie[a]	4.25	1,270
14	do	[c] 5.53	376	Aug. 23	do	3.00	494
May 3	do	3.11	504	Sept. 14	W. A. Lamb	2.94	454
7	do	3.18	562	18	A. W. P. Lowrie[a]	2.95	453

[a] Engineer, Reclamation Service, Department of Interior, Canada.
[b] Gage height referred to staff gage at cable.
[c] Gage height referred to chain gage on highway bridge 2 miles below regular station; stage-discharge relation affected by ice.

Daily discharge, in second-feet, of St. Mary River near Kimball, Alberta, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	511	300	245	239	100	132	110	547	3,470	3,130	837	332
2	483	325	235	241	100	131	110	568	3,350	3,100	772	294
3	469	336	245	240	102	130	110	581	3,280	2,970	708	268
4	455	336	245	240	103	130	250	588	3,140	3,060	672	253
5	442	320	230	240	104	130	375	634	3,080	3,020	610	247
6	469	305	225	240	106	130	530	664	3,050	3,040	560	236
7	422	295	220	240	108	130	650	570	3,180	3,060	538	230
8	448	325	215	240	112	131	690	660	3,520	2,990	538	222
9	455	350	210	240	120	133	735	818	3,880	2,830	546	250
10	442	310	210	239	128	135	780	1,110	4,610	2,850	551	318
11	422	280	210	235	134	138	824	1,410	5,200	2,730	560	318
12	378	280	210	227	136	140	597	1,660	5,090	2,680	515	386
13	360	280	210	214	140	140	485	2,050	4,940	2,600	470	458
14	360	280	210	194	150	140	376	2,500	4,600	2,530	458	470
15	348	290	210	170	155	140	372	2,850	4,410	2,330	434	462
16	336	340	210	150	160	140	370	3,040	4,430	2,160	434	454
17	342	440	210	140	160	140	372	3,220	4,690	2,100	430	450
18	348	418	210	132	155	140	374	3,200	4,760	2,100	426	450
19	378	395	210	124	146	140	384	3,170	4,760	2,160	430	450
20	390	355	210	120	140	140	410	3,220	4,740	1,890	438	450
21	410	340	210	120	140	138	438	3,140	4,760	1,850	452	442
22	390	340	210	120	140	137	450	2,890	4,690	1,820	466	442
23	378	345	215	120	139	134	460	2,640	4,510	1,720	470	430
24	348	342	215	123	138	130	466	2,510	4,240	1,570	462	470
25	348	333	215	128	136	128	472	2,780	4,140	1,440	446	458
26	330	323	220	128	134	125	477	3,380	4,100	1,320	418	450
27	342	312	220	120	132	122	481	3,560	3,940	1,210	390	458
28	330	296	225	112	132	120	468	3,740	3,820	1,130	378	442
29	330	278	230	105	.....	117	475	3,840	3,510	1,090	354	434
30	330	260	235	100	.....	115	517	3,950	3,240	1,010	318	430
31	336	.....	237	100	.....	111	.....	3,680	.....	928	340	.....

NOTE.—Gage not read, discharge estimated for following days: Oct. 8, 29, Nov. 5, 9, 19, Dec. 3, 10, 17, 20, 24, 31, Jan. 1, 7, Mar. 11, 18, Apr. 22, 27, May 6 and 29.

Monthly discharge of St. Mary River near Kimball, Alberta, for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	511	330	391	24,000
November	440	260	324	19,300
December	245	210	220	13,500
January	241	100	174	10,700
February	160	100	123	6,830
March	140	111	132	8,120
April	824	110	454	27,000
May	3,950	547	2,230	137,000
June	5,200	3,050	4,100	244,000
July	3,130	928	2,210	136,000
August	837	318	497	30,600
September	470	222	382	22,700
The year	5,200	100	940	680,000

Combined daily discharge, in second-feet, of St. Mary River near Kimball, Alberta, and St. Mary canal at Douglas bridge, near Browning, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	511	300	245	239	100	132	110	547	3,470	3,130	1,090	594
2	483	325	235	241	100	131	110	568	3,350	3,100	1,030	556
3	469	336	245	240	102	130	110	581	3,280	3,060	970	530
4	455	336	245	240	103	130	250	588	3,140	3,160	934	515
5	442	320	230	240	104	130	375	634	3,080	3,200	872	509
6	469	305	225	240	106	130	530	664	3,050	3,250	822	467
7	422	295	220	240	108	130	650	570	3,180	3,270	800	471
8	448	325	215	240	112	131	690	660	3,520	3,200	800	463
9	455	350	210	240	120	133	735	818	3,880	3,060	808	491
10	442	310	210	239	128	135	780	1,110	4,610	3,080	813	519
11	422	280	210	235	134	138	824	1,410	5,200	2,970	822	464
12	378	280	210	227	136	140	597	1,660	5,090	2,910	777	540
13	360	280	210	214	140	140	485	2,050	4,940	2,830	732	596
14	360	280	210	194	150	140	376	2,500	4,600	2,760	720	470
15	348	290	210	170	155	140	372	2,850	4,410	2,560	696	462
16	336	340	210	150	160	140	370	3,040	4,430	2,390	696	454
17	342	440	210	140	160	140	372	3,220	4,690	2,330	692	450
18	348	418	210	132	155	140	374	3,200	4,760	2,330	688	450
19	378	395	210	124	146	140	384	3,170	4,760	2,390	692	450
20	390	355	210	120	140	140	410	3,220	4,740	2,130	700	450
21	410	340	210	120	140	138	438	3,140	4,760	2,090	714	442
22	390	340	210	120	140	137	450	2,890	4,690	2,060	728	442
23	378	345	215	120	139	134	460	2,640	4,510	1,980	732	430
24	348	342	215	123	138	130	466	2,510	4,240	1,830	724	470
25	348	333	215	128	136	128	472	2,780	4,140	1,700	708	458
26	330	323	320	128	134	125	477	3,380	4,100	1,570	680	450
27	342	312	220	120	132	122	481	3,560	3,940	1,460	652	458
28	330	296	225	112	132	120	468	3,740	3,820	1,380	640	442
29	330	278	230	105	.....	117	475	3,840	3,510	1,340	616	434
30	330	260	235	100	.....	115	517	3,950	3,240	1,260	580	430
31	336	.....	237	100	.....	111	.....	3,680	.....	1,180	602	.....

NOTE.—For table of daily discharge of St. Mary canal at Douglas bridge, see p. 22.

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Combined monthly discharge of St. Mary River near Kimball, Alberta, and St. Mary canal at Douglas bridge near Browning, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	511	330	391	24,000
November	440	260	324	19,300
December	245	210	220	13,500
January	241	100	174	10,700
February	160	100	123	6,830
March	140	111	132	8,120
April	824	110	454	27,000
May	3,950	547	2,230	137,000
June	5,200	3,050	4,100	244,000
July	3,270	1,180	2,420	149,000
August	1,090	580	759	46,700
September	596	430	479	28,500
The year	5,200	100	988	715,000

NOTE.—For table of monthly discharge of St. Mary canal at Douglas bridge, see p. 22.

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, about 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, 1917.

GAGE.—Vertical staff on the right bank at the outlet of the lake. Prior to May 23, 1916, a staff gage on the left bank opposite the present gage was read. Gage read by George Hall.

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

CHANNEL AND CONTROL.—Control is a limestone outcrop at the outlet of the lake.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 4.20 feet at 6 p. m. June 9 (discharge, 1,220 second-feet); minimum discharge, 20 second-feet, by current-meter measurement, April 14, when stage-discharge relation was seriously affected by ice. No record of discharge January 1 to April 13.

1912–1917: 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.

ICE.—Stage-discharge relation seriously affected by ice January 1 to April 17. Ice cover on lake November 20 to June 9; records for December may be slightly in error on account of ice.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation probably permanent during year; seriously affected by ice. Rating curve used October 1 to December 31, and April 18 to September 30, well defined between 44 and 825 second-feet, but no current-meter measurements were made during open season. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Discharge, April 14, obtained from current-meter measurement of that date; April 15–17 interpolated because of ice. Records probably fair, but owing to lack of discharge measurements should be used with caution.

The following discharge measurement was made by W. A. Lamb: April 14, 1917: Gage height, 1.48 feet; discharge, 19.6 second-feet (stage-discharge relation affected by ice).

Daily discharge, in second-feet, of Swiftcurrent Creek at Many Glacier, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	70	63	55	.....	48	292	525	152	112
2	67	67	54	.....	47	470	545	149	112
3	67	68	55	.....	48	445	570	144	107
4	63	70	55	.....	45	410	570	133	101
5	62	73	54	.....	46	415	545	128	94
6	60	71	53	.....	47	485	555	128	86
7	60	70	53	.....	55	580	565	138	73
8	60	68	52	.....	76	759	520	128	78
9	59	71	52	.....	97	1,160	525	128	84
10	58	68	48	.....	133	1,020	525	133	81
11	58	65	47	.....	228	610	530	125	84
12	55	63	46	.....	315	510	460	138	90
13	55	62	46	.....	440	386	450	149	84
14	53	60	45	20	580	435	386	159	86
15	53	60	44	26	908	470	376	159	92
16	54	60	44	32	610	825	372	159	97
17	58	58	44	39	600	1,110	381	165	107
18	62	55	42	47	400	630	372	168	105
19	63	55	42	48	362	715	391	172	101
20	60	53	40	48	343	676	391	175	95
21	56	54	40	50	353	615	410	172	95
22	55	54	40	51	348	635	343	168	95
23	56	53	41	51	400	570	329	159	95
24	58	53	40	52	485	475	292	152	107
25	60	53	36	53	575	671	274	141	103
26	62	54	35	53	585	676	260	133	96
27	63	53	37	54	575	655	220	130	92
28	63	54	39	55	595	595	212	125	97
29	64	56	42	53	570	575	201	125	97
30	65	58	44	50	450	515	193	121	92
31	65	.....	40	.....	362	.....	172	116	.....

NOTE.—Stage-discharge relation seriously affected by ice, Jan. 1 to Apr. 17; data inadequate for determination of discharge Jan. 1 to Apr. 13.

Monthly discharge of Swiftcurrent Creek at Many Glacier, Mont., for the year ending Sept. 30, 1917.

[Drainage area, 31.4 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	70	53	60.1	1.91	2.20	3,700
November	73	53	60.7	1.93	2.16	3,610
December	55	35	45.3	1.44	1.66	2,790
April 14-30	55	20	46.0	1.46	.92	1,550
May	908	45	346	11.0	12.68	21,300
June	1,160	292	613	19.5	21.76	36,500
July	570	172	402	12.8	14.76	24,700
August	175	116	144	4.59	5.29	8,850
September	112	73	94.4	3.01	3.36	5,620

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, 1917.

GAGE.—Staff gage on left bank about 300 feet below the spillway of the 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 the left bank near the outlet of the lake, and at a different datum from the 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 the control; subject to slight shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 5.55 feet June 9–11 (discharge 1,070 second-feet); minimum stage 0.40 foot at 8 a. m. May 4 (discharge 6 second-feet).

1912–1917: Maximum stage recorded 7.85 feet June 17, 1916 (discharge 2,280 second-feet); minimum stage 0.5 foot April 25, 1916 (discharge 4 second-feet).

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

DIVERSION.—None.

REGULATION.—The natural flow of the stream was affected by placing and removing flashboards on the temporary construction dam built at the outlet in connection with the Sherburne Lake storage dam.

ACCURACY.—Stage-discharge relation changed probably March 27. Rating curves used October 1 to March 27 and March 28 to September 30 are well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Swiftcurrent Creek at Sherburne, Mont., during the year ending Sept. 30, 1917.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Gage.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 22	1.46	58	June 14	5.20	914	Aug. 17	2.30	154
Apr. 13	1.28	50	30	4.39	636	Sept. 13	1.82	85
May 17	5.25	970	July 20	3.96	515			

Daily discharge, in second-feet, of Swiftcurrent Creek at Sherburne, Mont., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	65	56	30	18	22	18	30	60	584	646	202	118
2	65	65	34	14	20	18	30	54	646	646	178	118
3	65	65	38	15	18	18	30	27	646	646	145	112
4	70	76	39	15	20	15	28	6	646	712	93	104
5	76	70	42	19	21	14	36	8	614	712	69	100
6	58	70	45	19	20	15	36	12	614	712	73	94
7	56	81	45	18	23	15	36	40	746	712	159	55
8	56	70	43	18	22	14	43	97	930	678	236	56
9	56	81	39	18	21	14	43	420	1,010	646	202	62
10	56	76	38	18	22	14	47	420	1,070	614	187	68
11	56	58	35	19	23	14	49	394	1,070	584	145	75
12	56	51	33	21	24	15	53	526	1,050	584	145	77
13	58	54	32	21	24	13	51	646	1,010	584	145	89
14	48	60	32	22	22	13	49	712	970	420	145	124
15	56	210	30	24	21	13	51	818	892	300	145	138
16	46	349	29	24	24	13	51	930	892	420	159	131
17	42	281	27	22	24	13	49	930	970	446	159	118
18	46	166	27	20	21	12	48	892	1,010	554	159	118
19	56	113	27	20	21	12	48	854	1,010	554	173	118
20	76	81	29	20	21	15	49	782	1,010	498	187	118
21	106	65	29	18	21	15	55	712	1,010	472	202	112
22	9	54	29	18	21	17	60	472	1,010	472	202	105
23	7	51	28	18	21	18	62	420	970	370	187	105
24	7	42	27	18	20	16	65	370	930	322	187	105
25	9	42	26	19	21	15	66	584	892	322	173	112
26	12	42	26	19	21	16	69	782	892	256	159	112
27	18	38	25	19	21	26	65	782	854	256	159	112
28	34	36	24	25	20	25	62	782	678	278	105	112
29	70	32	24	24	.....	28	59	818	614	300	105	112
30	54	34	21	25	.....	28	57	782	646	236	105	112
31	60	.....	21	22	.....	29	.....	678	.....	218	112	.....

Monthly discharge of Swiftcurrent Creek at Sherburne, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	106	7	50.0	3,070
November	349	32	85.6	5,090
December	45	21	31.4	1,930
January	25	14	19.7	1,210
February	24	18	21.4	1,190
March	29	12	16.8	1,030
April	69	28	49.2	2,930
May	930	6	510	31,400
June	1,070	584	863	51,400
July	712	218	489	30,100
August	236	69	155	9,530
September	138	55	103	6,130
The year	1,070	6	200	145,000

U. S. RECLAMATION SERVICE ST. MARY CANAL AT HUDSON BAY DIVIDE, NEAR BROWNING, MONT.

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

RECORDS AVAILABLE.—July 3 to September 13, 1917.

GAGE.—A vertical staff, graduated to tenths, nailed to upstream side of left pier of bridge; read by U. S. Reclamation Service ditch rider.

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

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

EXTREMES OF DISCHARGE.—Maximum discharge during the year 254 second-feet.

REGULATION.—The flow is regulated at the headgates 26 miles above. A small reservoir at Spider Lake serves to equalize sudden changes at the headgates.

ACCURACY.—Stage-discharge relation practically permanent. Gage read to tenths once daily. Discharge computed by using a rating curve based on discharge measurements made in 1918 and measurements of North Fork of Milk River at Peter's Ranch below the outlet of the canal. Records fair.

St. Mary canal diverts from St. Mary River near Babb, Mont., and carries the water across the divide into North Fork of Milk River. The water is used for irrigation in the Milk River valley in Montana.

Daily discharge, in second-feet, of U. S. Reclamation Service St. Mary canal at Hudson Bay divide, near Browning, Mont., for the year ending Sept. 30, 1917.

Day	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1	.....	243	254	11	233	254	138	21	233	254	.....
2	.....	254	254	12	223	254	146	22	233	254	.....
3	86	254	254	13	223	254	130	23	254	254	.....
4	91	254	254	14	223	254	.....	24	254	254	.....
5	173	*254	254	15	223	254	.....	25	254	254	.....
6	203	254	223	16	223	254	.....	26	243	254	.....
7	203	254	233	17	223	254	.....	27	243	254	.....
8	203	254	233	18	223	254	.....	28	243	254	.....
9	223	254	233	19	223	254	.....	29	243	254	.....
10	223	254	193	20	228	254	.....	30	243	254	.....
								31	243	254	.....

NOTE.—No flow in canal Oct. 1 to July 2 and Sept. 14–30.

Monthly discharge of U. S. Reclamation Service St. Mary canal at Hudson Bay divide, near Browning, Mont., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
July 3–31	254	86	218	12,500
August	254	243	254	15,600
September 1–13	254	130	215	5,540
The year				33,600

OTTERTAIL RIVER AT GERMAN CHURCH, NEAR FERGUS FALLS, MINN.

LOCATION.—At highway bridge on south line of sec. 31, T. 134 N., R. 42 W., about 5 miles upstream from old station known as "Ottertail River, near Fergus Falls," and about 8 miles north of Fergus Falls, Ottertail County.

DRAINAGE AREA.—1,300 square miles.

RECORDS AVAILABLE.—October 29, 1913, to September 30, 1917, when station was discontinued. May 9, 1904, to October 22, 1913, records were collected at a station about 5 miles downstream from the present site. The drainage area at the lower station is only 10 square miles larger than at the upper, and no tributaries intervene.

GAGE.—Chain gage attached to the downstream handrail near the right bank; read by D. S. Danielson.

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

CHANNEL AND CONTROL.—Bed composed of sand, gravel, and boulders. Rapids about 100 feet below the gage form a well-defined control, which is practically permanent except for an occasional slight growth of vegetation in the channel. Banks at and above the gage are high; probably not subject to overflow. At the control the land adjacent to the left bank is low and will be overflowed at a stage of about 5 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.45 feet October 2, 3, 12, and 13 (discharge, 613 second-feet); minimum stage recorded, 0.88 foot Sept. 10 and 11 (discharge, about 121 second-feet).

1914–1917: Maximum stage recorded, 3.0 feet at 8.30 a. m. June 29, 1916 (discharge, 982 second-feet); minimum stage recorded September 10, 11, 1917.

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

REGULATION.—Fluctuations caused by the operation of a number of dams and small mills above the station are equalized by small lakes through which the river flows before reaching the station, so that they are not observable at the gage.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 237 and 837 second-feet; extended and subject to error outside these limits. Gage read to quarter-tenths once daily; fluctuations in stage so gradual that good results are obtained from one reading a day. 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 table daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open water records excellent, except those for low stages, which are subject to error; winter records good.

Discharge measurements of Ottertail River at German Church, near Fergus Falls, Minn., during the year ending Sept. 30, 1917.

[Made by S. B. Soulé.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 29 [a]	3.07	324	Mar. 8 [a]	3.95	239
Jan. 26 [a]	3.39	284	June 29	1.84	340

[a] Complete ice cover.

Daily discharge, in second-feet, of Ottertail River at German Church, near Fergus Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	613	584	480	320	280	250	355	530	480	327	200	137
2	613	584	480	320	280	250	360	530	480	307	200	137
3	613	584	455	320	280	250	375	530	480	307	196	137
4	598	584	435	320	280	250	380	530	457	304	196	134
5	584	584	415	315	275	250	385	530	434	304	192	130
6	584	584	415	315	275	245	390	530	434	300	188	127
7	584	584	390	315	275	240	392	530	434	294	185	130
8	584	584	390	310	275	240	392	530	434	286	181	130
9	584	584	390	310	275	240	392	530	434	277	177	127
10	584	584	390	310	270	240	392	530	434	277	173	121
11	584	557	385	305	270	240	392	530	434	277	173	121
12	613	557	385	305	270	245	413	530	434	272	169	130
13	613	557	380	305	265	250	434	530	413	272	166	130
14	584	530	380	305	265	250	392	530	392	266	166	134
15	584	530	375	305	265	250	402	530	392	266	169	130
16	584	530	375	300	260	250	413	530	392	266	166	128
17	584	530	370	300	260	255	434	530	392	266	166	127
18	584	530	370	300	260	260	434	544	392	261	162	127
19	584	530	365	300	260	270	457	557	392	251	158	144
20	584	530	365	300	260	275	457	530	392	251	151	144
21	584	530	360	295	255	280	480	530	373	242	147	142
22	584	505	360	290	255	290	480	530	362	238	147	140
23	584	480	360	290	250	300	480	530	354	233	144	140
24	584	455	355	285	250	305	530	530	354	233	140	153
25	584	455	350	285	250	310	557	530	354	233	140	166
26	584	434	340	285	250	320	530	530	354	214	140	169
27	584	415	335	280	250	330	530	530	347	196	137	169
28	584	390	330	280	250	335	530	530	347	208	137	166
29	584	415	325	280	.....	340	530	530	347	208	134	154
30	584	480	325	280	.....	350	530	530	347	208	134	154
31	584	.....	320	280	.....	355	.....	557	.....	208	137	.....

NOTE.—Stage-discharge relation affected by ice Nov. 22 to Apr. 6. Gage not read, discharge interpolated Oct. 1, 4, 6, 8, 22, 29, Nov. 5, 19, Apr. 8, 15, 22, 27, 29, May 1, 6, 9, 11, 13, 15, 18, 23, 27, June 10, 15, 24, July 1, 8, 15, 22, 26, 29, Sept. 16 and 24.

Monthly discharge of Ottertail River at German Church, near Fergus Falls, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 1,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	613	584	589	0.453	0.52
November	584	390	526	.405	.45
December	480	320	379	.292	.34
January	320	280	300	.231	.27
February	280	250	265	.204	.21
March	355	240	275	.212	.24
April	557	355	441	.339	.38
May	557	530	532	.409	.47
June	480	347	402	.309	.34
July	327	196	260	.200	.23
August	200	134	164	.126	.14
September	169	121	139	.107	.12
The year	613	121	356	.274	3.71

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, 1917.

GAGE.—Vertical staff attached to tree on left bank about 6 rods above the dam; vertical staff for use at low stages attached to upper end of fishway at left end of dam; lowest point of crest of dam now about 0.90 foot above datum of gage. Prior to September 1, 1914, gage readings were obtained from a vertical staff attached to the breakwater for the center pier of the 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 its control is less permanent than that of the gage now used. The datum of the Front Street gage is such that if the dam were removed, or if the stage were so high as to completely drown the dam, readings on the Front Street gage would be about 10.4 feet greater than on the gage now used. At extreme low stage the fall over the dam is about 5 feet.

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

CHANNEL AND CONTROL.—Bed consists of clay and silt; nearly permanent. Dam below gage is the control.

EXTREMES OF DISCHARGE.—Maximum stage during year, 14.0 feet April 4 (discharge, 5,200 second-feet); minimum stage, 1.25 feet September 15 (discharge, 42 second-feet).

1901–1917: Maximum stage recorded, 19.9 feet April 6, 1916, when stage-discharge relation was affected by ice; maximum discharge, 7,440 second-feet April 7, 1916; minimum stage recorded, 5.7 feet November 1, 1910 (discharge, 36 second-feet).

ICE.—Stage-discharge relation not seriously affected by ice during winter; open-season rating table is applicable by making small correction for slight obstruction of crest of dam; in determining flow during spring break-up, however, corrections amounting to several feet must be applied to gage heights before applying open-season rating table, owing to backwater from ice.

DIVERSIONS.—None.

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

ACCURACY.—Stage-discharge relation practically permanent during year except as affected by ice. Rating curve well defined between 200 and 2,400 second-feet and fairly well defined at other stages. Gage read to hundredths daily. Open-water records good.

Discharge measurements of Red River at Fargo, N. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 23	L. B. Dale	2.88	513	June 13	A. Hulteng	3.24	786
Apr. 7	E. F. Chandler	10.64	4,130	July 14	E. F. Chandler	2.29	323
14	T. M. Wardwell	5.22	2,320	Aug. 16	do	1.69	143
15	do	5.03	2,210				

Daily discharge, in second-feet, of Red River at Fargo, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,240	876	.....	4,840	2,710	976	486	231	92
2	1,240	876	.....	5,000	2,710	942	465	200	92
3	1,240	876	.....	5,200	2,710	925	465	170	92
4	1,200	876	.....	5,200	2,800	908	444	156	92
5	1,160	876	.....	5,000	2,710	844	424	194	104
6	1,160	876	.....	4,680	2,570	844	424	231	116
7	1,120	876	.....	4,160	2,430	844	404	200	70
8	1,090	876	.....	3,880	2,230	814	395	170	70
9	1,090	876	.....	3,760	2,230	814	385	142	81
10	1,090	876	.....	3,480	2,130	783	366	129	92
11	1,010	876	.....	3,110	2,030	756	348	170	70
12	1,010	727	.....	2,800	1,930	756	330	170	60
13	1,010	600	.....	2,710	1,880	756	330	170	60
14	1,010	424	.....	2,530	1,830	756	330	170	50
15	1,010	424	.....	2,380	1,830	756	330	156	42
16	1,010	424	.....	2,230	1,730	784	330	142	79
17	976	444	.....	2,230	1,640	756	296	142	116
18	976	.....	.....	2,130	1,600	727	296	142	116
19	976	.....	.....	2,130	1,550	700	279	135	142
20	976	.....	.....	2,230	1,500	674	279	129	129
21	942	.....	.....	2,230	1,460	624	279	116	70
22	942	.....	.....	2,480	1,420	624	279	116	50
23	942	.....	.....	2,620	1,290	600	279	104	77
24	976	.....	.....	2,620	1,290	576	279	104	104
25	976	.....	.....	2,530	1,240	553	263	92	81
26	976	.....	784	2,430	1,200	530	263	98	104
27	942	.....	1,640	2,530	1,160	486	263	104	104
28	908	.....	3,180	2,710	1,120	508	231	92	104
29	908	.....	3,920	2,710	1,050	530	231	92	116
30	876	.....	4,440	2,710	1,010	508	231	92	136
31	876	.....	4,640	.....	976	.....	231	92	.....

Monthly discharge of Red River at Fargo, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	1,240	876	1,030	63,300
November 1–17	876	424	746	25,200
March 26–31	4,640	784	3,100	36,900
April	5,200	2,130	3,180	189,000
May	2,800	976	1,810	111,000
June	976	486	722	43,000
July	486	231	330	20,300
August	231	92	144	8,850
September	142	42	90.4	5,380

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, 1917. 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 gage attached to ice breaker below center pier of same bridge. The staff gages 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 datum 5 feet higher.

DISCHARGE MEASUREMENTS.—Made from Great Northern Railway bridge about a fifth of a mile above the gage.

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

EXTREMES OF DISCHARGE.—Maximum stage during year, 33.9 feet at 5 p. m. April 8 (discharge, 21,600 second-feet); minimum stage, 3.4 feet September 4 (discharge, 395 second-feet).

1882-1917: 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-feet).

ICE.—Stage-discharge relation seriously affected by ice. The ice cover is usually complete and smooth from late in November until about the beginning of April, and the flow is steady, with few fluctuations. Since 1905 sufficient discharge measurements have been made each winter to obtain fairly accurate summaries of winter flow. For a few days or weeks at the time of the spring break-up the water level is raised considerably by ice in the channel, and at times, as indicated by a few discharge measurements, this abnormal rise has been as much as 8 feet, though usually it is less; correction is made for this rise in applying open-season rating table.

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

ACCURACY.—Stage-discharge relation practically permanent during the year except as affected by ice. Rating curve fairly well defined between 400 and 9,000 second-feet. Gage read to half-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 daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of Red River at Grand Forks, N. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 22	Chandler and Dale.....	8.09	1,280	Apr. 16	Wardwell and Dale....	20.48	10,600
Jan. 18	Wardwell and Dale....	8.16	1,260	May 7	Wardwell and Hulteng.	14.48	5,990
Feb. 24	.....do.....	7.34	850	July 11	Chandler and Hulteng..	6.11	1,410
Mar. 19	.....do.....	7.83	1,000				

Daily discharge, in second-feet, of Red River at Grand Forks, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,480	2,940	2,440	1,390	1,050	920	11,400	6,780	2,780	1,520	824	446
2	3,420	2,940	2,340	1,300	1,030	934	13,200	6,630	2,720	1,480	789	420
3	3,420	2,940	2,280	1,260	1,010	950	14,800	6,700	2,610	1,440	754	420
4	3,480	3,000	2,280	1,300	1,010	960	16,800	6,700	2,560	1,340	720	395
5	3,420	3,060	2,340	1,300	1,010	972	19,000	6,700	2,500	1,300	720	420
6	3,420	3,060	2,340	1,260	1,010	990	19,700	6,630	2,450	1,390	687	420
7	3,420	3,060	2,340	1,210	1,010	1,010	19,400	6,490	2,450	1,440	687	420
8	3,420	3,060	2,280	1,170	1,010	1,030	20,200	6,280	2,390	1,300	654	446
9	3,360	3,060	2,220	1,190	970	1,050	17,300	6,000	2,340	1,340	654	446
10	3,300	3,000	2,170	1,210	934	1,080	16,100	5,860	2,280	1,340	622	446
11	3,240	2,880	2,070	1,220	900	1,100	15,200	5,650	2,280	1,300	622	420
12	3,120	2,830	1,970	1,240	860	1,130	14,400	5,380	2,220	1,300	622	446
13	3,060	2,780	1,870	1,260	880	1,090	13,400	5,050	2,280	1,300	622	473
14	3,000	2,660	1,770	1,260	900	1,090	12,300	4,790	2,280	1,300	591	473
15	2,940	2,500	1,670	1,260	920	1,090	11,400	4,660	2,220	1,260	591	473
16	2,880	2,390	1,570	1,260	934	1,090	10,700	4,460	2,170	1,260	591	473
17	2,830	2,500	1,480	1,280	930	1,130	9,940	4,340	2,170	1,170	591	501
18	2,830	2,610	1,460	1,300	920	1,090	9,260	4,140	2,120	1,130	591	501
19	2,830	2,720	1,460	1,260	900	1,090	8,440	4,020	2,120	1,090	591	501
20	2,830	2,720	1,440	1,210	897	1,130	7,900	3,900	2,170	1,050	560	530
21	2,830	2,780	1,370	1,190	880	1,170	7,680	3,840	2,120	1,050	530	591
22	2,780	2,720	1,300	1,170	870	1,210	7,520	3,720	2,070	1,010	530	754
23	2,720	2,720	1,340	1,170	860	1,260	7,300	3,600	2,020	1,010	501	860
24	2,720	2,720	1,340	1,170	824	1,340	7,150	3,540	1,970	972	501	897
25	2,780	2,660	1,340	1,170	840	1,480	7,150	3,420	1,870	1,010	501	897
26	2,830	2,610	1,390	1,170	860	1,770	7,000	3,360	1,820	1,010	501	897
27	2,780	2,560	1,390	1,170	880	2,280	6,850	3,300	1,770	897	473	789
28	2,830	2,500	1,440	1,130	900	3,120	6,700	3,240	1,720	897	473	720
29	2,880	2,560	1,440	1,090	.....	4,720	6,720	3,120	1,670	860	473	687
30	2,880	2,500	1,440	1,070	.....	6,630	6,750	2,940	1,620	860	473	687
31	2,940	.....	1,440	1,050	.....	8,760	.....	2,830	.....	824	473	.....

NOTE.—Stage-discharge relation affected by ice Nov. 11 to Apr. 17.

Monthly discharge of Red River at Grand Forks, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	3,480	2,720	3,050	188,000
November	3,060	2,390	2,770	165,000
December	2,440	1,300	1,780	109,000
January	1,390	1,050	1,220	75,000
February	1,050	824	929	51,600
March	8,760	920	1,760	108,000
April	20,200	6,700	11,700	696,000
May	6,780	2,830	4,780	294,000
June	2,780	1,620	2,190	130,000
July	1,520	824	1,180	72,600
August	824	473	597	36,700
September	897	395	562	33,300
The year	20,200	395	2,710	1,960,000

MUSTINKA RIVER ABOVE WHEATON, MINN.

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

DRAINAGE AREA.—About 900 square miles.

RECORDS AVAILABLE.—March 23 to September 30, 1917, when station was discontinued. June 7 to November 30, 1916, at point about 3½ miles farther downstream.

GAGE.—Chain gage attached to bridge; read by Henry Heggen.

DISCHARGE MEASUREMENTS.—Made from Chicago, Milwaukee & St. Paul Railway bridge 1 mile downstream from gage, or from highway bridge just below railway bridge.

CHANNEL AND CONTROL.—Bed composed of clay and silt. Control not well defined. Slope of river from station to Lake Traverse is so slight that the stage-discharge relation may possibly be affected by changes in the stage of the lake.

EXTREMES OF DISCHARGE.—Maximum stage during period, 14.7 feet at 6 p. m. April 1 (discharge, about 2,340 second-feet); minimum stage, 1.16 feet August 30, September 1, 4, and 5 (discharge, about 1 second-foot).

ACCURACY.—Stage-discharge relation probably permanent. Rating curve fairly well defined below 2,500 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Mustinka River above Wheaton, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 14[a]	S. B. Soulé	2.24	31	Apr. 1	S. B. Soulé	14.61	2,160
14[a]	do	2.22	32	12	R. B. Kilgore	6.08	398
Mar. 31	R. B. Kilgore	14.16	1,780	12	do	6.38	444
31	do	14.24	1,860	Sept. 21	do	1.33	1.1
Apr. 1	S. B. Soulé	14.64	2,300	21	do	1.33	1.1

[a] Measurement made at site of old gaging station "Mustinka near Wheaton" about 3½ miles downstream from present gage.

Daily discharge, in second-feet, of Mustinka River above Wheaton, Minn., for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	2,240	460	28	9	2	1
2	.....	2,040	446	27	7	3	1
3	.....	1,320	404	23	4	3	1
4	.....	740	348	20	4	3	1
5	.....	600	307	20	4	2	1
6	.....	530	270	24	4	2	2
7	.....	446	246	27	3	2	2
8	.....	404	222	30	3	2	2
9	.....	432	210	30	3	2	2
10	.....	404	188	28	3	2	1
11	.....	334	178	27	3	2	1
12	.....	418	159	22	2	2	2
13	.....	488	210	28	6	2	2
14	.....	460	137	24	4	2	2
15	.....	418	125	21	3	2	2
16	.....	404	117	17	3	3	2
17	.....	376	101	14	3	2	2
18	.....	376	93	11	3	2	2
19	.....	390	82	9	3	2	3
20	.....	488	79	8	2	2	2
21	.....	768	76	7	2	1	2
22	.....	768	71	8	2	1	2
23	89	614	68	9	2	1	2
24	125	530	58	10	2	1	2
25	294	516	52	11	2	1	3
26	446	530	48	10	2	2	3
27	586	474	44	10	2	2	3
28	866	418	40	10	1	1	3
29	964	404	36	8	1	1	3
30	1,550	446	32	9	2	1	3
31	1,840	.....	28	.....	3	1	.....

Monthly discharge of Mustinka River above Wheaton, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 900 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
March 23–31	1,840	89	751	0.834	0.28
April	2,240	334	626	.696	.78
May	460	28	159	.177	.20
June	30	7	17.7	.020	.02
July	9	1	3.13	.0035	.004
August	3	1	1.84	.0020	.002
September	3	1	2.00	.0022	.002

WILD RICE RIVER AT TWIN VALLEY, MINN.

LOCATION.—In SW. ¼ sec. 22, T. 144 N., R. 44 W., at highway bridge at Twin Valley, Norman County, 2 miles above a small tributary which enters from the right at Heiberg.

DRAINAGE AREA.—805 square miles.

RECORDS AVAILABLE.—June 30, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Vertical staff gage attached to pier of bridge, at left bank; read by Axel Johnson.

DISCHARGE MEASUREMENTS.—Made from the bridge by wading.

CHANNEL AND CONTROL.—One channel at all stages; bed composed of sand and silt. Control not well defined. Right bank high and wooded; left bank will be overflowed to some extent at stage of 12 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded, 7.2 feet April 3 (discharge, about 622 second-feet); minimum stage recorded, 4.48 feet, August 27 (discharge, 14 second-feet).

1909–1917: Maximum stage recorded, 20.0 feet at 7 a. m. July 22, 1909 (discharge, about 9,200 second feet); minimum open-water discharge 12 second-feet August 31 and September 1, 1913; minimum winter discharge measured by current meter, 10 second-feet February 5, 1913; the absolute minimum was probably less than this amount.

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

REGULATION.—Discharge affected by storage created by dams at the lower end of Lower Rice Lake, and at the outlet of Twin Lakes.

ACCURACY.—Stage-discharge relation not permanent; change occurred probably during spring when ice left the river. Rating curve used October 1 to April 1 well defined between 37 and 2,290 second-feet; curve used April 2 to September 30 well defined between 20 and 3,400 second-feet. Gage read to half-tenths twice daily, except November 21 to March 23, when it was read once weekly. Daily discharge ascertained by applying mean daily gage height to rating table, except during period when stage-discharge was affected by ice, for which it was obtained by applying to rating table a weekly gage height corrected for effect of ice by means of discharge measurements, observer's notes and weather records. Open-water records good; winter records fair.

Discharge measurements of Wild Rice River at Twin Valley, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 16	L. B. Dale	5.42	162	Aug. 1	E. F. Chandler	4.66	30
Jan. 2[a]	T. M. Wardwell	5.70	55	1	do	4.66	32
Feb. 11[a]	do	5.10	44	1	do	4.66	31
Mar. 17[a]	do	5.80	48	2	do	4.60	21
Apr. 2[a]	do	7.25	647	2	do	4.60	24

[a] Ice on control.

Daily discharge, in second-feet, of Wild Rice River near Twin Valley, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	157	143					530	344	139	62	29	90
2	147	136					560	358	128	55	25	90
3	147	128					622	331	101	55	24	90
4	157	128					530	318	101	59	26	85
5	157	128					560	305	93	49	26	85
6	157	128	100	70		40	560	280	114	48	29	85
7	163	128					591	280	69	48	29	80
8	167	138					500	280	69	69	29	77
9	167	138					471	256	74	59	25	77
10	167	147					442	244	80	55	26	77
11	157	119					442	233	85	55	26	77
12	157	94					385	221	83	55	19	69
13	147	87					358	210	83	48	19	55
14	157	94					331	199	85	54	19	31
15	147	138					331	199	80	48	19	26
16	157	119	85	65	40	45	331	199	77	49	15	28
17	147	110					331	199	62	48	19	29
18	147	110					331	188	85	48	24	19
19	147	102					358	188	90	45	17	29
20	143	102					385	163	85	45	19	29
21	128					50	399	147	80	41	19	26
22	128					60	385	137	74	48	19	26
23	128					70	358	124	65	45	19	26
24	147					110	358	143	77	35	19	29
25	147					210	358	165	69	35	19	29
26	138	90	55	45		331	344	167	69	35	14	29
27	138					188	344	167	69	35	14	33
28	138					280	344	167	65	35	14	33
29	138				.....	358	344	151	65	33	77	33
30	138				.....	413	344	143	62	29	77	33
31	138	.....			.....	530	.....	137	.....	29	80	.....

Note.—Stage-discharge relation affected by ice Nov. 14 to Apr. 1. Braced figures show mean discharge for period indicated.

Monthly discharge, in second-feet, of Wild Rice River at Twin Valley, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	167	128	148
November	147	.....	111
December	.....	.....	79.2
January	.....	.....	59.5
February	.....	.....	40.0
March	530	.....	111
April	622	331	418
May	358	124	214
June	139	62	82.6
July	69	29	46.9
August	80	14	26.9
September	90	19	50.8
The year	622	14	116

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 less than 60 square miles.

RECORDS AVAILABLE.—June 8, 1901, to September 30, 1917 (fragmentary).

GAGE.—Staff gage on pier at the biologic station. Zero of gage, 1,393.3 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 are furnished by the North Dakota Biological Survey.

Gage height of Devils Lake near Devils Lake, N. Dak., during the year ending Sept. 30, 1917.

Date.	Gage height.	Date.	Gage height.	Date.	Gage height.
	Feet.		*Feet.*		*Feet.*
Sept. 26	7.12	Aug. 6	6.22	Sept. 10	5.77
Nov. 5	(a)	9	6.19		
Apr. 15	7.07	30	5.91		

a About 6.9 feet.

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 September 30, 1917.

GAGE.—Inclined staff gage located on right bank; read by Dedrick Knutson.

DISCHARGE MEASUREMENTS.—Made from cable near gage.

CHANNEL AND CONTROL.—Gravel; practically permanent.

EXTREMES OF DISCHARGE.—Maximum open-water stage recorded, 10. 6 feet April 10 (discharge, 5,060 second-feet); minimum open-water stage recorded, 3.61 feet August 26 (discharge, 99 second-feet); minimum discharge estimated at 97 second-feet December 11, when river was frozen over.

1909–1917: Maximum open-water stage recorded, 12.2 feet, April 19–21, 1916 (discharge, 7,040 second-feet); minimum discharge recorded, zero, July 17 and August 27, 1911.

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

REGULATION.—A short distance above the station is a dam owned by the 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 the river at the gage.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well developed between 19 and 5,600 second-feet. 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 obtained by applying to rating table daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good except on certain days when diurnal fluctuation was such that one reading would not give mean for day; winter records fair.

Discharge measurements of Red Lake River at Thief River Falls, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 31[a]	T. M. Wardwell	6.35	346	Apr. 1	T. M. Wardwell	6.11	889
Feb. 11[a]	L. B. Dale	5.89	410	5	do	6.84	1,660
Mar. 18[a]	do	5.98	446	June 19	E. F. Chandler	5.21	610
Apr. 1	T. M. Wardwell	6.25	875	Sept. 6	do	4.22	293

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,300	1,170	515	393	357	472	890	1,430	790	582	412	159
2	1,300	1,300	538	431	290	472	940	1,360	790	605	306	258
3	1,110	1,300	538	323	357	472	995	1,300	765	538	274	258
4	1,050	1,300	605	323	357	472	1,360	1,300	765	515	274	133
5	1,050	1,300	538	290	323	472	1,720	1,230	765	560	186	186
6	1,050	1,300	538	258	323	560	2,110	1,300	765	538	274	159
7	1,050	1,170	515	258	290	605	1,950	1,230	790	515	242	133
8	1,050	1,300	472	290	323	605	3,700	1,300	765	452	186	258
9	995	1,230	605	290	323	560	4,000	1,230	740	472	274	186
10	995	1,170	605	323	357	605	5,060	1,110	718	494	266	212
11	940	605	97	323	323	605	4,500	1,110	695	515	258	290
12	840	290	560	290	393	605	4,610	1,050	718	452	186	323
13	790	515	605	323	431	605	4,610	1,050	628	452	274	258
14	1,050	560	650	290	431	605	4,200	995	538	340	242	186
15	940	640	650	290	472	650	3,600	995	515	452	242	212
16	940	718	560	258	393	740	2,820	970	560	472	186	227
17	1,500	790	650	258	323	650	2,460	940	628	472	186	242
18	1,570	695	740	258	393	393	2,280	840	605	340	212	258
19	840	695	740	290	431	472	2,280	840	650	357	212	212
20	890	650	740	290	431	740	2,280	940	560	472	212	242
21	940	840	740	258	431	890	2,110	995	560	412	186	274
22	890	605	472	290	431	695	1,870	940	582	412	242	242
23	940	605	393	393	393	840	1,720	940	605	375	186	212
24	840	431	375	323	431	840	1,570	890	560	357	186	186
25	940	452	357	258	472	740	1,640	890	605	375	142	242
26	995	452	382	258	472	695	1,570	890	605	357	99	186
27	1,050	452	406	258	472	650	1,640	865	560	340	133	212
28	1,050	452	431	258	472	790	1,640	840	560	323	186	186
29	1,050	452	418	323	.....	740	1,500	840	605	323	133	199
30	1,110	494	406	323	.....	890	1,430	840	593	290	212	212
31	1,170	.....	393	323	.....	940	.....	790	.....	357	306	.....

NOTE.—Stage-discharge relation affected by ice Nov. 13 to Apr. 5. Gage not read, discharge interpolated Oct. 20, Apr. 19, May 16, 27, June 13, 22, 30, Aug. 10, 25, Sept. 16 and 29.

Monthly discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	1,570	790	1,040
November	1,300	290	798
December	740	97	524
January	431	258	300
February	472	290	389
March	940	393	647
April	5,060	890	2,440
May	1,430	790	1,040
June	790	515	653
July	605	290	436
August	412	99	223
September	290	133	218
The year	5,060	97	725

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, 1917.

GAGE.—Barret & Lawrence water-stage recorder on right abutment of bridge; installed in September, 1911; replaced 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 inspected by Roy Lundahl.

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

CHANNEL AND CONTROL.—Control not well defined; one channel at all stages; slightly shifting.

EXTREMES OF DISCHARGE.—Maximum mean daily stage during year, from water-stage recorder, 11.9 feet April 11 (discharge, estimated because of ice at control, about 5,320 second-feet); minimum mean daily stage, from water-stage recorder, 2.39 feet August 30 (discharge, 78 second-feet).

1901–1917: Maximum mean daily stage recorded, 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 the operation of the power plant immediately above the station. The plant has little storage, so that the mean monthly flow should represent nearly the natural flow.

ACCURACY.—Stage-discharge relation fairly permanent throughout the year. Rating curve used well developed between 100 and 10,000 second-feet. Operation of water-stage recorder satisfactory throughout year except during extremely cold weather when records are fragmentary; during such periods readings from chain gage were taken. Daily discharge obtained by applying to rating table mean daily gage height obtained by planimeter from the gage-height graph except for winter period for which it was obtained by applying to the rating table the mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records excellent; winter records subject to error.

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Discharge measurements of Red Lake River at Crookston, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 9	E. F. Chandler	5.33	1,220	Mar. 17[a]	T. M. Wardwell	5.90	450
Dec. 28[a]	T. M. Wardwell	5.40	620	Apr. 2[a]	do	10.50	3,050
Jan. 6[a]	do	5.11	419	July 9	E. F. Chandler	4.07	647
Feb. 12[a]	do	5.40	377	Aug. 2	do	3.22	304

[a] Ice at control.

Daily discharge, in second-feet, of Red Lake River at Crookston, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,380	1,260	540	570	421	540	2,900	1,880	1,050	740	324	95
2	1,380	1,260	620	560	421	540	2,830	1,820	1,050	740	303	104
3	1,380	1,320	700	550	620	540	2,760	1,760	1,000	740	278	119
4	1,320	1,380	700	540	415	540	2,620	1,880	1,000	740	296	126
5	1,260	1,440	820	421	210	540	2,900	1,880	1,000	740	314	139
6	1,260	1,440	820	421	335	500	3,750	1,820	1,000	700	328	149
7	1,260	1,260	820	540	460	460	4,070	1,820	955	700	324	144
8	1,150	1,260	820	660	310	421	4,800	1,820	955	700	317	142
9	1,150	1,260	865	780	350	421	4,720	1,690	955	700	310	136
10	1,200	1,200	865	560	383	421	4,980	1,560	955	700	310	132
11	1,050	1,100	660	346	400	480	5,320	1,560	910	700	306	119
12	1,000	910	670	310	421	540	4,310	1,500	910	700	296	112
13	955	700	670	275	460	620	4,310	1,500	910	700	296	100
14	910	460	680	290	430	780	4,390	1,440	910	700	300	100
15	865	328	680	310	310	700	4,390	1,380	910	700	303	104
16	955	410	680	330	383	580	4,070	1,320	910	700	310	119
17	1,000	490	690	346	420	460	3,910	1,320	865	740	321	132
18	955	575	690	346	460	580	3,670	1,320	820	740	328	144
19	955	660	700	260	500	700	3,200	1,320	780	700	317	156
20	955	740	660	180	480	660	3,120	1,260	780	700	324	177
21	910	820	421	250	460	740	2,980	1,260	780	660	346	186
22	910	740	383	310	420	740	2,830	1,200	780	620	346	195
23	955	740	152	383	383	740	2,690	1,200	780	600	332	213
24	1,000	660	250	152	421	820	2,550	1,200	780	580	272	236
25	955	660	340	242	500	780	2,480	1,200	780	560	223	239
26	1,000	620	430	242	580	1,000	2,340	1,200	780	540	183	239
27	955	540	520	275	560	1,050	2,280	1,150	780	500	163	239
28	1,050	620	620	330	540	1,100	2,280	1,100	780	460	142	239
29	1,150	660	610	383	.....	1,200	2,280	1,100	780	421	112	239
30	1,200	620	600	400	.....	1,500	2,280	1,050	740	387	78	239
31	1,260	.....	590	421	.....	2,140	.....	1,050	.....	353	84	.....

NOTE.—Stage-discharge relation affected by ice Nov. 14 to Apr. 16. Gage not in operation Oct. 1; discharge estimated.

Monthly discharge, in second-feet, of Red Lake River at Crookston, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	1,380	865	1,090
November	1,440	328	871
December	865	152	621
January	780	152	387
February	620	210	430
March	2,140	421	737
April	5,320	2,280	3,400
May	1,880	1,050	1,440
June	1,050	740	880
July	740	353	644
August	346	78	274
September	239	95	160
The year	5,320	78	910

THIEF RIVER NEAR THIEF RIVER FALLS, MINN.

LOCATION.—In sec. 3, T. 154 N., R. 43 W., at Drybrook ford, Pennington County, 5 miles north of Thief River Falls. Nearest tributary, outlet of Mud Lake, which enters in northeastern part of T. 156 N., R. 42 W.

DRAINAGE AREA.—1,010 square miles.

RECORDS AVAILABLE.—July 1, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage installed August 26, 1915, on cantilever timber fastened to a tree on right bank. Inclined staff gage, installed September 4, 1913, to replace old inclined staff gage, which was set at incorrect gage datum, was used until August 26, 1915. Gage read by T. H. Risteigen.

DISCHARGE MEASUREMENTS.—Made from steel highway bridge 1,000 feet below the gage; at low stages made by wading near the gage.

CHANNEL AND CONTROL.—Heavy gravel and boulders; nearly permanent; one channel at all stages. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 12.6 feet April 11 (discharge, 2,550 second-feet); minimum stage 3.63 feet August 25 (discharge 0.5 second-foot).

1909–1917: Maximum stage recorded, 14.5 feet, April 23, 1916 (discharge, 4,080 second-feet); no flow in October, November, and December, 1910, January, February, and December, 1911, January and February, 1912, and February, 1916.

REGULATION.—Dam at Thief River Falls at the mouth of Thief River, backs up the water in Thief River for several miles, but station is protected from influence of dam by rapids below.

ACCURACY.—Stage-discharge relation nearly permanent. Rating curve well defined between 0.1 second-feet and 3,800 second-feet. Gage read to hundredths twice a day. Daily discharge ascertained by applying mean daily gage heights to rating table, except during period when stage-discharge relation was affected by ice, for which period it was obtained by applying to rating table occasional gage height corrected for ice effect by means of discharge measurements, observer's notes and weather records. Open-water records excellent except those for discharge below 10 second-feet which are subject to error; winter records subject to error.

Discharge measurements of Thief River near Thief River Falls, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 30	T. M. Wardwell	4.68	1.5	Apr. 6	T. M. Wardwell	9.77	845.
Feb. 10	L. B. Dale	3.54	1.4	June 19	E. F. Chandler	4.61	32.
Mar. 17	do	4.05	0.7	Sept. 6	do	3.81	1.6

Daily discharge, in second-feet, of Thief River near Thief River Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	244	185	26				32	322	37	29	5	0.7
2	244	187	26				32	295	37	29	4	0.9
3	232	182	26				35	282	37	27	4	1
4	232	182	26				32	256	36	27	4	2
5	220	182	25				126	244	36	32	4	2
6	208	182	25				440	231	35	37	4	2
7	208	182	25				1,370	219	35	40	4	2
8	196	178	25				1,210	219	35	38	4	1
9	191	178	20				1,410	207	34	34	4	1
10	169	173	20				2,020	183	34	31	4	2
11	308	155	14				2,550	150	35	26	4	2
12	155	151	14				1,970	109	42	22	3	1
13	134	130	10			2	1,740	86	51	21	2	1
14	134	126	10				1,660	77	52	21	2	1
15	130	116	10		3		1,370	72	49	20	1	1
16	122	106	10	5			1,020	66	47	18	.8	2
17	116	97	13				920	65	41	14	.7	2
18	108	87	16				850	65	36	12	.6	2
19	86	79	16				780	65	28	10	.6	2
20	86	68	4				710	63	15	10	.6	3
21	90	61					675	62	19	9	.6	4
22	99	50					572	58	20	9	.6	5
23	108	43					538	54	21	9	.6	6
24	112	38					472	51	20	9	.6	7
25	126	31					456	48	21	9	.5	8
26	140	23	3			3	440	46	23	8	.6	9
27	112	23				6	409	44	24	8	.6	9
28	134	23				10	379	40	25	8	.6	9
29	166	25			.....	14	364	39	29	8	.6	9
30	180	26			.....	25	350	39	29	7	.6	9
31	182	.....			.....	25	.....	37	.....	7	.7	.....

NOTE.—Stage-discharge relation affected by ice Nov. 11 to Apr. 13. Gage not read Sept. 16–19, 21–25, 27–30, discharge estimated. Braced figures show mean discharge for period included.

Monthly discharge, in second-feet, of Thief River near Thief River Falls, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	308	86	160
November	187	23	109
December	26	3	12.7
January	.....	.....	5.0
February	.....	.....	3.0
March	.....	.....	4.29
April	2,550	32	831
May	322	37	122
June	52	15	32.8
July	40	7	19.0
August	6	.5	2.03
September	9	.7	3.55
The year	2,550	.5	108

CLEARWATER RIVER AT RED LAKE FALLS, MINN.

LOCATION.—In sec. 22 T. 151 N., R. 44 W., at Great Northern Railway bridge at Red Lake Falls, Red Lake County, about 1½ miles above mouth and 2 miles below nearest tributary, a stream coming in from the left.

DRAINAGE AREA.—1,310 square miles.

RECORDS AVAILABLE.—June 18, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Combination vertical and inclined staff gage, installed September 12, 1911, about half a mile downstream from original gage, as the building of a dam caused several feet of backwater at the old section. New gage set to read 2.23 feet when the original gage read 5.83 feet. Gage read by Leo Steinert.

DISCHARGE MEASUREMENTS.—Made from Great Northern Railway bridge or by wading about 300 feet below gage.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; smooth. Control nearly permanent. Two channels at low stages, united at high stages. Banks high, wooded and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.4 feet April 11 (discharge, 1,080 second-feet); minimum stage recorded, 1.84 feet, August 21 (discharge 42 second-feet).

1909–1917: Maximum discharge recorded 3,990 second-feet, April 15 and 16, 1916; minimum discharge 20 second-feet, July 4, 1911.

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

REGULATION.—At low stages flow is affected by the Steinert dam, 600 feet above the gage. The storage at this plant is small and only a slight diurnal fluctuation is observable at gage.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well defined between 53 and 1,160 second-feet and fairly well defined between 1,160 and 3,550 second-feet. Gage read to tenths twice a day. Daily discharge ascertained by applying mean daily gage height to rating curve, except during period when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table daily or weekly gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good except those for extreme low stages which are fair; winter records subject to error.

Discharge measurements of Clearwater River at Red Lake Falls, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 30[a]	T. M. Wardwell	3.42	82	Aug. 3	E. F. Chandler	2.27	85
Feb. 12[a]	L. B. Dale	4.60	70	3	do	2.15	66
Mar. 16[a]	do	4.55	65	Sept. 17	do	2.22	82
Apr. 4[a]	T. M. Wardwell	6.15	450	17	do	2.12	63
Aug. 3	E. F. Chandler	2.21	68				

[a] Ice at control.

Daily discharge, in second-feet, of Clearwater River at Red Lake Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	101	120						476	116	62	84	51
2	120	120						376	116	62	72	55
3	120	101						376	116	62	72	62
4	120	101						291	116	62	67	55
5	110	101						291	99	72	62	55
6	101	85	40				740	270	99	67	62	62
7	101	85						251	99	72	62	67
8	85	78						251	91	77	62	72
9	78	72						251	84	91	62	72
10	72	72						219	84	84	72	72
11	72	72					1,080	219	84	72	72	62
12	78						1,000	219	91	84	72	67
13	85					65	968	219	99	84	72	62
14	85						895	219	91	72	72	62
15	85				70		700	251	84	72	72	62
16	93	46	60	70			556	251	72	67	67	67
17	101						529	251	72	62	67	77
18	101						529	219	84	62	48	84
19	101						476	173	84	55	48	84
20	101						476	138	84	55	45	84
21	120						450	138	84	55	42	84
22	120						425	138	72	55	42	77
23	142						425	116	72	55	48	72
24	142						425	116	72	48	45	72
25	142						425	116	72	48	42	77
26	142	45	70				425	116	67	51	42	84
27	131						400	127	62	55	42	84
28	120					290	376	138	67	62	48	84
29	101				-------		376	138	72	72	45	72
30	110				-------		425	138	67	84	42	62
31	120				-------		-------	127	-------	84	48	-------

NOTE.—Stage-discharge relation affected by ice Nov. 12 to Apr. 10. Braced figures show mean discharge for period included.

Monthly discharge, in second-feet, of Clearwater River, at Red Lake Falls, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	142	72	106
November	120	.....	63.9
December	.....	.....	57.1
January	.....	.....	70.9
February	.....	.....	70.0
March	.....	.....	109
April	.....	376	625
May	476	116	214
June	116	62	85.7
July	91	48	66.6
August	84	42	58.0
September	84	51	70.0
The year	.....	.....	133

ROSEAU RIVER AT CARIBOU, MINN.

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

DRAINAGE AREA.—1,340 square miles.

RECORDS AVAILABLE.—April 1 to October 6, 1917, when station was discontinued.

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

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—Channel is artificial, of trapezoidal cross-section, about 100 feet wide and 10 feet deep. Bed composed of hardpan, with few scattered large boulders. Stage of zero flow, bottom of channel, gage height about 3.0 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 9.4 feet April 17 and 18 (discharge, 1,370 second-feet); minimum stage, 3.15 feet September 29 (discharge, about 4 second-feet).

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

DIVERSIONS.—No diversions involving storage or loss of water. A channel about 3½ miles long was dredged some years ago from a point about 4 miles above the station to a point 1 mile below. At a stage of about 6.0 feet water flows in this channel and must be measured and included in all measurements of main channel.

REGULATION.—None.

ACCURACY.—Stage-discharge relation probably permanent. Rating curve, based on two discharge measurements and by use of Kutter formula, only fairly well defined between 5 and 1,200 second-feet. 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 effect of ice by means of discharge measurements, observer's notes, and weather records. Records fair.

Discharge measurements of Roseau River at Caribou, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 9[a]	T. M. Wardwell.....	7.30	336	Apr. 28	T. M. Wardwell.....	7.96	879
10[a]	.....do.....	7.97	396	Sept. 5	E. F. Chandler.....	3.30	9

[a] Ice at control.

Daily discharge, in second-feet, of Roseau River at Caribou, Minn., for the period Apr. 1 to Oct. 6, 1917.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	113	1,090	20	88	27	24	6
2	126	1,160	176	94	24	27	7
3	154	805	94	100	24	35	9
4	184	776	76	88	24	35	12
5	216	776	65	88	24	27	14
6	233	720	65	100	24	17	17
7	250	720	49	82	20	6	.....
8	250	666	44	76	20	6	.....
9	324	666	39	76	17	6	.....
10	405	614	35	72	17	4	.....
11	448	589	31	72	17	4	.....
12	564	564	40	65	20	4	.....
13	516	516	49	60	20	6	.....
14	666	516	44	60	24	6	.....
15	1,090	470	54	54	24	6	.....
16	1,200	448	72	54	24	7	.....
17	1,370	426	88	54	27	9	.....
18	1,370	384	82	49	27	9	.....
19	1,260	344	76	44	20	14	.....
20	1,200	324	65	44	12	60	.....
21	1,120	305	54	40	6	65	.....
22	1,060	259	54	40	9	54	.....
23	1,020	233	49	35	7	37	.....
24	988	200	49	31	6	24	.....
25	956	176	44	27	6	12	.....
26	925	162	44	27	6	7	.....
27	894	147	49	27	6	6	.....
28	894	100	65	31	6	6	.....
29	864	54	54	31	9	4	.....
30	925	27	88	27	14	4	.....
31	.....	9	.....	27	20	.....	.....

NOTE.—Stage-discharge relation affected by ice Apr. 1–14.

Monthly discharge, in second-feet, of Roseau River at Caribou, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
April	1,370	113	720
May	1,160	9	460
June	176	20	60.5
July	100	27	56.9
August	27	6	17.1
September	65	4	17.7

MOUSE RIVER AT MINOT, N. DAK.

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

DRAINAGE AREA.—8,400 square miles.

RECORDS AVAILABLE.—May 5, 1903, to September 30, 1917.

GAGE.—Vertical staff attached to Anne Street footbridge on pier nearest left bank; vertical staff for low-stage readings on same bridge on pier nearest right bank. From 1903 to December, 1909, gage was a vertical staff similarly placed on a footbridge then existing about 20 rods above Anne Street. All gages at same datum. Gage read by Ephraim Cox.

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

CHANNEL AND CONTROL.—Bed composed of clay and silt; nearly permanent. Capacity of channel at high stages changed slightly by artificial structures or encroachments through the city. Control is a 5-foot dam of timbers and loose rock a mile below the gage, at the Soo Railway water tank; the dam raises the water at the gage about 3 feet at ordinary low stage, when the water just reaches the crest of the dam. Some water leaks through the dam, and when the discharge of the river is less than about 8 second-feet the water level falls below the crest.

EXTREMES OF DISCHARGE.—Maximum stage during the year, 11.4 feet April 29 (discharge, 1,280 second-feet); minimum stage, 3.0 feet September 28 (discharge, 0.3 second-foot).

1903–1917: Maximum stage recorded, 21.9 feet April 20, 1904 (discharge, 12,000 second-feet); minimum stage, 1.8 feet February 28, 1913 (discharge, 9.1 second-foot).

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

DIVERSIONS AND REGULATION.—None above station, so far as known.

ACCURACY.—Stage-discharge relation not permanent; slightly affected by changes in control and by ice. Rating curve used October 1 to February 28 fairly well defined; curve used March 1 to September 30 fairly well defined above 30 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good, except for extreme low stages, which are fair.

Discharge measurements of Mouse River at Minot, N. Dak., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Dec. 28	L. B. Dale	4.39	7.5
Apr. 21	E. F. Chandler	9.08	901
July 16	do	4.66	39.3

Daily discharge, in second-feet, of Mouse River at Minot, N. Dak., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	23	23					548	1,250	253	113	21	0.8
2	23	23	29				500	1,230	240	104	21	.7
3	26	23			5	9	476	1,220	240	104	18	.7
4	29	23					476	1,210	227	96	18	.6
5	29	26					452	1,150	227	96	18	.6
6	29	26		12			500	1,120	240	96	16	.6
7	26	26					548	1,120	240	88	16	.6
8	23	29					596	1,140	227	88	18	.6
9	23	29	29				762	1,160	227	88	21	.6
10	26	33			3	24	886	1,190	227	74	21	.6
11	29	33					1,010	1,220	214	74	21	.6
12	29						1,050	1,210	214	61	24	.6
13	26			10			1,050	1,180	201	74	24	.6
14	23						1,080	1,080	214	74	24	.6
15	23						1,110	950	253	88	21	.5
16	23		23				1,140	816	214	74	16	.5
17	23				5	9	1,120	762	176	74	11	.5
18	26	42				10	1,080	722	188	66	11	.5
19	26					10	1,040	682	176	56	11	.4
20	26			17		10	966	640	188	45	11	.4
21	26					20	934	476	188	40	9	.4
22	23					40	918	452	176	36	8	.4
23	23		17			80	934	400	164	31	8	.4
24	23				8	142	966	400	153	31	4	.4
25	26	29				140	1,070	374	153	36	1.8	.4
26	26					140	1,150	320	142	36	1.6	.3
27	26			12		150	1,220	292	142	31	1.3	.3
28	26					200	1,250	279	132	28	1.2	.3
29	26					250	1,280	266	122	28	1.0	.3
30	26		12			300	1,260	266	113	24	0.9	.3
31	23					548		253		24	0.8	

The following table shows for each 10-day period during the years ending September 30, 1916 and 1917, 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 years ending Sept. 30, 1916 and 1917.

Date.	Evaporation.	Rainfall.	Mean temperature (°F.).		Date.	Evaporation.	Rainfall.	Mean temperature (°F.).	
			Water.	Air.				Water.	Air.
1915–1916.	*Inches.*	*Inches.*			1916–1917.	*Inches.*	*Inches.*		
Oct. 1–10	0.84	0.08	41	42	Oct. 1–10	0.79	0.06	51	43
11–20	.86	.09	46	48	11–20	.40	.31	39	36
21–31	1.24	.11	45	46	21–31	.44	.27	36	36
Nov. 1–10	.77	.64	37	38	Nov. 1–9	.50	.00	37	41
May 17–20	.65	.00	50	47	Apr. 25–30	.34	.61	45	39
20–31	1.27	.72	59	56	May 1–10	1.07	.23	56	48
June 1–10	1.70	.52	62	56	11–20	2.21	.00	66	58
11–20	1.37	.84	64	57	21–31	1.75	.00	62	49
21–30	1.30	2.17	67	62	June 1–10	1.61	.17	54	56
July 1–10	1.37	1.66	78	74	11–20	1.67	1.20	58	59
11–20	1.90	1.48	80	74	21–30	1.99	.58	62	62
21–31	2.15	.37	77	73	July 1–10	1.35	2.68	77	64
Aug. 1–10	2.41	1.07	75	70	11–20	1.52	.08	76	67
11–20	1.68	.59	73	66	21–31	2.07	.08	85	75
21–31	1.86	1.91	67	60	Aug. 1–10	1.54	.29	64	61
Sept. 1–10	1.59	.57	.....	63	11–20	1.73	1.20	63	69
11–20	1.17	.29	55	52	21–31	2.05	.09	63	63
21–30	1.00	.33	52	49	Sept. 1–10	1.38	.04	60	52
					11–20	.66	.79	60	60
					21–30	1.26	.05	57	55

RAINY LAKE AT RANIER, MINN.

LOCATION.—In sec. 30, T. 71 N., R. 23 W., at foot of Rainy Lake at Ranier, Koochiching County.

RECORDS AVAILABLE.—January 1, 1910, to September 30, 1917.

GAGE.—Vertical staff gage at sawmill, about 500 feet above the Canadian Northern Railway bridge. Prior to June 6, 1916, a vertical staff gage in connection with a Haskell water-stage recorder on protecting crib above the Canadian Northern Railway bridge. For further information regarding location and datum of gages from which earlier records were obtained see Water-Supply Papers 325, 355, 385, and 405. Elevation of zero of gage used during present year is 488.00 feet, referred to what is known as the Minnesota and Ontario datum. The records have been reduced to a gage whose zero is at 489.00 feet, to correspond to records previously published.

EXTREMES OF STAGE.—Maximum stage recorded during year, 8.56 feet October 1 and 2; minimum stage recorded, 1.9 feet September 26.

1910–1917: Maximum stage recorded, 10.99 feet June 10, 1916; minimum stage recorded, 0.85 foot March 22, 1911.

REGULATION.—The stage of Rainy Lake is controlled at the dam and power plant of the Minnesota & Ontario Power Co., at International Falls, 2 miles below the outlet of the lake, water being stored during periods of high run-off and drawn off during periods of low run-off.

COOPERATION.—Gage-height records furnished by the Canadian Department of Public Works.

Monthly discharge of Mouse River at Minot, N. Dak., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	29	23	25.3	1,560
November			31.6	1,880
December			22.2	1,360
January			12.5	766
February			5.4	299
March			74.1	4,560
April	1,280	452	912	54,300
May	1,250	253	801	49,200
June	253	113	196	11,600
July	113	24	63.8	3,920
August	24	.8	12.9	793
September	.8	.3	.5	30
The year	1,280	.3	180	130,000

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.

[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.

Daily discharge, in second-feet, of Rainy River at International Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	11,300	11,200	10,600	8,720	10,700	10,800	8,980	10,300	10,400	9,340	9,660	8,350
2	10,800	11,200	10,700	10,800	10,800	10,700	9,540	10,300	10,400	7,030	9,870	7,430
3	12,100	11,200	5,760	10,800	10,700	10,600	10,500	10,400	7,260	8,380	9,980	4,260
4	11,400	11,200	9,690	10,900	8,260	8,610	10,400	10,400	9,560	7,480	9,920	6,420
5	11,000	9,660	10,700	10,800	9,330	8,950	10,500	10,400	10,400	9,090	5,540	8,400
6	11,100	9,450	10,700	10,900	10,800	10,600	10,400	9,350	10,300	9,970	9,510	8,370
7	11,000	11,000	10,700	10,000	10,800	10,600	10,400	9,800	10,500	10,000	9,880	8,390
8	9,960	11,100	10,700	9,150	10,800	10,600	8,890	10,400	10,500	8,920	9,610	8,310
9	10,300	11,100	10,700	10,800	11,000	10,700	9,170	10,400	10,400	9,360	9,780	7,890
10	11,200	11,000	9,360	10,800	10,700	10,700	10,400	10,500	9,060	10,000	10,000	7,850
11	11,300	11,100	8,340	10,900	8,120	8,470	10,400	10,400	9,510	10,000	10,100	8,030
12	11,300	8,730	10,700	10,900	9,930	9,180	11,600	10,400	9,960	9,870	8,330	7,220
13	11,300	9,020	10,900	10,800	10,800	10,500	12,700	9,680	8,330	9,920	9,800	7,140
14	11,300	11,000	10,700	7,940	10,700	10,500	12,500	9,710	7,350	10,000	10,300	7,380
15	9,870	11,200	10,700	9,470	10,800	10,500	8,940	10,400	7,380	9,580	8,080	7,380
16	10,000	11,200	10,700	10,900	10,800	10,400	9,230	10,700	7,830	9,900	8,340	6,780
17	11,300	11,200	5,700	10,800	9,220	10,400	10,500	10,400	7,760	9,880	8,480	7,160
18	11,300	10,900	9,060	10,900	7,830	9,320	10,600	10,300	6,450	9,960	9,060	7,450
19	11,300	8,880	10,200	10,800	9,760	9,400	10,600	10,600	6,780	9,940	7,750	7,380
20	11,200	8,450	10,200	10,800	10,700	10,400	10,500	9,080	9,640	9,920	9,020	7,200
21	11,200	11,200	10,600	9,700	10,600	10,500	10,400	9,860	10,500	9,950	8,850	6,920
22	10,300	8,150	10,800	8,400	10,800	10,400	9,160	10,300	10,300	9,200	8,930	6,780
23	9,680	5,510	10,800	11,900	10,800	10,300	9,960	10,500	10,400	8,740	9,050	5,120
24	11,300	9,660	9,600	10,800	10,800	10,400	10,300	10,600	9,850	9,960	9,430	6,300
25	11,200	9,440	1,450	10,800	7,960	8,250	10,200	10,500	10,000	9,860	9,080	6,320
26	11,200	7,380	7,310	10,700	9,690	9,120	10,300	10,400	10,400	10,000	7,480	6,250
27	11,200	10,400	10,200	10,500	10,700	10,400	10,400	7,980	10,400	9,890	8,550	6,300
28	11,200	10,900	10,600	9,510	10,600	10,600	10,600	9,720	10,100	9,900	9,110	6,230
29	9,740	10,700	9,020	9,800	.....	10,400	9,470	10,300	10,400	8,430	8,900	6,210
30	9,950	10,600	10,700	10,700	.....	10,400	10,100	10,400	10,400	9,780	9,030	4,050
31	11,200	.....	7,640	10,800	.....	10,400	.....	10,400	.....	9,910	8,990	.....

Monthly discharge, in second-feet, of Rainy River at International Falls, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	12,100	7,870	10,900
November	11,200	5,510	10,100
December	10,900	1,450	9,530
January	11,900	7,940	10,400
February	11,000	7,830	10,200
March	10,800	8,250	10,100
April	12,700	8,890	10,300
May	10,700	7,980	10,200
June	10,500	6,450	9,420
July	10,000	7,030	9,490
August	10,300	5,540	9,040
September	8,400	4,050	6,980
The year	12,700	1,450	9,710

NOTE.—Monthly and yearly discharge computed by engineers of the United States Geological Survey from daily-discharge record furnished by the Canadian Department of Public Works.

KAWISHIWI RIVER NEAR WINTON, MINN.

LOCATION.—In. sec. 20, T. 62 N., R. 11 W., in a 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 30, 1907; and October 14, 1912, to September 30, 1917.

Daily gage height, in feet, of Rainy Lake at Ranier, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8.56	8.18	8.1	8.10	7.73	6.96	5.50	4.69	4.46	(a)	3.42	2.44
2	8.56	8.18	8.1	8.12	7.68	6.96	5.44	4.68	4.44	4.10	3.38	2.42
3	8.53	8.18	8.12	8.07	7.65	6.89	5.40	4.71	4.45	4.10	3.33	2.42
4	8.48	8.20	8.05	8.60	7.61	6.85	5.33	4.73	4.44	4.16	3.20	2.42
5	8.45	8.25	8.05	8.00	7.60	6.77	5.28	4.73	4.43	4.12	3.25	2.40
6	8.44	8.21	8.05	8.00	7.60	6.70	5.21	5.21	4.40	4.08	3.25	2.37
7	8.40	8.18	8.10	8.00	7.57	6.70	5.16	5.16	4.35	4.05	3.28	2.35
8	8.38	8.18	8.10	7.98	7.55	6.70	5.14	5.14	4.34	(a)	3.25	2.35
9	8.35	8.20	8.07	7.95	7.53	6.60	5.10	5.10	4.32	4.00	3.23	2.30
10	8.32	8.15	8.10	7.95	7.50	6.50	5.05	5.05	4.35	3.98	3.10	2.20
11	8.30	8.16	8.05	7.95	7.50	6.48	4.90	4.90	4.28	3.98	3.05	2.17
12	8.27	8.20	8.10	7.90	7.47	6.46	4.90	4.90	4.10	3.95	3.05	2.22
13	8.26	8.20	8.05	7.88	7.44	6.45	4.85	4.70	(a)	3.90	3.00	2.25
14	8.28	8.20	8.05	7.90	7.41	6.41	4.80	4.70	4.20	3.88	2.90	2.22
15	8.26	8.15	8.05	7.90	7.37	6.36	4.70	4.70	4.23	3.90	2.85	2.20
16	8.28	8.15	8.05	7.90	7.35	6.30	4.73	4.70	4.30	3.88	2.90	2.17
17	8.30	8.15	8.05	7.85	7.31	6.25	4.73	4.70	4.35	3.82	2.87	2.15
18	8.31	8.15	8.09	7.84	7.35	6.20	4.70	4.66	4.40	3.76	2.86	2.10
19	8.31	8.15	8.08	7.85	7.30	6.16	4.70	4.65	4.40	3.76	2.82	2.05
20	8.28	8.19	8.05	7.85	7.27	6.10	4.70	4.70	4.35	3.74	2.77	2.10
21	8.26	8.17	8.05	7.84	7.23	6.05	4.70	4.67	4.30	3.72	2.70	2.07
22	8.22	8.15	8.03	7.83	7.20	6.00	4.70	4.65	4.30	3.75	2.65	2.05
23	8.22	8.15	8.02	7.84	7.20	5.96	4.71	4.65	4.28	3.70	2.65	2.10
24	8.21	8.15	8.02	7.83	7.15	5.92	4.70	4.60	4.24	3.64	2.65	2.00
25	8.18	8.20	8.06	7.80	7.10	5.89	4.72	4.58	4.25	3.55	2.62	1.92
26	8.20	8.2	8.10	7.78	7.05	5.84	4.70	4.55	4.20	3.60	2.65	1.90
27	8.20	8.15	8.10	7.76	7.02	5.80	4.70	4.60	4.15	3.55	2.60	2.00
28	8.20	8.1	8.10	7.76	7.00	5.70	4.70	4.58	4.15	3.55	2.55	2.02
29	8.20	8.1	8.10	7.75	.....	5.65	4.70	4.54	4.15	3.55	2.55	2.00
30	8.19	8.1	8.10	7.74	.....	5.62	4.70	4.52	4.15	3.50	2.49	2.02
31	8.17	.....	8.10	7.74	.....	5.50	.....	4.48	.....	3.45	2.46	.....

a Gage not read owing to wind.

NOTE.—Gage heights referred to the same gage datum as those previously published in water-supply papers containing records for this drainage basin.

RAINY RIVER AT INTERNATIONAL FALLS, MINN.

LOCATION.—In sec. 34, T. 71 N., R. 24 W., at dam and powerhouse of Minnesota & Ontario Power Co.

DRAINAGE AREA.—14,600 square miles.

RECORDS AVAILABLE.—March 1, 1907, to September 30, 1917.

DISCHARGE.—Determined by Canadian Department of Public Works from power-house records.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 12,700 second-feet April 13; minimum daily discharge, 1,450 second-feet December 5.

1907–1917: Maximum daily discharge, 37,300 second-feet June 7, 1916; minimum discharge, 431 second-feet April 21, 1909.

WINTER FLOW.—Determined from power-house records.

REGULATION.—Except during periods of high discharge, the flow is completely regulated at the dam and power plant of the Minnesota & Ontario Power Co. The plant is run on a 24-hour basis, so that except on Sunday the flow is fairly uniform; it is in fact much more uniform than the natural flow, use being made of the storage capacity of Rainy Lake, which has an area of about 344 square miles.

COOPERATION.—Estimates of flow through the power house are furnished by the Canadian Department of Public Works.

GAGE.—Stevens water-stage recorder installed the last part of September, 1912, at a point just above right end of dam. Well was attached to timbers bolted to the vertical rock wall of the right bank of the 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 the pool above the dam by a pipe through the dam. The gage was repaired and again put in operation about July 1, 1914. Both water-stage recorders refer to the same datum.

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 and is permanent unless the dam is destroyed or alterations are made in the crest. About 200 feet above the dam is a decided falls. Banks not overflowed in the vicinity of the gage. At the measuring section the bed of the stream is rock and bowlders; rough; current swift except at low stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.25 feet 8 p. m. June 20 (discharge, 3,140 second-feet); minimum discharge recorded 17 second-feet April 17.

1905–1907 and 1912–1917: Maximum stage recorded, 7.2 feet April 30 and May 7, 1916 (discharge, 5,370 second-feet); no flow August 24, 25, 30, 31, and September 1, 1915, August 6 and 8, 1906, and April 23, 24, and 26, 1907.

ICE.—Stage-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.—The St. Croix Lumber Co. has a dam at the outlet of Garden Lake to control the level of water in that lake and store 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. The 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 is held as high as possible during the summer. A number of low dams in Stony River are used for sluicing logs off rapids but create no large amount of storage back of them. Large volumes of water are allowed to pass through the sluices of the dam at the outlet of Harden Lake for a few hours at a time, at irregular intervals, when desired to drive logs from Garden Lake to Fall Lake; when the gates are closed there is only a slight flow caused by leakage through the dam. At 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 record from recording gage during the open-water period; weekly gage readings during winter. Daily discharge ascertained as follows: October 1 to December 31 and April 17 to May 16 from hourly gage heights; January 1 to April 11 determined from weekly gage heights; May 20 to September 30 by the discharge integrator. Discharge estimated for brief periods when gage was not working, or record fragmentary, for periods shown in footnote to daily-discharge table. Records good except those for low stages, which are subject to error.

The following discharge measurement was made by W. G. Hoyt:
September 12, 1917: Gage height, 1.05 feet; discharge, 245 second-feet.

Daily discharge, in second-feet, of Kawishiwi River near Winton, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	855	1,240	615				150	145	715	1,600	480	485
2	1,110	1,230	595				150	195	645	1,650	600	350
3	875	760	580				150	170	980	1,760	600	745
4	830	755	566				150	140	790	1,150	600	850
5	815	745	556				150	135	640	1,720	600	240
6	650	740	540				150	145	700	1,340	925	1,120
7	980	735	520				150	120	875	1,460	185	400
8	490	730	505				150	85	800	1,200	580	1,290
9	490	725	500				150		470	1,220	595	910
10	490	720	495				150		580	1,450	750	680
11	490	715	495				150		780	1,080	795	660
12	490	710	495				50	70	760	1,230	895	555
13	780	1,130	495				30		680	1,500	1,040	270
14	500	1,160	495				25		540	1,680	550	830
15	740	1,150	495		190		22		430	1,730	750	600
16	890	1,140	495	300		145	20		895	1,740	940	600
17	660	1,140	495				17	700	480	1,920	900	850
18	610	1,140	485				27	700	910	1,840	1,390	560
19	840	1,130	475				42	700	2,200	1,970		740
20	1,080	1,130	470				48	765	2,390	1,940		665
21	1,240	1,120	455				51	895	2,440	1,020		190
22	140	1,120	440				53	680	2,140	1,140		600
23	805	1,110	430				57	650	1,820	1,300	880	195
24	950	1,100	425				57	1,040	1,130	1,360		800
25	950	1,060	410				57	710	2,060	1,220		710
26	950	540	400				62	665	2,130	815		1,040
27	965	690	395				62	345	2,340	755	1,170	510
28	1,270	670	390				62	865	2,120	630	725	630
29	1,270	650	385		.....		64	1,090	2,260	520	710	1,010
30	1,260	630	380		.....		64	490	2,250	550	880	425
31	1,250	.....	380		.....		.....	905	.....	760	725	.....

NOTE.—No gage readings, discharge estimated, Apr. 12–16, May 17–19, Aug. 2–5, 19–26, Sept. 15 and 16. Discharge based on record of stage for less than 24-hour periods, May 27, June 15, 17, July 29, 30, Sept. 14 and 15. Braced figures show mean discharge for period included.

Monthly discharge, in second-feet, of Kawishiwi River near Winton, Minn., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	1,270	140	830
November	1,240	540	920
December	615	380	479
January	.....	.....	300
February	.....	.....	190
March	.....	.....	145
April	.....	17	84
May	1,090	.....	416
June	2,440	430	1,260
July	1,970	520	1,330
August	.....	.....	788
September	1,290	190	650
The year	2,440	17	619

VERMILION RIVER BELOW VERMILION LAKE, NEAR TOWER, MINN.

LOCATION.—In sec. 2, T. 63 N., R. 17 W., in St. Louis County, about 100 yards below dam at outlet of Vermilion Lake, 4 miles above Twomile Creek, which enters from the west, and about 18 miles across Vermilion Lake from Tower.

DRAINAGE AREA.—507 square miles.

RECORDS AVAILABLE.—May 17, 1911, to September 30, 1917, when station was discontinued.

GAGE.—Vertical staff gage attached to a tree at the left bank; read by Mrs. A. E. Shively.

DISCHARGE MEASUREMENTS.—From 1911–1913 made from a cable just below the gage; from 1914–1916 made from a boat about 1 mile below the gage.

CHANNEL AND CONTROL.—Bed composed of solid rock and large boulders. Heavy falls a short distance below the gage form permanent control; banks are not overflowed to any considerable extent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.7 feet October 1–5 and July 5 (discharge, 397 second-feet); minimum stage recorded, 0.70 foot March 4–12, April 5–6, and September 28–30 (discharge 130 second-feet).

1911–1917: Maximum stage recorded, 3.8 feet April 29 to May 7, 1916 (discharge, 2,050 second-feet); minimum stage recorded, 0.22 foot October 1 and 2, 1914 (discharge 60 second-feet).

ICE.—Stage-discharge relation not affected by ice, owing to the heavy fall at the control section, and to the proximity to Vermilion Lake.

REGULATION.—At the outlet of Vermilion Lake, a few hundred feet above the gage, is a loose rock dam which is used to raise the water surface of the lake for aid in navigation. This dam has no gates, but was repaired on July 19, 1912, thus for a period reducing the flow below normal. From April 28 to May 10, 1914, parts of the dam were removed and for some time subsequent the flow exceeded normal.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Gage read to quarter-tenths daily; fluctuations in stage so gradual that good results are obtained from one reading a day. Daily discharge ascertained by applying daily gage height to rating table. Records good.

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

September 13, 1917: Gage height, 0.88 foot; discharge, 156 second-feet.

Daily discharge, in second-feet, of Vermilion River below Vermilion Lake, near Tower, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	397	321	244	187	158	139	134	272	272	378	272	208
2	397	321	244	187	158	139	134	287	272	378	272	187
3	397	321	244	187	158	139	134	287	272	378	272	187
4	397	321	231	187	148	130	134	304	272	378	257	187
5	397	321	231	187	148	130	130	304	272	397	257	187
6	397	321	231	187	148	130	130	321	257	378	244	183
7	378	321	231	187	148	130	130	321	257	378	244	183
8	358	321	231	187	148	130	130	321	257	378	244	177
9	358	304	231	187	148	130	134	321	257	378	244	177
10	358	304	231	183	148	130	134	340	257	378	236	171
11	340	304	231	183	148	130	134	340	257	378	236	167
12	321	287	231	183	148	130	134	340	257	378	231	167
13	321	287	220	177	148	139	134	340	257	378	231	163
14	321	287	220	177	148	139	134	340	257	378	220	163
15	321	287	208	177	148	139	139	340	257	358	220	158
16	321	287	208	171	148	139	139	340	257	358	220	158
17	321	287	208	171	148	139	139	340	257	358	208	158
18	321	272	208	171	139	139	139	340	272	358	208	158
19	321	272	208	171	139	139	139	340	287	358	208	152
20	321	272	208	167	139	139	148	321	287	340	208	152
21	321	257	208	167	139	139	158	321	304	340	198	148
22	321	257	208	167	139	139	171	321	321	340	198	148
23	321	257	208	167	139	139	198	321	340	340	208	144
24	358	257	208	167	139	139	220	321	358	340	208	139
25	358	257	208	167	139	139	231	304	378	340	208	139
26	340	257	198	167	139	139	231	287	378	321	208	134
27	340	257	198	163	139	139	231	287	378	321	208	134
28	340	257	187	158	139	139	231	287	378	304	208	130
29	321	257	187	158	.....	139	257	287	378	304	208	130
30	321	244	187	158	.....	139	272	272	378	287	208	130
31	321	.....	187	158	.....	134	.....	272	.....	287	208	.....

Monthly discharge of Vermilion River below Vermilion Lake, near Tower, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 507 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	397	321	346	0.682	0.79
November	321	244	286	.564	.63
December	244	187	216	.426	.49
January	187	158	175	.345	.40
February	158	139	146	.288	.30
March	139	130	136	.268	.31
April	272	130	163	.321	.36
May	340	272	314	.619	.71
June	378	257	296	.584	.65
July	397	287	354	.698	.80
August	272	198	226	.446	.51
September	208	130	161	.318	.35
The year	397	130	236	.465	6.30

LITTLE FORK RIVER AT LITTLE FORK, MINN.

LOCATION.—In sec. 9, T. 68 N., R. 25 W., at lower of two highway bridges at Little Fork, Koochiching County, about 1½ miles above mouth of Beaver Brook and 2½ miles above Big Fork & International Falls Railway Bridge.

DRAINAGE AREA.—1,720 square miles.

RECORDS AVAILABLE.—June 23, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage attached to new steel bridge about 100 feet above the location of the vertical staff gage which was read prior to March 5, 1917, by G. H. French and Vernon Jamison. Chain gage was set to read the same as staff gage at a gage height of 6.5 feet.

DISCHARGE MEASUREMENTS.—Made from the bridge at medium and high stages; at low stages made by wading a short distance above the bridge.

CHANNEL AND CONTROL.—Bed composed of sand, gravel, and bowlders. Banks high and not subject to overflow. Control permanent up to the summer of 1915, but during the high water in June there was a decided shift.

EXTREMES OF DISCHARGE.—Maximum stage during year, 18.7 feet 10 a. m. April 22, caused by backwater from a log jam at the railroad bridge; maximum discharge probably occurred April 23 (mean for day estimated at 4,460 second-feet); minimum discharge (estimated at 40 second-feet), February 9–20.

1909–1917: Maximum stage recorded, 37 feet April 18, 1916 (discharge, 19,300 second-feet); minimum discharge, about 40 second-feet, September 5, 1910, and February 9–20, 1917.

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

ACCURACY.—Stage-discharge relation permanent since high water of June, 1915 Rating curve used, well defined below 5,670 second-feet and poorly defined above that point. Gage read to quarter tenths 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 ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observers' notes, and weather records. Open-water records good; winter records subject to error.

Discharge measurements of Little Fork River at Little Fork, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage eight.	Dis-charge.	Date.	Made by—	Gage height.	Dis-charge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 12	R. B. Kilgore	7.11	551	Mar. 5[a]	S. B. Soulé	6.50	62
Dec. 26[a]	S. B. Soulé	6.41	117	June 27	do	7.55	685
Jan. 23[a]	do	6.25	64	Sept. 17	R. B. Kilgore	5.58	149

[a] Made through complete ice cover.

Daily discharge, in second-feet, of Little Fork River at Little Fork, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Sept.
1	790	1,200	425	135	50	60	185	3,680	586	167
2	756	1,320	380	130	50	60	185	3,580	518	167
3	790	1,320	321	120	50	60	185	3,240	502	167
4	722	1,320	307	115	55	60	185	2,800	485	158
5	654	1,240	321	110	55	60	200	2,590	470	158
6	620	1,200	335	105	50	65	255	2,490	470	177
7	552	1,160	350	100	50	65	280	2,340	440	177
8	518	1,120	350	95	45	70	280	2,240	425	167
9	502	1,120	335	90	40	75	425	2,140	395	158
10	485	1,080	321	85	40	85	520	2,040	380	158
11	518	968	294	85	40	90	790	1,940	350	148
12	552	932	294	85	40	90	1,080	1,840	335	139
13	518	896	307	85	40	95	1,360	1,640	321	139
14	502	860	281	85	40	95	1,640	1,560	307	148
15	518	824	281	85	40	100	1,990	1,560	281	139
16	485	790	268	80	40	105	2,190	1,480	281	130
17	485	722	281	75	40	110	2,390	1,440	307	139
18	518	688	268	70	40	115	2,590	1,360	335	139
19	586	654	244	65	40	115	2,800	1,320	425	158
20	654	620	198	65	40	120	3,020	1,240	455	158
21	722	586	167	65	45	130	3,460	1,200	502	148
22	722	518	148	65	45	140	3,860	1,160	620	139
23	722	518	139	65	50	150	4,460	1,040	722	148
24	688	518	132	60	50	160	4,400	968	756	148
25	688	502	124	60	55	160	4,400	860	860	127
26	722	502	117	60	55	170	3,980	790	790	123
27	756	502	138	55	60	170	3,460	756	722	122
28	790	485	158	50	60	180	3,410	688	654	122
29	896	485	148	50	.....	180	3,630	688	654	123
30	932	455	139	50	.....	180	3,680	654	654	122
31	1,040	.....	139	45	.....	185	.....	620	.....	.....

NOTE.—Stage-discharge relation affected by ice Nov. 14-20 and Nov. 24 to Apr. 24. Gage not read July 1 to Aug. 31; no determinations of discharge.

Monthly discharge of Little Fork River at Little Fork, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 1,720 square miles.]

Month.	Discharge in second-fee.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,040	485	658	0.383	0.44
November	1,320	455	837	.487	.54
December	425	117	249	.145	.17
January	135	45	80.3	.047	.05
February	60	40	46.6	.027	.03
March	185	60	113	.066	.08
April	4,460	185	2,040	1.19	1.33
May	3,680	620	1,680	.978	1.13
June	860	281	500	.291	.32
September	177	122	147	.086	.10

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, about 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, 1917.

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

DISCHARGE MEASUREMENTS.—Made from the 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 discharge occurred during period April 1–10, when gage was not read; discharge not known, although on basis of power plant records was probably about 34,000 second-feet and occurred about April 5; minimum stage 3.6 feet 7.50 a. m. September 3 and 7 p. m. September 5 (discharge, about 3,530 second-feet).

1915–1917: Maximum stage recorded during unobstructed channel, 10.8 feet April 7, 1916 (discharge, 27,000 second-feet); minimum stage recorded, 3.6 feet at 8 a. m. September 3 and 7 p. m. September 5 (discharge, about 3,530 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 the Crow and Rum rivers, entering between Coon Rapids and the station.

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

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 4,620 and 12,400 and fairly well defined between 12,400 and 26,300 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except when stage-discharge relation was affected by ice, for which period it was estimated from Coon Creek power-plant records (see heading "Ice"). Open water records good; winter records subject to error.

COOPERATION.—Records of discharge at Coon Rapids power plant, upon which are based estimates of discharge during the winter months, furnished by the Minneapolis General Electric Co.

Discharge measurements of Mississippi River at Elk River, Minn., during the year ending Sept. 30, 1917.

[Made by S. B. Soulé.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Apr. 12	8.19	17,800
June 1	4.40	5,640

Daily discharge, in second-feet, of Mississippi River at Elk River, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8,880	7,260						16,000	5,800	5,500	4,340	4,340
2	8,880	7,310						16,000	6,100	4,910	4,910	4,340
3	8,880	7,310						16,000	5,500	5,200	4,620	3,790
4	8,560	7,000						15,400	5,200	5,200	4,620	4,340
5	8,880	7,000						15,000	4,620	6,400	4,620	3,530
6	8,560	6,400					24,000	13,400	5,200	4,340	4,060	5,200
7	8,560	6,400						12,400	5,500	4,620	4,620	4,910
8	8,560	6,700						12,100	6,100	5,500	6,400	4,910
9	8,240	7,000						12,400	5,800	6,400	4,910	4,620
10	8,240	7,000						12,100	5,500	5,500	4,910	4,340
11	8,240	7,000					19,100	11,400	5,200	5,500	4,910	4,340
12	7,930	6,700					18,100	10,800	5,200	6,700	5,500	4,910
13	7,930	6,100					16,700	10,200	4,910	5,800	5,800	5,500
14	8,240	5,800					15,700	9,200	5,500	6,100	5,200	5,500
15	7,620	4,340					15,400	8,560	5,500	5,800	5,500	5,500
16	7,310	4,620	4,800	4,600	4,200	4,000	15,000	8,560	5,500	5,800	5,800	5,200
17	7,620	4,340					14,700	9,200	5,200	4,910	5,800	5,500
18	7,310	4,620					14,000	8,560	4,910	5,200	5,200	4,340
19	7,310	4,340					14,000	8,560	5,200	5,800	5,200	6,100
20	7,620	4,620					13,000	7,620	5,200	5,200	4,620	4,620
21	7,260	5,500					15,700	7,310	5,500	5,910	4,620	5,500
22	7,260	5,500					17,700	6,400	4,340	5,200	4,620	5,500
23	7,310	5,200					18,400	6,700	4,620	5,200	5,500	5,500
24	7,620	5,800					19,100	7,930	4,620	4,340	4,910	5,500
25	7,620	4,060					19,400	7,000	5,500	4,620	4,340	4,910
26	7,310						19,400	6,400	5,500	4,620	4,340	5,500
27	7,620						18,800	5,800	5,800	4,620	4,340	5,800
28	7,310	5,500					17,700	5,500	5,800	4,060	4,340	5,500
29	7,310						17,400	5,200	5,500	4,060	4,060	5,500
30	7,310						16,700	6,100	5,500	4,060	4,340	5,500
31	7,620	.....					.....	6,700	.....	4,060	4,340	.....

NOTE.—Stage-discharge relation affected by ice Nov. 26 to Apr. 10; discharge estimated by comparison with records of discharge at Coon Rapids power plant, furnished by the Minneapolis General Electric Co., allowance being made for the discharge of Crow and Rum rivers, which enter between Coon Rapids and the station. Braced figures show mean discharge for periods or months included.

Monthly discharge of Mississippi River at Elk River, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 14,500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	8,880	7,260	7,900	0.545	0.63
November	.....	.....	5,850	.403	.45
December	.....	.....	4,800	.331	.38
January	.....	.....	4,600	.317	.37
February	.....	.....	4,200	.290	.30
March	.....	.....	4,000	.276	.32
April	.....	.....	19,200	1.32	1.47
May	16,000	5,200	9,820	.677	.78
June	6,100	4,340	5,340	.368	.41
July	6,700	4,060	5,160	.356	.41
August	6,400	4,060	4,880	.337	.39
September	6,100	3,530	5,020	.346	.39
The year	.....	.....	6,730	.464	6.30

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, 1917. Observations of stage begun in 1873 by United States Signal Service and continued by United States Weather Bureau. Many discharge measurements made proir 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 employees of United States Weather Bureau. From 1911 to May 9, 1913, the gage was a vertical staff gage, attached to a piling on the left bank of river, about 800 feet upstream from the 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. During 1916 and 1917 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, 16.2 feet at 8 a. m. April 8 (discharge, 70,200 second-feet); minimum discharge occurred during the period when river was frozen over, and was probably somewhat less than 5,000 second-feet.

1892–1917: 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, −0.9 foot March 22, 1896 (discharge, 1,420 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; monthly mean flow generally ascertained from records obtained by United States Engineer Corps at lock and dam No. 2, below Minneapolis, allowance being made for the flow of the Minnesota River. During winter of 1916–17 records of flow past lock and dam No. 2 were not available, and determinations of flow were based on records obtained from the St. Anthony Falls Water Power Co., of Minneapolis.

REGULATION.—During extreme low water regulation of the flow through the 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 fairly permanent except as affected by ice. Rating curve well defined throughout. Gage read once daily to tenths, but this reading 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. Daily discharge obtained by applying daily gage height to rating table except for period when stage-discharge relation was affected by ice, during which determinations were based on flow of Mississippi River at Minneapolis plus flow of Minnesota River. (See note regarding Ice.) Open-water records range from fair to good; winter records subject to error.

COOPERATION.—Gage-height record furnished by United States Weather Bureau. Data upon which mean monthly flow during winter periods have been based furnished by United States Corps of Engineers.

Discharge measurements of Mississippi River at St. Paul, Minn., during the year ending Sept. 30, 1917.

[Made by Soulé and Kilgore.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 6	2.89	7,810
Apr. 18	13.05	46,700

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for the year ending Sept. 30 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	13,300	11,000	7,010				31,100	38,500	18,100	17,500	8,420	5,910
2	12,800	10,800	7,800				35,000	37,900	18,700	16,600	7,600	7,010
3	12,800	10,800	8,000				36,200	37,300	18,700	15,800	7,800	5,910
4	12,800	10,600	8,420				41,600	36,700	19,700	14,900	7,600	5,730
5	13,000	10,400	8,000				52,600	36,200	19,700	14,100	7,600	5,730
6	12,800	10,600	8,000				58,000	35,000	20,600	14,400	7,400	5,560
7	12,500	9,920	8,630				63,700	33,500	21,000	13,600	7,800	5,560
8	12,200	9,920	8,630				68,600	32,000	21,300	13,000	7,600	6,450
9	12,000	10,100	7,600				67,000	30,200	21,300	12,800	8,210	6,270
10	12,500	10,400	6,270				65,300	29,800	21,300	13,800	8,210	6,090
11	12,000	9,920	5,730				62,000	28,200	21,000	14,100	8,000	5,910
12	11,800	9,920	5,730				58,800	26,700	21,300	13,300	8,000	5,910
13	11,500	9,920	5,910				55,600	25,200	21,300	13,800	8,210	6,090
14	11,500	8,000					53,400	23,700	21,600	13,000	8,630	6,450
15	11,500	7,200		5,100	4,500	4,300	54,100	22,300	22,000	12,800	8,210	6,630
16	11,500	6,270					51,100	21,000	22,000	12,000	8,000	6,630
17	11,000	7,200					48,300	20,000	22,000	11,500	8,210	6,450
18	11,300	7,200					46,200	19,300	21,300	10,800	7,800	6,630
19	10,800	7,800					43,600	18,700	19,700	10,400	7,400	6,270
20	11,000	8,000					42,200	18,100	18,100	10,800	7,600	6,270
21	11,000	8,210					39,100	17,800	16,300	10,100	7,200	6,450
22	11,000	8,420	5,100				38,500	16,900	15,200	9,920	7,010	6,270
23	10,800	8,420					39,700	16,000	13,800	10,100	6,450	6,630
24	10,600	7,600					39,700	15,500	13,600	10,100	7,010	6,630
25	10,800	6,450					40,300	16,300	14,100	10,100	6,820	6,630
26	11,000	5,390					41,000	16,000	14,600	10,100	6,450	6,630
27	11,000	6,090					41,000	15,500	15,800	10,400	6,270	6,270
28	10,800	6,630				13,000	40,300	15,200	16,000	10,100	6,270	6,820
29	10,800	8,000				15,500	40,300	15,500	17,200	9,260	6,090	6,630
30	10,600	7,800				17,500	39,700	15,200	16,000	8,840	6,450	6,630
31	10,800	.....				19,000	.....	16,600	.....	8,210	6,270	.....

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Mar. 27. Braced figures show mean discharge for period included.

Monthly discharge of Mississippi River at St. Paul, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 35,700 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	13,300	10,600	11,600	0.325	0.37
November	11,000	5,390	8,630	.242	.27
December	8,630	.....	6,050	.169	.19
January	.....	.....	5,100	.143	.16
February	.....	.....	4,500	.126	.13
March	19,000	.....	5,840	.164	.19
April	68,600	31,100	47,800	1.34	1.50
May	38,500	15,200	24,100	.675	.78
June	22,000	13,600	18,800	.527	.59
July	17,500	8,210	12,100	.339	.39
August	8,630	6,090	7,440	.208	.24
September	7,010	5,560	6,300	.176	.20
The year	68,600	.....	13,200	.369	5.01

CROW WING RIVER AT MOTLEY, MINN.

LOCATION.—Near north border of sec. 18, T. 133 N., R. 31 W., at highway bridge in Motley, Cass County, about a quarter of a mile north of Northern Pacific Railway station and 2 miles above mouth of Long Prairie River, the nearest tributary.

DRAINAGE AREA.—2,140 square miles.

RECORDS AVAILABLE.—June 10 to November 30, 1909; April 17, 1913, to September 30, 1917, when station was discontinued. Records for 1909 consist of discharge measurements and gage heights only.

GAGE.—Chain gage attached to upstream handrail of bridge near right bank, read by S. W. Jacobs. Prior to July 21, 1916, gage was a staff gage in two sections, the lower section attached to an old log bulkhead which constituted the abutment of a former bridge, and was about 20 feet above the upstream edge of the bridge, at the left bank; upper section was attached to an old piling just above the lower section.

DISCHARGE MEASUREMENTS.—Made from upstream side of the bridge.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; fairly permanent. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.2 feet at 6 p. m. April 5 when stage-discharge relation was affected by ice (mean discharge for day estimated at 3,600 second-feet); minimum open-water stage recorded, 5.70 feet August 28 and 29 (discharge, about 270 second-feet).

1913–1917: Maximum stage recorded, 11.5 feet April 5 and 6, 1916 (discharge, 9,440 second-feet); minimum open-water stage recorded, 5.70 feet August 28 and 29, 1917 (discharge, about 270 second-feet).

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

REGULATION.—Nearest dam above station is at outlet of Lower Crow Wing Lake, about 67 miles above Motley; regulation at this point has very little effect at the gage.

ACCURACY.—Stage-discharge relation fairly permanent. Rating curve well defined between 450 and 4,790 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to the rating table except for period when stage-discharge relation was affected by ice for which it was obtained by applying to rating table mean daily gage heights corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of Crow Wing River at Motley, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 31	R. B. Kilgore	6.60	1,050	Apr. 10	R. B. Kilgore	7.55	2,290
Dec. 27[a]	S. B. Soulé	6.95	506	June 28	S. B. Soulé	6.28	701
Jan. 24[a]	do	7.36	489	Sept. 18	R. B. Kilgore	6.08	532
Mar. 6[a]	do	7.61	476				

[a] Made through ice.

Daily discharge, in second-feet, of Crow Wing River at Motley, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,360	990	650	510	470	470	1,420	1,980	875	621	450	332
2	1,290	930	650	500	470	470	1,830	1,980	842	594	450	332
3	1,290	930	680	490	470	470	2,440	1,900	842	549	443	350
4	1,290	930	680	490	470	475	3,260	1,830	831	504	422	332
5	1,290	930	710	490	470	475	3,600	1,760	842	495	394	350
6	1,230	930	710	485	470	475	3,260	1,690	800	495	380	350
7	1,170	930	710	480	470	490	2,920	1,550	810	549	387	350
8	1,170	908	710	475	460	500	2,760	1,480	800	558	415	350
9	1,110	908	680	470	460	510	2,760	1,420	770	558	408	368
10	1,050	930	680	470	450	520	2,600	1,360	730	585	387	350
11	1,050	930	650	470	450	530	2,060	1,290	760	585	374	350
12	1,050	800	650	475	450	550	1,830	1,290	875	576	374	387
13	1,050	468	625	480	450	560	1,690	1,170	908	567	380	459
14	990	580	625	485	450	570	1,550	1,170	886	558	380	486
15	990	625	600	490	460	580	1,480	1,110	800	549	380	504
16	990	710	600	480	460	600	1,420	1,170	750	540	368	540
17	1,050	770	600	470	460	610	1,290	1,110	720	531	368	531
18	1,050	770	580	475	470	620	1,420	1,170	750	513	368	522
19	1,050	770	580	480	470	640	1,620	1,290	711	504	368	522
20	1,050	805	555	485	470	650	1,830	1,230	675	495	368	648
21	1,050	840	555	490	470	660	2,200	1,170	666	468	368	702
22	1,050	840	535	490	470	670	2,280	1,110	621	468	368	702
23	1,050	770	535	490	470	690	2,440	1,050	612	443	350	702
24	1,050	650	535	490	470	700	2,520	1,050	740	436	350	675
25	1,050	510	510	485	470	710	2,280	1,050	810	422	350	675
26	1,050	535	510	480	470	710	2,200	990	831	415	350	675
27	1,050	555	505	470	470	710	2,130	930	740	401	344	648
28	1,050	600	510	470	470	710	1,980	930	684	394	300	648
29	990	625	490	470	.....	710	1,830	908	630	380	270	630
30	990	650	490	470	.....	710	1,900	908	630	374	310	630
31	990	.....	490	470	.....	940	.....	908	.....	450	326	.....

NOTE.—Stage-discharge relation affected by ice Nov. 14 to Apr. 9. Discharge, Sept. 17, interpolated.

Monthly discharge of Crow Wing River at Motley, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 2,140 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,360	990	1,090	0.509	0.59
November	990	468	771	.360	.40
December	710	490	599	.280	.32
January	510	470	481	.225	.26
February	470	450	465	.217	.23
March	940	470	603	.282	.32
April	3,600	1,290	2,160	1.01	1.13
May	1,980	908	1,290	.603	.70
June	908	612	765	.357	.40
July	621	374	502	.235	.27
August	450	270	373	.174	.20
September	702	332	503	.235	.26
The year	3,600	270	800	.374	5.08

LONG PRAIRIE RIVER NEAR MOTLEY, MINN.

LOCATION.—On west line of sec. 19, T. 133 N., R. 31 W., at highway bridge 1 mile south of Motley and 2 miles above mouth of river, in Morrison County.

DRAINAGE AREA.—973 square miles.

RECORDS AVAILABLE.—June 10, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage attached to downstream handrail of bridge, near middle of stream; read by Mrs. Clem Thompson. Prior to August 9, 1916, the gage was a staff attached to an overhanging stump on right bank of the river, about 100 yards above bridge.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge to which gage is attached; low-stage measurements made by wading a short distance above gage.

CHANNEL AND CONTROL.—Bed composed of light gravel; practically permanent, affected by aquatic plants during portion of the year; left bank low, subject to overflow; right bank high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded when control was unobstructed, 9.00 feet at 8.30 a. m. April 6 (discharge, 2,540 second-feet); minimum discharge 105 second-feet March 1–11.

1909–1917: Maximum stage during period, 15.0 feet, April 5, 1916 determined by leveling from flood marks (estimated discharge, 4,280 second-feet, allowance being made for backwater). A discharge of 39 second-feet was measured by current meter on February 27, 1914; absolute minimum probably about 30 second-feet.

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

ACCURACY.—Stage-discharge relation probably permanent except as affected by ice and growth of aquatic plants. Rating curve used October 1 to July 30 fairly well defined between 78 and 1,730 second-feet; extension above 1,730 second-feet determined from area and mean velocity curves. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table; discharge August 1 to September 30, determined by shifting-control method owing to obstruction of the channel by vegetation. Discharge for periods when stage-discharge relation was affected by ice ascertained by applying to rating table gage height corrected for backwater by means of discharge measurements, observer's notes, and weather records. Open-water records fair; winter records subject to error.

Discharge measurements of Long Prairie River near Motley, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 14	R. B. Kilgore	6.02	433	Apr. 3[b]	S. B. Soulé	10.82	1,270
Dec. 28[a]	S. B. Soulé	6.10	139	11	R. B. Kilgore	7.46	1,370
Jan. 25[a]	do	6.39	126	June 28	S. B. Soulé	5.62	278
Mar. 7[a]	do	6.49	106	Sept. 19	R. B. Kilgore	5.35	142

[a] Made through complete ice cover. [b] Open water at measuring section; ice jam at control.

Daily discharge, in second-feet, of Long Prairie River near Motley, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	680	265	340	140	125	105	740	1,070	320	229	248	127
2	624	265	340	140	125	105	1,000	1,000	320	219	265	130
3	624	265	300	140	125	105	1,280	1,000	320	216	282	132
4	570	265	300	140	125	105	1,730	935	320	213	229	130
5	570	282	320	135	120	105	2,290	870	320	213	206	130
6	520	300	340	135	120	105	2,450	870	320	219	206	127
7	495	360	360	135	120	105	2,130	805	320	265	197	127
8	470	360	380	135	120	105	1,890	740	320	300	188	130
9	470	360	360	135	120	105	1,730	680	300	300	194	132
10	470	340	380	130	120	105	1,350	624	300	300	185	132
11	470	340	320	130	120	105	1,280	570	300	300	173	130
12	495	300	300	130	120	110	1,140	570	300	300	176	130
13	520	300	265	130	120	115	1,000	520	300	265	194	142
14	520	300	265	130	120	115	870	520	300	232	203	152
15	422	300	250	130	120	120	870	470	300	232	197	144
16	422	300	230	125	115	120	805	470	300	229	182	144
17	422	300	230	125	115	130	740	470	282	219	176	142
18	401	300	215	125	115	145	680	446	265	213	173	134
19	401	300	200	125	115	150	680	446	265	203	170	130
20	401	282	200	125	115	160	935	422	248	200	160	127
21	401	282	185	125	115	175	1,140	422	248	197	157	132
22	401	282	170	125	115	190	1,280	401	232	203	149	130
23	401	282	170	125	115	205	1,420	380	232	213	154	127
24	401	282	155	125	115	225	1,500	380	232	203	149	122
25	401	282	145	125	115	250	1,350	380	282	197	149	127
26	401	282	145	125	110	265	1,280	340	300	188	147	122
27	401	300	145	125	110	300	1,210	340	300	176	142	120
28	401	300	140	125	110	340	1,140	340	265	167	139	120
29	340	320	140	125	.....	380	1,070	340	248	165	134	118
30	320	340	140	125	.....	470	1,000	340	232	182	132	113
31	292	.....	140	125	.....	570	.....	340	.....	216	134	.....

NOTE.—Stage-discharge relation affected by ice Dec. 9 to Apr. 5 and by aquatic plants Aug. 1 to Sept. 30.

Monthly discharge of Long Prairie River near Motley, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 973 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	680	320	456	0.469	0.54
November	360	265	301	.309	.34
December	380	140	244	.251	.29
January	140	125	130	.134	.15
February	125	110	118	.121	.13
March	570	105	184	.189	.22
April	2,450	680	1,270	1.30	1.45
May	1,070	340	532	.547	.63
June	320	232	286	.294	.33
July	300	165	225	.231	.27
August	282	132	180	.185	.21
September	152	113	130	.134	.15
The year	2,450	105	340	.349	4.71

ELK RIVER NEAR BIG LAKE, MINN.

LOCATION.—In sec. 23, T. 33 N., R. 27 W., at highway bridge 4 miles east of Big Lake, Sherburne County, three-fourths of a mile north of Bailey station on Northern Pacific and Great Northern railways, half a mile above Tebbetts Brook, and 4 miles below mouth of St. Francis River.

DRAINAGE AREA.—615 square miles.

RECORDS AVAILABLE.—April 15, 1911, to September 30, 1917, when station was discontinued.

GAGE.—Vertical staff gage attached to upstream edge of left abutment; read by Michael Tracy. Prior to April 7, 1916, the gage was a staff gage attached to a piling about 10 feet above the upstream edge of the bridge, near the right bank of the river.

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

CHANNEL AND CONTROL.—Bed composed of sand and light gravel. Just below the gage is a slight rapids which constitutes the control at medium and low stages, and at which the bed consists of heavier gravel and cobblestones and is fairly permanent. From July to October the channel is usually obstructed by aquatic plants, which cause considerable backwater, that increases as the summer advances and reaches a maximum some time in September. No obstruction due to aquatic plants during the period April to September, 1917, due apparently to the change in control section. Right bank high and not subject to overflow; left bank subject to overflow at a stage of about 9 feet, and some of the water cuts across a point formed by a loop in the river, and does not pass under the bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.88 feet April 6 (discharge, 2,850 second-feet); minimum discharge about 75 second-feet January 24, 25, 28, and 29.

1911–1917: Maximum stage recorded, 10 feet at 6.30 p. m. May 7, 1912 (discharge, 5,100 second-feet); minimum open-water stage recorded during period, 0.22 foot July 16, 1911 (discharge, 43.4 second-feet, measured by current meter); a discharge of 39 second-feet was measured by current meter on January 27, 1912.

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

ACCURACY.—Stage-discharge relation not permanent; change in control occurred about April 4 and 5 caused by breaking of ice jam with flood stage. Rating curve used October 1 to April 4, well defined throughout; curve used April 5 to September 30 well defined between 124 and 2,930 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for period when stage-discharge was affected by aquatic plants, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of backwater by means of discharge measurements, and for winter period by observer's notes and weather records. Records good for period when channel was unobstructed, winter records fair.

Discharge measurements of Elk River near Big Lake, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 16[a]	R. B. Kilgore	1.29	108	Apr. 13	S. B. Soulé	4.03	1,190
Jan. 16[a]	S. B. Soulé	1.65	118	May 24	do	1.60	207
Mar. 3[a]	do	1.84	93	Aug. 20	R. B. Kilgore	1.47	159
Apr. 7	do	6.49	2,590				

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

Daily discharge, in second-feet, of Elk River near Big Lake, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	297	356	283	125	95	95	510	700	251	282	167	127
2	283	356	269	125	95	95	870	700	236	266	158	127
3	283	356	269	130	95	95	1,330	660	221	251	156	124
4	283	356	269	130	95	100	1,860	660	236	236	150	124
5	283	356	240	135	95	100	2,360	620	251	251	140	124
6	297	356	230	135	95	100	2,860	580	266	266	150	124
7	297	356	215	135	95	105	2,600	540	266	266	178	121
8	297	341	205	135	95	110	2,300	500	266	251	178	124
9	297	341	190	135	90	120	2,000	482	266	236	178	124
10	297	341	180	135	90	130	1,720	464	251	236	172	124
11	312	341	165	130	90	130	1,560	428	236	266	164	134
12	312	341	155	130	90	135	1,390	394	236	282	192	161
13	312	341	140	125	90	140	1,170	378	221	298	221	161
14	312	325	130	125	90	140	1,070	346	221	362	221	161
15	312	325	120	120	90	145	925	330	206	378	206	158
16	312	356	110	120	90	145	835	314	192	362	192	156
17	312	371	110	115	95	145	745	282	192	330	192	156
18	312	341	110	110	95	145	660	282	175	282	178	153
19	326	326	110	100	95	145	660	236	167	251	178	156
20	326	326	110	90	95	145	620	221	161	236	172	167
21	341	312	115	90	95	155	620	221	178	221	167	167
22	341	312	115	80	95	170	620	221	172	206	161	161
23	341	312	115	80	90	185	620	221	175	236	156	156
24	341	310	115	75	90	205	660	206	206	221	156	156
25	326	312	115	75	90	220	745	192	330	206	150	156
26	341	297	120	70	90	240	745	192	330	206	145	153
27	341	283	120	70	90	260	745	192	378	192	140	153
28	341	297	120	75	90	265	745	178	378	178	134	156
29	341	297	120	75	.....	295	745	178	346	170	129	156
30	341	283	120	80	.....	350	745	221	314	161	129	156
31	341	.....	120	85	.....	415	.....	251	.....	170	127	.....

NOTE.—Stage-discharge relation affected by backwaters from aquatic plants Oct. 1–31, and by ice Nov. 14, 15, 24, and Dec. 5 to Apr. 4.

Monthly discharge of Elk River near Big Lake, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 615 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	341	283	316	0.514	0.59
November	371	283	331	.538	.60
December	283	110	158	.257	.30
January	135	70	108	.176	.20
February	95	90	92	.150	.16
March	415	95	169	.275	.32
April	2,860	510	1,170	1.90	2.12
May	700	178	367	.597	.69
June	378	161	244	.397	.44
July	378	161	250	.406	.47
August	221	127	166	.270	.31
September	167	121	146	.237	.26
The year	2,860	70	293	.476	6.46

CROW RIVER AT ROCKFORD, MINN.

LOCATION.—In sec. 29, T. 119 N., R. 24 W., at highway bridge at Rockford, about 400 feet below dam (not in use at present), about one-third mile below "Soo" Railway bridge and about a mile below junction of north and south branches. Between junction and station are outlets of Rebecca Lake and Lake Sarah, both very small streams.

RECORDS AVAILABLE.—June 4, 1909, to September 30, 1917, when station was discontinued.

DRAINAGE AREA.—2,520 square miles.

GAGE.—Vertical staff gage attached to a piling a few feet above the right end of the bridge; read by George W. Florida.

DISCHARGE MEASUREMENTS.—Made from the bridge or by wading about 600 feet below the gage.

CHANNEL AND CONTROL.—For most part bed of stream is composed of heavy gravel; practically permanent. Banks are not overflowed except during extreme floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.5 feet at 6 p. m. April 7, and 7 a. m. April 6 (discharge, 8,500 second-feet); minimum discharge, 75 second-feet (measured by current meter February 27).

1909–1917: Maximum stage recorded, 15.9 feet at 6 p. m. April 2 and 7 a. m. April 3, 1916 (discharge, 10,600 second-feet); minimum open-water stage recorded, 4.55 feet January 29 and February 5, 1911 (discharge, 34 second-feet); true minimum, probably about 30 second-feet, occurred in February, 1915.

ICE.—Stage-discharge relation seriously affected by ice. Prior to the winter of 1911–12, little ice formed at the control, and the open-water rating curve was applicable throughout the year. Before the dam just above the station was destroyed the temperature of the large body of water back of the dam was considerably above freezing, and the water did not freeze quickly when released; but since the destruction of the dam natural conditions exist and ice forms.

REGULATION.—On the North, Middle, and South forks of Crow River there are seven power plants with small storage, but the regulation at the various points is so slight that no appreciable effect is observed at the gage. The dam immediately above the gage was partly destroyed May 31, 1911, and has not since been repaired.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 90 and 10,700 second-feet. Gage read to hundredths twice daily. Owing to effect of ice on gage there is some question as to the gage datum used during the winter and early spring. 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 roughly estimated from discharge measurements and observer's notes. Open-water records good except for flood stages, for which they are fair; winter records roughly approximate.

Discharge measurements of Crow River at Rockford, Minn., during the period Oct. 1, 1916, to Oct. 4, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 12[a]	S. B. Soulé	4.83	97	May 28	S. B. Soulé	6.67	1,020
Feb. 27[a]	do	5.37	75	June 19	do	6.40	857
Apr. 10	do	13.91	7,840	Oct. 4	R. B. Kilgore	4.84	111

[a] Made through complete ice cover.

Daily discharge, in second-feet, of Crow River at Rockford, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	610	445					6,100	4,230	1,450	304	220	102
2	610	445					7,560	4,050	1,660	327	214	102
3	610	420					5,990	4,050	1,800	472	211	108
4	610	429					5,990	3,870	1,870	555	220	110
5	610	420					6,810	3,690	1,800	528	214	106
6	610	395					7,560	3,510	1,730	500	208	104
7	610	395					8,360	3,330	1,730	500	196	106
8	582	370					8,500	3,150	1,590	472	190	106
9	582	370	240	110			8,080	2,970	1,520	445	178	108
10	582	395					7,690	2,810	1,520	472	166	110
11	582	345					7,430	2,650	1,450	472	166	110
12	582	336					7,050	2,490	1,450	445	184	114
13	555	336					6,690	2,330	1,380	395	202	120
14	555	345				110	6,210	2,250	1,380	345	202	130
15	555	336					5,880	2,090	1,310	336	187	139
					80							
16	500	327					5,550	1,940	1,250	327	178	151
17	472	322					5,440	1,800	1,190	300	163	160
18	472	309					5,130	1,730	1,010	284	154	154
19	472	318					5,030	1,590	860	268	145	148
20	445	309					4,930	1,450	775	252	136	136
21	445	304					4,630	1,380	692	240	130	128
22	472	300					4,430	1,310	638	260	126	122
23	500	309	130	90			4,230	1,250	610	318	126	124
24	500						4,430	1,130	610	318	126	126
25	472						4,330	1,070	610	314	124	122
26	472	290					4,630	1,010	555	304	122	126
27	500						4,330	1,010	472	284	116	126
28	472					750	4,330	950	395	268	114	122
29	472				-------		4,230	1,310	345	228	108	118
30	472				-------		4,140	1,310	313	228	102	118
31	445	-------			-------		-------	1,380	-------	214	102	-------

NOTE.—Stage-discharge relation affected by ice Nov. 24 to Mar. 31. Braced figures show mean discharge for period included.

Monthly discharge of Crow River at Rockford, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 2,520 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	610	445	530	0.210	0.24
November	445	.....	343	.136	.15
December	.....	.....	183	.073	.08
January	.....	.....	99.7	.039	.04
February	.....	.....	80.0	.032	.03
March	.....	.....	234	.093	.11
April	8,500	4,140	5,860	2.33	2.60
May	4,230	950	2,230	.885	1.02
June	1,870	313	1,130	.448	.50
July	555	214	354	.140	.16
August	220	102	169	.067	.08
September	160	102	122	.048	.05
The year	8,500	.....	941	.373	5.06

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, 1917.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.16 feet at 6 p. m. April 4 (discharge, about 10,200 second-feet); minimum discharge 72 second-feet Sept. 9 (gage-height, 2.24 feet).

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

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

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

ACCURACY.—Stage-discharge relation fairly permanent, except as affected by ice. Rating curve fairly well defined. Gage read to hundredths twice daily. 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 tri-weekly gage heights corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good except those for extreme flood stages which are fair; winter records subject to error.

Discharge measurements of Minnesota River near Montevideo, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 12	S. B. Soulé	5.89	891	Apr. 13	R. B. Kilgore	14.43	7,750
Dec. 30[a]	do	4.70	286	14	Soulé and Kilgore	14.35	7,510
Jan. 27[a]	do	4.58	191	Sept. 23	R. B. Kilgore	2.64	130
Mar. 10[a]	do	4.44	94				

[a] Made through complete ice cover.

Daily discharge, in second-feet, of Minnesota River near Montevideo, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,100	731	480	280	180	110	5,050	5,390	1,740	967	386	104
2	1,130	703	470	280	180	110	5,810	5,210	1,690	967	338	150
3	1,100	703	465	275	170	105	8,220	5,050	1,650	906	314	150
4	1,030	703	460	270	170	105	10,000	4,760	1,650	876	314	150
5	1,030	621	450	265	170	105	10,000	4,630	1,570	817	314	118
6	998	703	440	260	165	100	9,650	4,400	1,570	817	279	118
7	998	675	430	255	160	100	9,650	4,200	1,570	788	268	97
8	998	675	425	250	155	95	9,290	4,030	1,570	731	248	134
9	998	675	420	250	155	95	8,570	3,880	1,610	731	268	72
10	998	648	415	245	155	95	8,220	3,750	1,570	788	238	74
11	967	648	405	240	150	95	8,220	3,630	1,570	703	238	84
12	936	516	395	235	150	95	7,880	3,520	1,570	675	228	166
13	936	490	390	235	150	95	7,540	3,400	1,530	647	268	134
14	906	568	385	235	145	95	7,210	3,240	1,530	619	248	166
15	876	542	375	230	140	95	6,890	3,130	1,450	592	228	158
16	846	621	370	225	140	95	6,590	3,020	1,410	675	208	110
17	817	817	365	220	140	100	6,050	2,910	1,340	675	208	102
18	846	731	355	220	135	110	5,590	2,810	1,300	540	218	100
19	876	675	350	220	135	110	5,390	2,660	1,160	566	248	126
20	846	621	345	215	130	130	5,390	2,560	1,100	514	228	104
21	817	621	340	210	130	140	5,590	2,460	1,030	514	218	118
22	759	594	330	210	130	160	5,590	2,360	1,060	514	208	166
23	817	594	325	200	130	180	5,590	2,320	1,060	488	218	150
24	846	568	320	200	125	200	5,590	2,280	1,030	462	190	166
25	788	568	315	195	120	225	5,590	2,140	1,030	462	166	166
26	788	542	310	190	120	315	5,590	2,100	1,030	436	134	182
27	788	542	300	190	120	490	5,590	2,000	967	436	150	190
28	759	516	295	190	115	2,660	5,590	1,920	936	386	150	166
29	758	542	290	185	.....	3,240	5,590	1,820	1,060	314	142	150
30	731	490	285	180	.....	3,570	5,390	1,820	936	362	134	134
31	731	.....	285	180	.....	4,200	.....	1,820	.....	338	105	.....

NOTE.—Stage-discharge relation affected by ice Dec. 1 to Mar. 27. High discharge Nov. 17 reported by observer to be caused by going out of dam on Chippewa River.

Monthly discharge of Minnesota River near Montevideo, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 6,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,130	731	897	0.142	0.16
November	817	490	621	.099	.11
December	480	285	374	.059	.07
January	280	180	227	.036	.04
February	180	115	145	.023	.02
March	4,200	95	562	.089	.10
April	10,000	5,050	6,900	1.09	1.22
May	5,390	1,820	3,200	.508	.59
June	1,740	936	1,340	.213	.24
July	967	314	623	.099	.11
August	386	105	229	.036	.04
September	190	72	134	.021	.02
The year	10,000	72	1,270	.202	2.72

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, 1917.

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 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, 15.8 feet April 5 (discharge, about 26,900 second-feet); minimum discharge 248 second-feet measured by current meter February 28.

1903–1917: Maximum stage recorded, 21.2 feet June 26, 1908 (discharge, 43,800 second-feet); minimum stage recorded, 0.5 foot August 31, September 1 and 2, 1911 (discharge, 89 second-feet). The highest known stage of this river occurred in 1881, and is shown in Mankato by a well-marked line which was 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 Minnesota River is at Minnesota Falls, 140 miles upstream. A dam on Blue Earth River at Rapidan, a few miles above the mouth, controls the flow of that river, which is about 20 per cent of that at the Mankato station, and produces considerable daily fluctuation at the gage, amounting at times to more than 1 foot.

ACCURACY.—Stage-discharge relation not permanent; change in control section probably occurred during high water of June or was gradual between June and September. Rating curve used October 1 to June 15, well defined throughout; curve used June 16 to September 30 poorly defined. Gage read to tenths once daily. This reading does not represent accurately the mean daily stage on account of fluctuation caused by artificial regulation. Daily discharge ascertained by applying the 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 height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records fair; winter records poor.

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

Discharge measurements of Minnesota River near Mankato, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 10	R. B. Kilgore	2.15	1,330	Feb. 28[a]	S. B. Soulé	1.59	248
Dec. 22[a]	do	1.90	554	June 15	do	9.13	11,100
Jan. 13[a]	S. B. Soulé	1.71	393	Sept. 29	R. B. Kilgore	1.30	445

[a] Measurement made from complete ice cover.

Daily discharge, in second-feet, of Minnesota River at Mankato, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug	Sept.
1	1,440	1,140	910	490	320	250	21,600	13,800	11,200	7,700	1,750	570
2	1,380	1,140	910	480	320	250	22,100	13,800	12,900	7,340	1,510	520
3	1,380	1,080	860	470	320	250	22,400	13,600	11,800	6,470	1,220	520
4	1,320	1,080	860	460	310	250	25,500	13,400	11,400	5,990	1,360	520
5	1,320	1,080	860	450	310	250	26,900	12,700	10,700	5,830	1,080	520
6	1,320	1,140	860	440	310	260	25,500	12,500	11,200	6,150	945	520
7	1,260	1,140	910	430	310	260	24,700	12,500	11,400	6,470	1,010	520
8	1,320	1,140	910	430	300	260	22,900	12,000	12,500	6,150	1,010	470
9	1,380	1,140	910	420	300	260	24,700	11,600	15,000	5,830	1,080	520
10	1,380	1,140	910	410	300	260	25,000	11,400	15,500	5,530	1,010	520
11	1,260	1,080	910	400	300	270	23,700	10,100	16,000	5,830	945	470
12	1,260	1,080	860	390	290	270	23,400	9,270	16,200	4,950	945	470
13	1,260	1,080	860	390	290	270	21,400	8,490	15,200	4,460	880	470
14	1,200	1,080	860	390	290	270	20,900	7,930	12,500	4,010	880	470
15	1,200	1,080	860	380	280	270	19,400	8,110	10,900	3,760	945	470
16	1,260	1,080	810	370	280	280	18,400	6,880	10,100	3,640	945	470
17	1,260	1,080	760	370	280	280	16,900	6,230	9,050	3,080	945	470
18	1,260	1,080	710	370	280	280	16,000	5,330	8,270	3,080	880	420
19	1,260	1,020	660	370	270	280	15,200	5,770	8,460	2,980	815	470
20	1,260	960	635	360	270	280	14,500	5,620	6,980	2,980	815	470
21	1,200	960	590	360	270	370	14,100	5,920	5,990	3,080	815	470
22	1,200	960	550	360	270	490	14,500	6,230	5,530	3,190	750	520
23	1,200	960	550	360	260	610	14,300	5,770	5,680	3,300	750	420
24	1,200	910	550	350	260	1,080	14,500	5,470	5,090	3,300	690	520
25	1,260	910	530	350	250	1,870	15,000	5,470	8,460	3,190	630	420
26	1,260	960	530	350	250	8,300	14,800	5,620	9,450	3,760	690	420
27	1,200	960	510	340	250	10,300	15,200	5,920	10,300	3,760	690	420
28	1,140	910	510	340	250	12,500	14,500	5,920	10,500	3,520	630	420
29	1,140	910	510	340	.....	14,800	14,300	5,770	9,250	3,190	630	420
30	1,140	910	490	330	.....	14,800	14,300	6,230	8,270	2,680	630	470
31	1,140	.....	490	330	.....	14,800	.....	6,390	.....	2,380	570	.....

NOTE.—Stage-discharge relation affected by ice Dec. 16 to Mar. 31.

Monthly discharge of Minnesota River at Mankato, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 14,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,440	1,140	1,260	0.086	0.10
November	1,140	910	1,040	.071	.08
December	910	490	730	.050	.06
January	490	330	390	.027	.03
February	320	250	285	.020	.02
March	14,800	250	2,750	.188	.22
April	26,900	14,100	19,200	1.32	1.47
May	13,800	5,330	8,570	.587	.68
June	16,200	5,090	10,500	.719	.80
July	7,700	2,380	4,440	.304	.03
August	1,750	570	918	.063	.75
September	570	420	478	.033	.04
The year	26,900	250	4,210	.288	3.92

CHIPPEWA RIVER NEAR WATSON, MINN.

LOCATION.—On line between secs. 10 and 15, T. 118 N., R. 41 W., at highway bridge about 2½ miles northeast of Watson, Chippewa County, about 2 miles below mouth of Dry Weather Creek and 10 miles above mouth of river.

DRAINAGE AREA.—1,940 square miles.

RECORDS AVAILABLE.—Apr. 27, 1910, to September 30, 1917, when station was discontinued. From July 6 to September 17, 1909, four discharge measurements were made at the station.

GAGE.—Chain gage attached to downstream side of the bridge, near left bank of river; read by Clifford Bonde.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge to which gage is attached or by wading a short distance above gage.

CHANNEL AND CONTROL.—Bed consists partly of sand and light gravel and partly clay: shifts somewhat. The right bank slopes gradually, and the width of the stream increases rapidly as stage increases from 10 to 12 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.86 feet April 4 (discharge, assuming there was no backwater from ice jams, about 9,600 second-feet); minimum stage recorded 4.55 feet September 5 (discharge 21 second-feet).

1910–1917: Maximum stage recorded April 4, 1917; minimum stage recorded during open-water periods 3.90 feet August 7, 8, and 9, 1910 (discharge, 5 second-feet). A discharge of 1.7 second-feet was measured by current meter February 9, 1912.

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

ACCURACY.—Stage-discharge relation not permanent; change occurred probably during the high water of April and May. Rating curve used October 1 to November 11, well defined between 358 and 4,250 second-feet; curve used April 6 to September 30, poorly defined throughout. Gage read to hundredths once daily; observations discontinued during winter. Daily discharge ascertained by applying gage height to rating table. Records fair.

Discharge measurements of Chippewa River near Watson, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct. 13	S. B. Soulé	8.09	532
Apr. 13	R. B. Kilgore	13.38	2,780
Sept. 22[a]	do	5.03	65

[a] Made by wading 400 feet above gage.

Daily discharge, in second-feet, of Chippewa River near Watson, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	646	424	3,330	2,300	623	248	86	55
2	646	407	3,330	2,170	623	232	80	32
3	623	407	6,520	2,110	578	217	80	25
4	623	407	9,700	1,990	578	202	100	31
5	600	390	8,620	1,930	578	194	100	21
6	600	374	8,080	1,830	600	187	86	36
7	578	374	7,720	1,780	623	172	86	49
8	578	358	3,680	1,690	600	180	80	31
9	578	358	3,560	1,610	578	172	74	34
10	556	342	3,220	1,530	556	164	80	43
11	556	342	2 930	1,450	535	172	80	23
12	556	.....	2,750	1,410	517	157	86	60
13	556	.....	2,590	1,300	499	164	107	62
14	535	.....	2,440	1,300	463	172	107	41
15	535	.....	2,300	1,240	445	164	114	34
16	515	.....	2,230	1,200	428	164	107	74
17	496	.....	2,050	1,140	411	157	100	52
18	496	.....	1,930	1,100	377	150	107	68
19	477	.....	1,930	1,080	344	142	100	54
20	468	.....	2,300	1,020	344	135	86	62
21	459	.....	2,440	986	328	121	74	74
22	459	.....	2,440	930	328	135	68	68
23	459	.....	2,370	903	312	121	49	74
24	459	.....	2,370	876	296	114	51	51
25	459	.....	2,440	849	280	121	56	80
26	459	.....	2,510	822	264	121	54	62
27	459	.....	2,440	770	248	114	50	44
28	459	.....	2,370	719	296	93	36	74
29	441	.....	2,370	694	280	86	27	44
30	424	.....	2,300	670	264	80	23	33
31	424	.....	.....	670	.....	100	68	.....

NOTE.—Gage not read Oct. 20 and Apr. 3; discharge interpolated.

Monthly discharge of Chippewa River near Watson, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 1,940 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	646	424	519	0.268	0.31
November 1–11	424	342	380	.196	.08
April	9,700	1,930	3,510	1.81	2.02
May	2,300	670	1,290	.665	.77
June	623	248	440	.227	.25
July	248	80	153	.079	.09
August	114	23	77.5	.040	.05
September	80	21	49.7	.026	.03

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, about 2 miles above point where St. Croix River becomes boundary line between Wisconsin and Minnesota, 10 miles northeast of Danbury, Minn., on Minneapolis, St. Paul & Sault Ste. Marie Railway. Namakagon River enters from left about 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, 1917.

GAGE.—Cast-iron staff gage bolted to concrete pier at left end of bridge; read by Capt. Richard Goldschmidt.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Gravel, smooth; acquatic 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 extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 3.05 feet at 6.40 a. m., July 21 (discharge, 2,840 second-feet); minimum discharge estimated at 710 second-feet February 22.

1914–1917: Maximum stage recorded, 6.73 feet at 6.45 a. m., April 22, 1916 (discharge, 8,480 second-feet); minimum discharge, February 22, 1917.

ACCURACY.—Stage-discharge relation practically permanent except as affected by backwater from grass October 1–19, and by ice November 15 to April 4. Two rating curves used during year, applicable as follows: October 1 to April 4, fairly well defined between 1,000 and 7,500 second-feet; April 5 to September 30, fairly well defined between 850 and 7,500 second-feet. Gage read to quarter-tenths twice daily. Daily discharge, except as noted below, ascertained by applying mean daily gage height to rating table; discharge October 1–29 determined by shifting-control method, owing to backwater from grass; discharge November 15 to April 4, estimated, because of ice, 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, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 26 [a]	2.12	863	May 9	1.80	1,680
Jan. 25 [a]	2.28	734	Aug. 18	.90	909
Feb. 27 [a]	2.78	820			

[a] Complete ice cover.

Daily discharge, in second-feet, of St. Croix River at Swiss, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,350	1,270	1,130	850	780	790	2,000	2,070	1,450	1,210	1,170	885
2	1,310	1,270	1,130	865	775	790	2,130	2,070	1,450	1,170	1,130	913
3	1,310	1,270	1,100	880	780	790	2,200	2,070	1,450	1,130	1,060	864
4	1,350	1,270	1,100	870	730	800	2,280	1,980	1,450	1,060	1,020	815
5	1,310	1,270	1,070	865	790	815	2,270	1,890	1,490	1,130	983	843
6	1,270	1,200	1,070	855	805	810	2,070	1,800	1,490	1,290	990	885
7	1,270	1,200	1,040	850	800	810	2,070	1,760	1,530	1,410	990	878
8	1,240	1,270	1,010	860	790	905	2,170	1,710	1,530	1,450	1,100	906
9	1,200	1,240	980	865	780	1,000	2,070	1,620	1,530	1,450	1,100	885
10	1,160	1,270	950	860	765	1,020	1,980	1,580	1,490	1,410	1,060	843
11	1,200	1,200	890	855	760	1,040	2,070	1,530	1,450	1,450	1,020	857
12	1,200	1,130	865	860	750	1,040	1,980	1,450	1,370	1,450	1,020	962
13	1,240	1,130	840	865	760	1,040	1,980	1,410	1,290	1,370	983	1,130
14	1,240	1,070	815	830	765	1,070	1,980	1,370	1,250	1,330	955	1,210
15	1,200	1,040	790	790	760	1,100	1,890	1,370	1,210	1,250	934	1,210
16	1,200	1,010	790	765	755	1,120	1,800	1,330	1,170	1,250	934	1,170
17	1,240	1,010	790	740	745	1,140	1,800	1,290	1,170	1,210	920	1,130
18	1,270	1,010	815	735	740	1,160	1,800	1,290	1,130	1,130	920	1,060
19	1,310	1,040	815	730	735	1,190	1,890	1,290	1,170	1,100	934	990
20	1,350	1,070	815	740	730	1,280	2,070	1,250	1,210	2,370	913	955
21	1,350	1,100	815	750	720	1,380	2,170	1,210	1,250	2,780	892	934
22	1,350	1,130	840	760	710	1,440	2,170	1,210	1,250	2,470	885	920
23	1,310	1,130	840	765	715	1,500	2,170	1,170	1,250	2,370	906	906
24	1,310	1,160	865	775	720	1,560	2,070	1,130	1,290	2,070	920	892
25	1,310	1,160	865	785	750	1,630	2,070	1,130	1,370	1,710	906	864
26	1,270	1,160	865	780	780	1,740	2,070	1,130	1,450	1,530	927	843
27	1,310	1,160	860	780	820	1,860	1,980	1,100	1,490	1,410	913	850
28	1,310	1,130	850	780	800	1,820	1,980	1,060	1,450	1,290	885	878
29	1,270	1,130	845	775	.....	1,770	1,980	1,100	1,370	1,170	878	885
30	1,270	1,130	840	780	.....	1,820	2,070	1,130	1,330	1,100	892	864
31	1,240	.....	845	790	.....	1,860	.....	1,290	.....	1,060	864	.....

Monthly discharge of St. Croix River at Swiss, Wis., for the year ending Sept. 30, 1917.

[Drainage area 1,550 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,350	1,160	1,270	0.819	0.94
November	1,270	1,010	1,150	.742	.83
December	1,130	790	908	.586	.68
January	880	730	808	.521	.60
February	820	710	763	.492	.51
March	1,860	790	1,230	.794	.92
April	2,280	1,800	2,040	1.32	1.47
May	2,070	1,060	1,440	.929	1.07
June	1,530	1,130	1,360	.877	.98
July	2,780	1,060	1,470	.948	1.09
August	1,170	864	968	.625	.72
September	1,210	815	941	.607	.68
The year	2,780	710	1,200	.774	10.49

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

DRAINAGE AREA.—5,930 square miles.

RECORDS AVAILABLE.—January 10, 1902, to June 30, 1905; January 1, 1910, to September 30, 1917. 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 during year, 17,700 second-feet April 5; minimum daily discharge 1,120 second-feet January 1, 1917.

1902–1905 and 1910–1917: Maximum daily discharge 35,100 second-feet April 23, 1916; minimum daily discharge 75 second-feet July 17, 1910. Minimum discharge 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 any discharge measurements been made by engineers of the United States Geological Survey; probably reliable.

COOPERATION.—Records furnished by the Minneapolis General Electric Co.

Daily discharge, in second-feet, of St. Croix River near St. Croix Falls, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,670	3,730	2,080	1,120	1,690	1,710	8,220	8,600	3,650	2,580	4,090	1,980
2	3,300	2,740	3,040	1,620	1,540	1,710	9,520	8,340	3,290	3,470	3,760	2,030
3	2,780	2,750	1,980	1,760	2,090	1,990	10,400	8,780	2,590	2,950	2,680	1,880
4	3,710	3,100	2,180	1,640	1,430	1,350	11,000	8,160	3,640	2,380	2,460	1,970
5	2,900	2,550	2,190	1,720	1,390	1,740	17,700	8,110	3,770	3,020	2,640	2,120
6	2,900	2,420	2,480	2,150	1,600	1,710	16,700	5,490	3,800	3,330	2,360	2,140
7	3,000	2,540	2,370	1,440	1,650	1,780	16,400	5,480	3,800	3,230	2,710	2,220
8	2,440	2,810	2,250	1,690	1,700	1,780	11,100	6,030	3,980	2,500	2,790	2,070
9	3,040	2,550	2,950	1,780	1,590	1,690	10,400	4,420	3,790	3,600	2,790	1,710
10	2,420	2,600	1,550	1,650	2,000	2,040	10,200	4,950	2,520	3,680	2,730	1,830
11	2,350	2,510	1,360	1,740	1,360	1,510	11,100	4,190	3,680	3,830	2,740	1,740
12	3,000	2,040	1,580	1,770	1,600	1,730	10,400	4,260	3,880	3,680	2,540	2,420
13	2,990	2,430	1,690	2,080	1,660	1,790	10,200	4,220	3,850	3,640	2,700	1,800
14	2,900	1,900	1,360	1,290	1,640	1,750	8,760	4,150	3,960	3,760	2,680	2,100
15	2,360	1,210	1,510	1,680	1,680	1,730	6,600	3,910	3,930	3,030	2,700	2,120
16	2,970	1,660	1,540	1,680	1,700	1,730	12,500	3,940	3,840	3,510	2,630	1,930
17	2,630	1,890	1,490	1,630	1,940	1,890	8,530	4,050	2,540	3,750	2,503	2,170
18	2,870	2,890	1,640	2,040	1,450	1,450	6,810	3,840	3,680	3,760	2,450	2,530
19	3,310	1,690	1,700	1,570	1,710	1,680	6,940	3,840	3,900	3,780	2,380	2,700
20	2,960	2,420	1,730	1,920	1,700	1,800	7,460	2,590	4,070	3,690	2,230	2,640
21	3,320	2,940	1,660	1,320	1,760	1,840	8,200	4,170	3,870	3,750	2,430	2,650
22	2,510	2,290	1,510	1,600	1,690	1,940	7,260	4,080	3,950	3,660	2,250	2,580
23	3,450	2,300	2,300	1,660	1,660	2,220	8,240	4,230	3,240	5,820	2,150	2,280
24	3,580	2,230	1,780	1,670	1,940	2,620	8,700	3,890	2,480	3,870	2,150	2,590
25	3,140	3,240	1,220	1,620	1,530	1,920	8,860	3,840	3,380	4,210	2,190	2,760
26	3,040	1,390	1,690	1,500	1,650	2,450	8,640	3,760	3,020	3,920	2,210	2,480
27	3,140	1,140	1,650	2,000	1,660	2,720	7,780	2,440	3,600	3,920	2,220	2,380
28	3,180	2,030	1,740	1,280	1,690	3,080	8,550	2,670	3,620	3,860	1,990	2,510
29	2,710	2,620	1,720	2,020	.....	3,170	6,650	3,700	3,400	3,140	2,070	2,350
30	3,380	2,240	2,320	1,660	.....	3,560	8,000	2,480	3,350	3,790	2,080	2,120
31	3,240	.....	1,780	1,720	.....	5,220	.....	3,640	.....	4,000	2,100	.....

Monthly discharge of St. Croix River near St. Croix Falls, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 5,930 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,710	2,350	2,970	0.501	0.58
November	3,730	1,140	2,360	.398	.44
December	3,040	1,220	1,870	.315	.36
January	2,150	1,120	1,680	.283	.33
February	2,090	1,360	1,670	.282	.29
March	5,220	1,350	2,110	.356	.41
April	17,700	6,600	9,730	1.64	1.83
May	8,780	2,440	4,720	.796	.92
June	4,070	2,480	3,540	.597	.67
July	5,820	2,380	3,580	.604	.70
August	4,090	1,990	2,530	.427	.49
September	2,760	1,710	2,230	.376	.42
The year	17,700	1,120	3,250	.548	7.44

NOTE.—Monthly and yearly discharge computed by engineers of the U. S. Geological Survey from records of daily discharge furnished by the 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, about 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, 1917.

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.—Bed composed of 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, 2.3 feet April 4 (discharge, 803 second-feet); minimum discharge estimated, 235 second-feet December 19.

1914–1917: Maximum stage recorded, 3.0 feet April 23, 1916 (discharge, 1,330 second-feet); minimum discharge estimated, 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; extended below 330 second-feet by estimation. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for period in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table 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 Namakagon River at Trego, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 8 [a]	2.21	273	Mar. 8 [a]	2.83	327
Feb. 3 [a]	2.70	334	Aug. 17	1.65	398

[a] Complete ice cover at control section.

Daily discharge, in second-feet, of Namakagon River at Trego, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	564	472	472	280	300	280	488	733	472	472	393	350
2	332	444	472	280	320	290	444	733	502	444	393	332
3	350	472	472	290	330	305	624	698	502	472	369	320
4	369	472	458	300	320	300	803	664	532	472	369	369
5	532	472	444	290	300	295	786	698	532	472	369	417
6	564	393	430	290	290	300	768	733	502	532	369	350
7	502	393	417	280	290	300	786	698	564	597	393	350
8	472	472	430	270	290	325	803	664	597	532	472	332
9	369	472	444	290	290	320	768	614	564	472	444	393
10	472	417	388	310	300	315	733	564	502	532	444	369
11	472	393	332	310	300	310	750	548	502	564	417	350
12	472	369	310	300	280	310	768	532	472	597	393	332
13	502	369	290	290	270	305	682	532	472	597	393	369
14	472	350	270	280	280	330	597	532	472	564	417	369
15	472	330	260	270	290	350	597	532	472	502	369	350
16	472	350	250	260	280	340	597	502	472	472	393	332
17	532	370	245	280	280	330	648	502	472	502	369	332
18	532	395	240	300	270	340	698	472	417	444	369	320
19	532	417	235	300	260	350	733	472	502	444	369	332
20	502	474	240	300	260	330	768	472	502	472	332	332
21	532	532	245	280	270	330	786	472	532	564	369	332
22	502	502	245	260	280	340	803	472	502	532	393	320
23	393	472	250	260	290	350	768	472	532	564	369	320
24	417	402	250	255	290	360	733	472	532	472	369	320
25	502	332	255	280	280	370	716	472	532	472	393	332
26	472	362	255	310	290	395	698	444	597	417	320	332
27	472	393	300	280	300	417	698	444	532	417	320	350
28	472	462	300	260	300	430	698	393	564	444	369	350
29	417	532	310	290	.....	444	716	417	532	417	393	332
30	393	502	290	310	.....	488	733	472	502	393	369	332
31	472	.....	280	300	.....	532	.....	502	.....	369	393	.....

NOTE.—Stage-discharge relation affected by ice Nov. 14–18 and Dec. 12 to Mar. 26. Gage read every other day Nov. 20 to May 11; discharge for intervening days estimated.

Monthly discharge of Namakagon River at Trego, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 420 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	564	332	469	1.12	1.29
November	532	330	426	1.01	1.13
December	472	235	325	.774	.89
January	310	255	286	.681	.79
February	330	260	289	.688	.72
March	532	280	348	.829	.96
April	803	444	706	1.68	1.87
May	733	393	546	1.30	1.50
June	597	417	513	1.22	1.36
July	597	369	491	1.17	1.35
August	472	320	384	.914	1.05
September	417	320	344	.819	.91
The year	803	235	428	1.02	13.82

KETTLE RIVER NEAR SANDSTONE, MINN.

LOCATION.—Near south line of sec. 34, T. 43 N., R. 20 W., at quarries of Barber Asphalt Co. at Banning, 3 miles above Sandstone, Pine County.

DRAINAGE AREA.—825 square miles.

RECORDS AVAILABLE.—October 18, 1908, to December 7, 1916, when station was discontinued.

GAGE.—Vertical staff in two sections, bolted to rock wall on right bank of river, about 300 feet above the steam power house of the Barber Asphalt Co.; read by F. L. Betts.

DISCHARGE MEASUREMENTS.—Made from highway bridge about a mile above gage.

EXTREMES OF DISCHARGE.—1908–1916: Maximum stage recorded, 7.7 feet, April 24, 1916 (discharge, 10,600 second-feet); minimum stage recorded, 0.7 foot, November 30, 1912 (discharge about 12 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; not, however, for so long a period as at most gaging stations in the same latitude, owing to the fact that a decided rapids about 50 feet below the gage constitutes the control. The published records of winter discharge to which the open-channel rating curve is not applicable, have been based on gage readings and a comparison of the records with those for Snake River.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined from 52 to 5,940 second-feet; above 5,940 second-feet it is an extension. Gage read daily to quarter-tenths. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Daily discharge, in second-feet, of Kettle River near Sandstone, Minn., for the period Oct. 1 to Dec. 7, 1917.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	201	250	173	11	186	186	.....	21	216	112	.....
2	201	233	186	12	186	186	.....	22	216	124	.....
3	183	233	186	13	201	173	.....	23	201	136	.....
4	183	233	186	14	201	173	.....	24	201	136	.....
5	186	233	186	15	201	160	.....	25	201	136	.....
6	173	233	186	16	201	148	.....	26	216	136	.....
7	173	216	186	17	216	136	.....	27	233	148	.....
8	160	216	.....	18	216	124	.....	28	233	148	.....
9	173	216	.....	19	250	124	.....	29	233	160	.....
10	173	201	.....	20	216	112	.....	30	250	173	.....
								31	250	.....	.....

Monthly discharge of Kettle River near Sandstone, Minn., for the period Oct. 1, to Dec. 7, 1916.

[Drainage area, 825 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	250	160	204	0.247	0.29
November	250	112	173	.210	.23
December 1–7	186	173	184	.223	.06

SNAKE RIVER NEAR PINE CITY, MINN.

LOCATION.—In sec. 26 T. 39 N., R. 21 W., at Changwatana power station of Eastern Minnesota Power Co., 600 feet below dam belonging to that company, 3,500 feet below Cross Lake, 2 miles below Pine City, and about 11 miles above the mouth, in Pine County.

DRAINAGE AREA.—915 square miles.

RECORDS AVAILABLE.—June 26, 1913, to September 30, 1917, when station was discontinued.

GAGE.—Staff gage attached to stone retaining wall in front of the power plant on the left bank of the river; read by E. W. Barnum, and other employees of the Eastern Minnesota Power Co. This gage is used for determining the flow over the dam during periods when all of the flow does not pass through the turbines.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge about 1,800 feet above the gage.

CHANNEL AND CONTROL.—Bed of stream rock and heavy gravel; banks in vicinity of gage high and not likely to be overflowed. Zero flow at stage 0.2 foot.

DETERMINATION OF FLOW.—Flow determined by adding to the flow through the turbines the flow over the crest of the dam as obtained from readings of the staff gage. The flow through the turbines is computed from hourly records of the gate openings and head.

EXTREMES OF DISCHARGE.—Maximum daily discharge, 4,580 second-feet, April 6; minimum daily discharge, 59 second-feet, January 28 and March 4.

1913–1917: Maximum discharge 7,315 second-feet, April 25, 1916; minimum discharge 33 second-feet, February 11, 1914.

WINTER FLOW.—All water goes through the wheels in winter; flow estimated from gate openings and head.

REGULATION.—Power plant at the station is operated with a varying load for light and power, causing daily and weekly fluctuations in discharge at low stages. No appreciable regulation above plant.

ACCURACY.—When the flow is about 200 second-feet or less, the greater part of it passes through the power plant and is estimated from turbine gate openings and head on the wheels, an hourly record of which is kept at the plant. The results of this determination can be considered only fair. As the volume of flow increases a larger portion passes by the plant as waste, at very high stages by far the greater part of the discharge is waste; this part of the discharge is determined from gage heights read from a gage in the river opposite the power plant. Stage-discharge relation for river gage permanent. Rating curve well defined throughout. Gage read to hundredths every four hours. Daily discharge ascertained by applying each gage height to the rating table, and taking the mean of the six determinations of discharge. Records of total flow at the station range from fair for low stages to excellent for high stages.

COOPERATION.—The hourly records of gate openings of the turbines and head, and reading of the river gage are furnished by the Eastern Minnesota Power Co. Records for last part of current year computed by the employees of the company by use of rating curves prepared by the engineers of the Survey.

Daily discharge, in second-feet, of Snake River near Pine City, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	203	264	128	81	71	75	547	1,230	293	93	162	76
2	279	258	138	81	71	76	1,120	1,460	306	174	137	86
3	286	262	94	81	69	74	1,860	1,170	199	176	133	76
4	273	267	137	81	64	59	2,700	1,160	270	96	159	78
5	291	234	139	81	67	77	3,920	1,070	284	211	115	82
6	273	248	136	82	69	76	4,580	1,050	287	335	144	98
7	243	260	139	73	69	77	4,440	968	290	253	172	96
8	181	251	139	83	69	78	4,190	922	288	100	167	77
9	258	249	140	79	70	78	3,770	799	262	271	152	98
10	260	241	99	79	69	78	3,330	750	175	358	142	96
11	254	245	126	76	60	64	2,910	686	257	370	163	82
12	250	132	135	76	70	83	2,520	587	303	395	123	105
13	247	212	137	76	70	77	2,240	533	291	382	194	119
14	246	239	129	70	70	76	1,940	545	283	360	167	121
15	125	235	127	76	71	78	1,690	471	260	297	157	124
16	226	229	128	76	71	78	1,490	449	234	339	157	85
17	243	169	100	77	72	79	1,250	398	115	268	160	138
18	231	138	116	75	62	70	1,220	351	188	225	155	139
19	245	99	118	74	73	83	1,100	412	212	207	121	138
20	242	132	115	69	73	79	1,080	309	212	232	142	138
21	243	143	104	64	73	81	1,120	364	202	231	145	138
22	216	144	102	70	73	79	1,180	360	184	163	139	138
23	234	144	100	70	75	89	1,340	359	195	251	147	113
24	235	146	87	70	72	96	1,410	364	114	242	131	130
25	243	143	97	71	64	76	1,450	304	200	240	134	127
26	224	97	99	71	76	96	1,480	254	202	215	113	120
27	227	131	96	71	76	109	1,400	137	190	191	133	120
28	231	138	97	59	75	117	1,300	241	178	200	125	118
29	133	139	96	71	.....	133	1,260	247	168	111	119	117
30	229	105	95	71	.....	198	1,230	160	173	186	108	101
31	268	.....	73	71	.....	388	.....	274	.....	185	101	.....

Monthly discharge of Snake River near Pine City, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 915 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	291	125	237	0.259	0.30
November	267	97	190	.208	.23
December	140	73	115	.126	.15
January	83	59	74.3	.081	.09
February	76	60	70.1	.077	.08
March	388	59	96.0	.105	.12
April	4,580	547	2,040	2.23	2.49
May	1,460	137	593	.648	.75
June	306	114	227	.248	.28
July	395	93	237	.259	.30
August	194	101	142	.155	.18
September	139	76	109	.119	.13
The year	4,580	59	343	.376	5.10

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, 1917.

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 the day from a record of the number of wheels in operation and the load; the sum of the discharge divided by 24 gives the average discharge through the turbines. To this quantity is added the leakage through the average number of wheels idle each day, the sum giving the daily flow through the power house. Water is seldom wasted over the spillway of the dam, but when it is so wasted the quantity is computed from weir formulas and added to the flow through the plant. There is a constant leakage through the gate and flashboards amounting to 3 second-feet. This quantity has not been taken into consideration in computing the published records.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 966 second-feet, April 6; minimum daily discharge, 62 second-feet October 26.

1904–1917: Maximum daily discharge, 2,280 second-feet in June, 1905; minimum daily discharge, 38 second-feet May 10, 1910. Minimum discharge caused by regulation. Records of maximum and minimum discharge, 1901–1903, not available.

REGULATION.—There are a number of power plants on Apple River above the 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.—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 12 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 the St. Paul Gas Light Co., of St. Paul, Minn., F. L. Cross, general manager.

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

Daily discharge, in second-feet, of Apple River near Somerset, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	136	216	292	195	211	262	741	547	351	339	261	229
2	234	265	234	258	219	230	910	510	524	324	259	127
3	211	278	216	259	200	253	893	487	492	273	187	175
4	303	231	294	265	233	172	913	459	519	280	247	181
5	278	81	329	275	201	267	944	388	479	300	138	166
6	238	292	277	256	269	264	966	222	398	314	181	202
7	252	214	275	134	277	252	896	343	333	350	217	168
8	245	265	278	261	161	246	885	459	301	192	169	200
9	235	296	319	215	229	271	865	470	365	320	204	186
10	265	275	138	201	245	298	831	377	401	319	166	169
11	254	266	223	202	197	254	799	352	418	321	262	126
12	290	188	185	194	221	281	759	302	355	311	150	222
13	306	255	215	235	249	284	629	311	312	293	220	162
14	296	264	153	155	252	283	578	379	289	279	241	214
15	136	255	233	212	246	290	631	349	296	255	194	245
16	232	228	206	204	257	293	679	291	303	307	204	121
17	237	265	263	235	262	272	519	312	169	306	211	193
18	186	247	242	251	146	190	348	291	236	280	260	182
19	265	195	230	253	252	292	506	266	306	312	136	188
20	274	268	264	233	254	304	652	169	297	314	200	184
21	265	278	245	205	247	295	658	279	344	359	195	290
22	62	274	243	213	159	300	462	263	258	240	205	252
23	291	296	275	220	264	317	338	204	341	316	206	151
24	215	247	171	230	226	579	489	209	237	290	202	206
25	249	273	203	257	192	437	555	277	299	276	227	236
26	276	151	272	252	257	397	625	282	456	296	213	210
27	250	363	224	223	223	471	431	163	373	232	286	197
28	315	250	237	216	244	534	367	256	367	269	253	210
29	68	319	209	237	.....	599	472	300	295	128	204	256
30	301	153	242	218	.....	575	691	217	339	274	106	147
31	247	.....	234	202	.....	736	.....	326	.....	313	196	.....

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

Monthly discharge of Apple River near Somerset, Wis., for the year ending Sept. 30, 1917

[Drainage area, 550 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	315	62	239	0.435	0.50
November	363	81	248	.451	.50
December	329	138	239	.435	.50
January	275	134	225	.409	.47
February	277	146	228	.415	.43
March	736	172	339	.616	.71
April	966	338	668	1.21	1.35
May	547	163	325	.591	.68
June	524	169	348	.633	.71
July	359	128	290	.527	.61
August	286	106	206	.375	.43
September	290	121	193	.351	.39
The year	966	62	296	.538	7.28

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, 1917.

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.—Bed composed of rather heavy gravel and sand; control is head of small rapids 150 feet below the gage. High water will wash out and fill in this control section, causing small changes.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.66 feet 4.30 p. m. March 27 (discharge, about 1,900 second-feet); minimum stage recorded, 1.7 feet (discharge, about 15 second-feet), occurred several times following complete shutdown. The maximum is about the natural maximum; minimum 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, however, relatively small, and the monthly flow is considered to be nearly the normal flow.

ACCURACY.—Stage-discharge relation not permanent. Three rating curves used as follows: October 22 to March 25, well defined between 0 and 120 second-feet; March 26 to July 18, fairly well defined between 15 and 400 second-feet, extended and subject to error above and below these limits; July 19 to September 30, 1917, poorly defined throughout. Continuous gage record obtained by recording gage, except during a portion of January and February, when gage well was frozen. Daily discharge ascertained by means of discharge integrator, except during last part of January and February, when it was estimated. Open-water records good, except those for high water, which are fair; winter records subject to some error.

Discharge measurements of Kinnikinnic River near River Falls, Wis., during the years ending Sept. 30, 1916 and 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1916.		*Feet.*	*Sec.-ft.*	1916-17.		*Feet.*	*Sec.-ft.*
Sept. 21	W. G. Hoyt	2.39	70	Feb. 15	R. B. Kilgore	2.53	86
1916-17.				Apr. 4	do	2.36	78
Oct. 18	R. B. Kilgore	2.44	68	June 4	do	3.38	344
22	do	1.88	15	4	do	1.90	22
Dec. 4	do	2.40	67	4	do	1.89	20
Jan. 16	do	2.50	84	Aug. 9	do	1.82	18
				9	do	3.24	358

Daily discharge, in second-feet, of Kinnikinnic River near River Falls, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	61	57	80	65	53	331	67	85	50	89	60
2	.....	62	81	104	65	45	195	65	73	108	62	81
3	.....	61	35	102	65	51	126	66	76	76	56	49
4	.....	72	79	97	65	66	132	64	156	72	74	74
5	.....	54	54	94	65	67	106	69	117	133	57	91
6	.....	92	54	82	65	82	104	44	97	124	58	74
7	.....	70	78	33	65	112	89	79	78	93	79	68
8	.....	59	47	54	65	76	66	74	78	96	72	79
9	.....	80	56	57	65	75	82	55	82	160	63	76
10	.....	57	49	51	65	96	74	68	86	112	52	74
11	.....	86	83	53	65	64	76	63	83	167	80	56
12	.....	39	63	61	65	78	65	73	88	138	80	74
13	.....	72	61	60	65	86	60	46	49	84	66	79
14	.....	40	53	53	65	66	69	59	102	92	66	88
15	.....	53	60	72	67	68	60	66	96	73	72	73
16	.....	62	74	73	67	82	79	58	64	140	58	76
17	.....	71	60	71	89	71	72	60	108	107	60	80
18	.....	64	80	71	60	62	62	63	160	90	57	76
19	.....	48	102	70	60	96	68	78	54	85	44	83
20	.....	69	74	65	60	82	68	84	94	78	81	87
21	.....	57	79	78	60	64	76	58	61	66	67	74
22	.....	59	77	69	60	103	64	84	78	78	72	62
23	61	77	84	68	60	58	72	59	89	78	63	46
24	63	60	75	65	60	128	75	61	210	76	56	86
25	85	62	65	69	40	375	76	53	361	74	65	62
26	54	47	124	66	62	908	74	95	232	74	58	78
27	56	73	82	65	63	1,300	62	61	132	74	68	80
28	56	57	76	65	64	1,110	74	73	114	69	70	75
29	55	62	87	65	.....	1,030	63	104	126	83	64	75
30	95	48	88	65	.....	920	80	108	48	68	67	70
31	61	.....	123	65	.....	938	.....	84	.....	62	70	.....

NOTE.—Gage well frozen Jan. 27 to Feb. 28; discharge estimated. Discharge determined from gage-height record for less than the 24-hour period, Oct. 28, 29, Nov. 15–17, Dec. 23–24, 30, 31, Jan. 6, 7, 13, 14, 21–26, June 9, and Sept. 28–29.

Monthly discharge of Kinnikinnic River near River Falls, Wis., for the year ending Sept. 30, 1917.

[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 23–31	.....	.....	65.1	0.383	0.13
November	92	39	62.5	.368	.41
December	124	35	72.9	.429	.49
January	104	33	69.1	.406	.47
February	.....	.....	63.6	.374	.39
March	1,300	45	271	1.59	1.83
April	331	60	90.0	.529	.59
May	108	44	69.1	.406	.47
June	361	48	109	.641	.72
July	167	50	92.9	.546	.63
August	89	44	66.2	.389	.45
September	91	46	73.5	.432	.48

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, 1917.

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 MEASUREMENTS.—Made from downstream side of highway bridge.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.23 feet at 9 a. m. April 22 (discharge, 3,020 second-feet); minimum discharge estimated at 175 second-feet February 17.

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

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

ACCURACY.—Stage-discharge relation permanent except as effected 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 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 the rating table daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records; discharge for periods of April and May, when logs were present, interpolated. Open-water records excellent except those for April and May which are fair; winter records good.

Discharge measurements of Chippewa River at Bishop's Bridge, near Winter, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 24	5.36	883	Mar. 9[a]	6.01	233
Jan. 5[a]	5.36	269	Aug. 14	4.45	309
Feb. 5[a]	5.53	211			

[a] Complete ice cover.

Daily discharge, in second-feet, of Chippewa River at Bishop's Bridge, near Winter, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	750	710	405	340	230	210	590	2,440	915	1,200	360	340
2	710	675	530	320	225	210	630	2,540	1,000	1,000	340	322
3	675	675	405	305	210	210	635	2,640	1,000	915	322	304
4	610	640	405	285	210	210	690	2,740	1,100	915	322	304
5	580	640	405	270	210	210	675	2,840	1,400	830	322	304
6	555	640	505	260	210	205	680	2,700	1,520	1,150	322	304
7	530	675	405	255	210	215	675	2,270	1,740	1,400	322	304
8	505	710	405	255	210	225	800	1,830	1,620	1,400	340	304
9	555	710	322	255	210	230	830	1,400	1,520	1,400	340	304
10	555	750	285	250	210	240	830	1,350	1,520	1,350	360	304
11	530	750	270	240	200	255	915	1,400	1,520	1,350	360	304
12	530	750	255	240	195	265	1,000	1,290	1,400	1,300	360	340
13	675	750	255	240	190	265	1,050	1,190	1,200	1,100	340	360
14	790	790	240	225	180	320	1,100	1,080	1,100	960	322	430
15	870	750	240	210	190	330	1,150	975	1,000	870	304	430
16	1,000	750	240	210	195	350	1,250	870	915	790	304	430
17	1,100	610	240	210	175	380	1,200	870	790	675	304	430
18	1,150	640	240	210	195	390	1,300	1,050	710	610	304	455
19	1,100	580	240	210	210	430	1,400	1,150	710	580	304	480
20	1,100	555	240	220	210	435	1,960	1,100	790	640	287	480
21	1,000	530	255	225	225	435	2,520	1,050	750	675	287	455
22	1,000	505	285	230	225	440	2,980	1,050	750	675	270	430
23	915	480	340	240	210	485	2,840	1,000	870	610	287	380
24	830	405	360	240	210	485	2,700	960	1,050	555	287	360
25	830	405	380	240	210	495	2,840	915	1,200	530	287	360
26	790	405	380	230	225	510	2,700	830	1,400	505	304	360
27	790	405	380	225	210	530	2,440	790	1,300	480	304	360
28	750	430	380	225	225	535	2,180	580	1,350	430	287	360
29	710	430	360	225	.....	565	2,240	304	1,350	405	304	380
30	710	455	340	230	.....	590	2,310	530	1,350	380	322	380
31	710	.....	340	240	.....	580	.....	790	.....	380	322	.....

NOTE.—Stage-discharge relation affected by ice Nov. 25–28 and Dec. 10 to Apr. 9; discharge interpolated, because of logs on control, Apr. 11, 18, 20, 21, 23, 29, May 2–4, 7, 8, and 12–15.

Monthly discharge of Chippewa River at Bishop's Bridge, near Winter, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 775 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,150	505	771	0.995	1.15
November	790	405	607	.783	.87
December	530	240	333	.430	.50
January	340	210	244	.315	.36
February	230	175	208	.268	.28
March	590	205	362	.467	.54
April	2,980	590	1,500	1.94	2.16
May	2,840	304	1,370	1.77	2.04
June	1,740	710	1,160	1.50	1.67
July	1,400	380	841	1.09	1.26
August	360	270	316	.408	.47
September	480	304	369	.476	.53
The year	2,980	175	675	.871	11.83

CHIPPEWA RIVER NEAR BRUCE, WIS.

LOCATION.—In sec. 4, T. 35 N., R. 7 W., at Minneapolis, St. Paul & Sault Ste. Marie Railway bridge 1 mile east of Bruce, Rush County. Thornapple River enters from the left immediately above the station, and Flambeau River from the left about 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, 1917.

GAGE.—Chain gage, attached to downstream side of Minneapolis, St. Paul & Sault Ste. Marie Railway 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, 8.05 feet April 21 (discharge, 7,060 second-feet); minimum discharge estimated 310 second-feet during January and February.

1910–1917: Maximum stage recorded: 12.3 feet at 5.45 p. m., April 22, 1916 (discharge 13,400 second-feet); minimum discharge, about 310 second-feet during January and February, 1917.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Flow modified to some extent by reservoir on the West Fork of Chippewa River, in sec. 14, T. 41 N., R. 6 W. 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. Rating curves poorly defined. Gage read to quarter tenths twice daily. 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 height 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 near Bruce, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 26	R. B. Kilgore	2.76	1,310	Mar. 12[a]	R. B. Kilgore	3.68	408
Jan. 9[a]	E. L. Williams	3.06	426	May 14	do	3.40	1,800
Feb. 7[a]	R. B. Kilgore	3.25	392	Aug. 15	do	1.33	313

[a] Complete ice cover.

Daily discharge, in second-feet, of Chippewa River near Bruce, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,230	1,140	1,050	650	310	340	1,040	4,840	3,400	1,800	575	430
2	1,140	1,140	1,050	615	310	360	1,440	4,600	3,100	1,600	690	380
3	1,050	1,050	970	580	310	390	1,830	4,300	2,600	1,400	430	480
4	1,010	1,050	890	545	340	390	2,060	3,900	2,500	1,200	540	380
5	970	1,050	890	510	370	385	2,290	3,600	2,600	1,200	510	540
6	890	1,010	890	510	390	380	2,970	3,300	2,900	1,800	405	380
7	890	1,010	930	475	405	370	3,980	3,100	4,200	3,100	510	540
8	850	1,230	890	440	390	405	3,980	3,000	4,200	3,200	540	326
9	850	1,520	850	425	370	440	3,870	2,600	4,000	2,800	480	575
10	890	1,720	810	410	370	420	3,900	2,500	3,000	2,400	610	455
11	890	1,520	810	400	370	405	4,840	2,300	2,600	2,300	510	405
12	930	1,520	770	390	370	405	5,200	2,200	2,400	2,200	690	430
13	970	1,320	730	380	370	405	4,300	2,100	2,300	2,100	610	455
14	1,230	690	690	370	355	450	4,000	2,000	2,000	1,800	540	510
15	1,320	615	650	365	340	495	3,400	1,900	1,700	1,600	326	610
16	1,420	1,520	615	360	355	520	3,100	1,600	1,500	1,400	575	340
17	1,720	1,420	580	355	370	545	3,100	1,800	1,400	1,100	310	610
18	1,720	1,320	580	350	355	600	3,400	1,700	1,200	1,100	480	610
19	1,720	1,230	545	340	340	650	4,400	1,800	1,100	890	480	455
20	1,720	1,230	510	330	355	690	5,680	1,800	690	1,060	455	540
21	1,620	1,140	475	320	370	730	7,000	1,900	1,300	1,500	430	540
22	1,520	1,050	440	310	390	750	6,760	1,800	1,400	1,300	430	510
23	1,520	1,050	440	310	405	770	5,800	1,500	890	1,200	430	480
24	1,320	970	440	310	390	790	4,840	1,600	810	1,200	455	810
25	1,320	970	440	310	370	810	4,300	1,500	1,900	930	282	510
26	1,320	970	475	310	370	830	4,000	1,100	2,100	930	650	350
27	1,320	1,050	510	310	370	850	4,000	1,020	2,100	610	326	575
28	1,230	1,050	580	310	355	870	4,000	1,020	1,700	890	455	510
29	1,230	1,050	615	310	.....	890	4,100	1,020	2,000	930	380	510
30	1,140	1,050	650	310	.....	950	4,600	1,060	1,800	610	370	510
31	1,140	.....	650	310	.....	1,010	.....	2,200	.....	610	480	.....

NOTE.—Stage-discharge relation affected by ice Nov. 16 to Dec. 1 and Dec. 9 to April 10.

Monthly discharge of Chippewa River near Bruce, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 1,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,720	850	1,230	0.769	0.89
November	1,720	615	1,160	.725	.81
December	1,050	440	691	.432	.50
January	650	310	394	.246	.28
February	405	310	363	.227	.24
March	1,010	340	590	.369	.43
April	7,000	1,040	3,940	2.46	2.74
May	4,840	1,020	2,280	1.42	1.64
June	4,200	690	2,180	1.36	1.52
July	3,200	610	1,510	.944	1.09
August	690	282	482	.301	.35
September	810	326	492	.308	.34
The year	7,000	282	1,280	.800	10.83

CHIPPEWA RIVER AT CHIPPEWA FALLS, WIS.

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

DRAINAGE AREA.—5,600 square miles.

RECORDS AVAILABLE.—June 22, 1888, to September 30, 1917. The gage was originally established by the Chippewa Lumber & Boom Co., which has kept a continuous record since 1889. Since 1904 the United States Weather Bureau has obtained gage readings during the 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 Friez water-stage recorder which was installed January, 1914, on web between cushing piers supporting first right-hand span and about 10 feet upstream from the gage formerly used by United States Weather Bureau; gage referred to the 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, 8.32 feet at 12 a. m., April 23 (discharge 24,900 second-feet); minimum discharge estimated 40 second-feet February 4; on this date all gates and other openings in the Wissota plant of the Wisconsin & Minnesota Light & Power Co. were closed, the discharge of 40 second-feet being the inflow between the dam and the station.

1888–1917: Maximum stage recorded, 26.03 feet December 6, 1896. September 10, 1884, a stage of 26.94 feet was reached; discharge not estimated. Minimum discharge recorded February 4, 1917.

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

REGULATION.—From October to January 15 little fluctuation was caused by the operation of power plant about half a mile above gage. Considerable fluctuation was, however, caused by the operation of larger plants above, notably the plant of the Burnett Falls Manufacturing Co., at Cornell, Wis. Beginning about January 15 operation was started at the Wissota plant of the Wisconsin & Minnesota Light & Power Co. The pond was filled during January and February and operation of the wheels was begun about February 15. After this date flow during medium and low stage is controlled by this plant.

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 water-stage recorder was satisfactory throughout the year. Except for periods when stage-discharge relation was affected by ice, daily discharge October 1 to May 11 ascertained by applying to rating table, mean daily gage height obtained by planimeter from gage-height graph; discharge May 12 to September 30 obtained with the discharge intergrator. Discharge during periods when stage-discharge relation was affected by ice November 18–24, December 14 to April 5 ascertained by applying to rating curve mean daily gage height corrected for the effect of ice 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 roughly approximate.

Discharge measurements of Chippewa River at Chippewa Falls, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 11[a]	Kilgore and Williams..	1.75	1,730	Mar. 21[a]	R. B. Kilgore.....	0.55	1,020
18[a]	R. B. Kilgore.....	.12	393	May 17	.....do.....	1.32	3,070
Feb. 20[a]	.....do.....	.62	627	Aug. 12	.....do.....	—.11	656

[a] Complete ice cover.

Daily discharge, in second-feet, of Chippewa River at Chippewa Falls, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,620	3,850	3,190	580	365	2,210	4,310	16,300	5,700	5,170	2,800	1,700
2	3,400	4,080	3,190	450	365	1,830	5,950	17,300	6,830	4,570	2,950	960
3	3,400	4,080	3,190	450	365	1,440	7,150	17,300	7,910	4,690	3,340	740
4	3,400	4,080	2,980	640	40	1,080	8,760	16,300	7,970	3,860	3,300	1,570
5	3,190	4,080	3,190	3,400	600	1,400	10,600	14,700	5,870	4,880	1,030	1,600
6	2,780	3,850	2,980	2,030	395	1,480	11,800	13,100	9,310	4,470	2,900	1,880
7	2,780	3,850	3,190	1,620	550	1,600	15,600	13,400	9,610	6,910	1,790	1,980
8	2,780	4,080	2,980	820	335	1,580	14,400	12,800	9,920	9,840	2,570	1,620
9	2,980	4,310	2,980	580	335	1,520	15,000	9,720	13,000	8,340	2,360	900
10	2,780	5,790	2,780	1,940	395	1,490	9,720	9,140	11,000	6,870	2,250	1,200
11	2,780	6,850	2,780	1,700	450	835	12,800	8,270	8,670	5,820	2,020	1,860
12	2,780	6,850	2,480	1,620	490	1,280	19,000	7,300	6,420	5,780	950	1,480
13	2,780	6,050	2,480	1,340	490	1,510	20,000	5,720	4,060	4,320	1,340	2,010
14	2,980	5,020	2,390	820	510	1,700	19,400	6,000	3,650	4,800	1,640	1,850
15	3,190	3,620	2,390	1,860	2,210	1,680	16,600	5,230	4,150	3,110	1,480	1,720
16	4,310	3,400	1,620	430	2,390	1,910	14,000	5,630	2,630	3,760	1,710	960
17	3,850	3,190	1,620	395	1,410	1,930	12,500	4,700	2,390	2,880	1,320	1,640
18	3,190	3,190	1,050	395	1,050	1,580	14,000	4,580	2,600	2,940	1,900	2,070
19	5,020	3,190	1,410	380	1,580	1,280	13,100	4,390	2,630	3,260	1,290	2,190
20	4,780	3,190	1,860	380	610	1,320	13,700	5,730	2,710	3,380	1,550	2,410
21	4,540	2,980	2,030	380	660	980	16,600	5,400	2,900	2,900	1,890	2,150
22	4,310	2,980	2,120	380	3,190	1,370	20,400	4,610	2,410	4,270	1,740	2,160
23	4,540	2,980	2,120	365	2,430	950	23,300	4,760	5,500	2,400	1,350	1,050
24	4,080	2,980	2,120	365	2,300	950	21,500	5,320	3,980	2,790	1,800	2,190
25	4,080	2,980	900	365	2,230	745	19,000	4,810	4,540	2,680	1,750	2,160
26	3,850	3,190	2,030	365	1,890	790	17,300	3,560	4,690	2,310	1,360	2,250
27	4,080	3,190	2,480	350	1,320	895	14,700	3,910	4,370	2,410	1,570	2,190
28	4,080	2,980	2,480	350	1,580	895	14,700	4,620	8,400	2,160	1,870	1,930
29	4,080	3,400	2,480	335	.....	745	12,800	3,680	4,630	800	1,770	1,930
30	4,080	3,190	2,030	335	.....	1,010	15,600	3,320	4,260	3,860	1,710	905
31	4,310	.....	860	350	.....	2,520	.....	3,740	.....	2,860	1,650	.....

NOTE.—Stage-discharge relation affected by ice Nov. 18-24 and Dec. 14 to Apr. 5.

Monthly discharge of Chippewa River at Chippewa Falls, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 5,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	5,020	2,780	3,640	0.650	0.75
November	6,850	2,980	3,920	.700	.78
December	3,190	860	2,330	.416	.48
January	3,400	335	831	.148	.17
February	3,190	40	1,090	.195	.20
March	2,520	745	1,370	.245	.28
April	23,300	4,310	14,500	2.59	2.89
May	17,300	3,320	7,910	1.41	1.63
June	13,000	2,390	5,760	1.03	1.15
July	9,840	800	4,160	.743	.86
August	3,340	950	1,900	.339	.39
September	2,410	740	1,710	.305	.34
The year	23,300	40	4,090	.730	9.92

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 & Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 30, 1914, to September 30, 1917.

GAGE.—Chain gage supported by built-up cantilever attached to posts set in the right bank of the 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 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 the cable site, 1,500 feet below the 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, 4.02 feet April 21, and 23 (discharge, 1,400 second-feet), minimum discharge estimated 340 second-feet February 9.

1914–1917: Maximum stage recorded, 9.0 feet, April 22 and 23, 1916 (discharge, 5,430 second-feet); minimum discharge, February 9, 1917.

REGULATION.—Storage reservoirs are maintained by the Chippewa & Flambeau Improvement Co. on the headwaters of the Flambeau River. Of these reservoirs, Rest Lake, in sec. 9, T. 42 N., R. 5 E., with an allowable capacity of approximately 1.5 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 to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating curve except for periods in which stage-discharge 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. Gage not read on most Sundays part of April to July; discharge interpolated. Open-water records good; winter records fair.

Discharge measurements of Flambeau River near Butternut, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 3[a]	2.78	514	Mar. 1[a]	3.15	384
29[a]	2.63	389	May 12	3.39	1,070

[a] Complete ice cover.

Daily discharge, in second-feet, of Flambeau River near Butternut, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	760	940	760	535	385	385	675	1,280	1,080	1,060	554	432
2	716	985	782	520	370	385	695	1,330	1,170	1,030	518	400
3	716	1,080	805	520	380	385	715	1,330	1,140	940	554	416
4	716	1,120	782	520	390	385	740	1,330	1,120	1,120	554	416
5	673	1,080	760	520	400	385	760	1,330	1,170	1,330	554	400
6	632	895	782	520	380	385	805	1,300	1,170	1,120	554	416
7	673	805	805	500	355	385	830	1,280	1,280	1,220	554	449
8	632	895	805	485	350	385	850	1,220	1,330	1,200	554	449
9	632	985	805	475	340	385	870	1,220	1,330	1,170	554	432
10	632	985	782	465	355	385	895	1,170	1,280	1,080	554	400
11	632	985	760	450	370	385	940	1,120	1,220	985	554	400
12	673	940	738	430	385	385	960	1,080	1,120	985	554	385
13	895	940	716	415	370	385	985	1,030	1,030	940	518	416
14	940	985	715	415	355	385	1,030	985	940	895	518	518
15	985	449	715	420	355	385	1,080	985	895	872	554	592
16	1,080	342	690	435	355	385	1,120	940	805	850	554	554
17	1,120	508	675	450	355	385	1,170	895	805	760	554	554
18	1,120	673	675	445	355	385	1,220	940	805	716	554	518
19	1,120	739	650	440	355	400	1,120	985	895	673	554	483
20	1,080	805	630	430	360	400	1,280	962	985	673	554	449
21	1,030	850	630	420	365	415	1,380	940	1,030	632	554	432
22	985	895	610	415	370	430	1,380	895	1,030	632	518	416
23	940	850	590	400	370	450	1,380	850	1,030	632	483	385
24	940	828	590	385	370	465	1,380	805	1,100	632	449	370
25	895	805	575	390	370	485	1,380	760	1,170	632	449	356
26	895	718	575	400	370	500	1,380	760	1,170	632	554	400
27	895	632	555	395	385	520	1,330	738	1,170	632	554	432
28	895	674	555	390	385	555	1,220	716	1,120	592	554	449
29	895	716	555	390	.....	575	1,220	716	1,080	592	483	432
30	895	738	535	395	.....	590	1,220	716	1,080	592	449	416
31	895	.....	535	400	.....	630	.....	985	.....	554	449	.....

NOTE.—Stage-discharge relation affected by ice, Dec. 14 to Apr. 17. No gage-height records, Apr. 22, 29, May 6, 13, 20, 27, June 3, 10, 17, 24, July 1, 8, 15, 22, 29 and Aug. 5; dischage interpolated.

Monthly discharge of Flambeau River near Butternut, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 660 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,120	632	858	1.30	1.50
November	1,120	342	828	1.25	1.40
December	805	535	682	1.03	1.19
January	535	385	444	.673	.78
February	400	340	368	.558	.58
March	630	385	430	.651	.75
April	1,380	675	1,070	1.62	1.81
May	1,330	716	1,020	1.55	1.79
June	1,330	805	1,080	1.64	1.83
July	1,330	554	851	1.29	1.49
August	554	449	531	.805	.93
September	592	356	439	.665	.74
The year	1,380	340	718	1.09	14.79

FLAMBEAU RIVER NEAR LADYSMITH, WIS.

LOCATION.—In SE. ¼ sec. 20, T. 35 N., R. 5 W., at H. J. Cornelissen's farm, about 6 miles by road northeast of Ladysmith, Rusk County, 21 miles below mouth of South Fork of Flambeau River, coming in from the left, and 28 miles above mouth of river.

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

RECORDS AVAILABLE.—January 2, 1914, to September 30, 1917. From February 15, 1905, to December 2, 1906, records were collected at a station in the city of Ladysmith, three-fourths of a mile south of the Minneapolis, St. Paul & Sault Ste. Marie Railway station, half a mile below the dam of the Menasha Pulp Co., and about 6 miles below the present station.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year when chanel was clear of ice and logs 6.6 feet June 7, 8 (discharge 7,880 second-feet); minimum discharge, 605 second-feet March 10–17.

1903–1906 and 1914–1917: Maximum discharge recorded, 17,400 second-feet April 23, 1916; minimum discharge, 390 second-feet December 4, 1904.

ICE.—Large quantities of frazil ice 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 company's dam at Ladysmith, seriously affecting the stage-discharge relation.

REGULATION.—The Chippewa & Flambeau Improvement Co. operates storage reservoirs on Rest Lake and smaller reservoirs on Manitowish and Turtle rivers and Bear Creek. Weekly fluctuations at the 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, roughly 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 or logs for which discharge was obtained by applying to rating table mean daily gage heights corrected for backwater by means of discharge measurements, observers' notes, and weather records. Open-water records excellent except those for April, May, and June, when logs were in river, for which they are fair; winter records fair.

Discharge measurements of Flambeau River near Ladysmith, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 10 [a]	4.94	814	May 16 [b]	3.53	1,980
Feb. 8 [a]	4.55	616	Aug. 16	2.06	807
Mar. 13 [a]	4.90	607			

[a] Complete ice cover.

[b] Logs in channel below gage.

Daily discharge, in second-feet, of Flambeau River near Ladysmith, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,620	1,910	1,910	880	660	620	1,340	4,310	1,910	2,510	920	920
2	1,450	1,910	1,910	880	660	620	1,450	4,480	2,900	2,390	920	805
3	1,500	1,910	1,910	880	660	620	1,560	4,480	3,040	2,510	920	880
4	1,500	1,910	1,790	880	660	620	1,560	3,970	3,180	2,390	920	685
5	1,400	1,790	1,790	835	620	620	1,670	3,800	3,800	1,910	920	920
6	1,450	1,790	1,790	835	620	620	1,790	3,800	5,600	2,390	880	770
7	1,340	1,790	1,670	835	620	620	1,910	3,800	7,880	3,180	1,000	770
8	1,230	1,910	1,670	835	620	620	2,030	3,040	7,880	3,970	920	805
9	1,280	2,270	1,620	835	620	620	2,150	3,180	6,660	3,640	1,000	770
10	1,280	2,640	1,560	815	620	605	2,270	2,900	3,640	3,180	1,000	840
11	1,230	2,640	1,500	790	620	605	2,390	2,900	4,140	2,770	1,000	685
12	1,230	2,640	1,450	790	620	605	2,510	2,900	3,480	2,390	1,000	770
13	1,340	2,390	1,400	745	620	605	2,640	2,900	2,900	2,510	960	840
14	1,790	2,330	1,340	745	620	605	2,770	2,510	2,900	2,150	840	840
15	1,910	2,270	1,280	745	620	605	2,900	2,270	2,150	1,910	840	1,000
16	2,030	2,270	1,230	745	620	605	3,040	1,910	2,150	1,790	770	1,080
17	2,270	2,210	1,230	700	620	605	3,180	1,910	1,910	1,670	805	1,160
18	2,390	2,150	1,180	700	620	620	3,480	1,910	1,790	1,560	920	1,080
19	2,390	2,090	1,120	700	620	620	4,480	1,910	1,790	1,450	920	1,040
20	2,150	2,030	1,120	700	620	660	5,400	2,270	1,910	1,500	920	1,000
21	2,150	1,910	1,120	700	620	660	6,000	2,390	2,390	1,500	920	880
22	2,150	1,790	1,070	700	620	700	6,000	2,510	2,150	1,290	960	840
23	2,030	1,670	1,020	700	620	700	5,400	2,390	2,270	1,240	960	770
24	2,030	1,670	1,020	700	620	745	4,840	2,900	2,150	1,240	960	770
25	1,910	1,730	1,020	700	620	835	4,480	2,510	2,640	1,120	880	840
26	1,670	1,910	970	660	620	880	3,800	1,790	2,640	1,160	920	805
27	1,910	2,030	970	660	620	925	3,480	1,620	4,140	1,120	920	920
28	1,790	2,030	925	660	620	1,020	3,480	1,560	4,480	1,080	740	1,000
29	1,910	2,030	925	660	.....	1,070	3,640	1,450	3,040	1,120	1,200	1,040
30	1,910	1,970	925	660	.....	1,120	4,140	1,620	2,770	1,120	1,040	1,000
31	1,910	.....	925	660	.....	1,230	.....	1,620	.....	920	920	.....

NOTE.—Stage-discharge relation affected by ice, Nov. 14 to Apr. 17; by logs May 5–25 and June 28.

Monthly discharge of Flambeau River near Ladysmith, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 1,940 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,390	1,230	1,750	0.902	1.04
November	2,640	1,670	2,050	1.06	1.18
December	1,910	925	1,330	.686	.79
January	880	660	753	.388	.45
February	660	620	626	.323	.34
March	1,230	605	716	.369	.43
April	6,000	1,340	3,190	1.64	1.83
May	4,480	1,450	2,690	1.39	1.60
June	7,880	1,790	3,340	1.72	1.92
July	3,970	920	1,960	1.01	1.16
August	1,200	740	929	.479	.55
September	1,160	685	884	.456	.51
The year	7,880	605	1,690	.871	11.80

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, 1917.

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

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—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, 6.89 feet at 8 a. m. April 22 (discharge, 4,020 second-feet); minimum discharge estimated 20 second-feet, January and February.

1915–1917: Maximum discharge 8,600 second-feet April 22, 1916; minimum discharge about 18 second-feet January 20, 1916.

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 height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of Jump River at Sheldon, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1911.	*Feet.*	*Sec.-ft.*	1912.	*Feet.*	*Sec.-ft.*
Jan. 9[a]	3.46	36	Mar. 14[a]	3.65	35
Feb. 9[a]	3.69	24	May 15	3.64	354

[a] Complete ice cover.

Daily discharge, in second-feet, of Jump River at Sheldon, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	195	256	169	35	20	25	840	2,510	330	270	44	45
2	183	310	155	30	20	25	1,020	2,510	355	225	38	44
3	143	285	165	25	20	25	1,200	2,110	330	176	33	39
4	118	251	175	25	25	25	1,510	1,740	330	148	36	39
5	76	238	165	25	25	30	1,620	1,300	380	140	38	55
6	107	207	155	25	25	30	1,860	1,110	840	164	42	88
7	85	195	165	30	25	30	2,370	840	1,300	255	55	148
8	58	246	175	30	25	30	2,370	680	1,510	305	65	148
9	76	680	140	35	25	30	2,650	610	1,510	260	68	112
10	68	930	100	35	25	35	2,510	540	1,110	200	70	65
11	76	930	110	35	25	35	2,950	485	840	176	65	55
12	97	645	120	30	25	35	3,400	458	610	144	60	58
13	91	540	100	30	25	35	3,250	405	485	180	48	77
14	118	540	80	30	25	35	2,650	355	405	176	39	156
15	139	420	75	30	25	35	1,980	330	330	140	33	180
16	132	390	70	25	25	40	1,510	305	280	133	36	164
17	124	360	55	25	20	45	1,200	305	230	136	33	144
18	195	335	40	25	20	60	1,400	275	205	112	36	136
19	179	310	35	25	20	70	1,860	330	185	119	38	112
20	163	260	25	25	20	70	2,510	380	176	122	42	91
21	143	253	35	20	20	85	3,720	430	164	105	42	70
22	143	246	40	20	20	100	3,880	405	160	102	48	68
23	128	204	45	20	20	120	3,250	380	164	88	50	58
24	124	163	50	20	25	135	2,370	330	172	77	48	50
25	132	183	40	20	25	155	1,860	270	280	70	44	50
26	171	203	25	20	25	175	1,510	250	430	65	50	77
27	335	224	25	20	25	215	1,400	220	485	58	48	77
28	285	246	25	20	25	310	1,510	200	430	58	45	148
29	260	214	30	20	.....	360	1,860	180	305	50	45	205
30	251	183	40	20	.....	480	2,370	185	305	45	48	176
31	260	.....	40	20	.....	610	.....	230	.....	44	50	.....

NOTE.—Stage-discharge relation affected by ice Nov. 16–20, Dec. 7 to Apr. 4.

Monthly discharge of Jump River at Sheldon, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 510 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	335	58	150	0.294	0.34
November	930	163	348	.682	.76
December	175	25	86.1	.169	.19
January	35	20	25.6	.050	.06
February	25	20	23.2	.046	.05
March	610	25	113	.222	.26
April	3,880	840	2,150	4.22	4.71
May	2,510	180	666	1.31	1.51
June	1,510	160	488	.957	1.07
July	305	44	140	.274	.32
August	70	33	46.4	.091	.10
September	205	39	97.8	.192	.21
The year	3,880	20	359	.704	9.58

EAU CLAIRE RIVER NEAR AUGUSTA, WIS.

LOCATION.—In sec. 12, T. 26 N., R. 6 E., at Trouble Water Bridge, about 7 miles northeast of Augusta, Eau Claire County. South Fork of Eau Claire River enters from left about 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, 1917.

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, 7.08 feet April 3 and 4 (discharge, 3,710 second-feet); a stage of 11.0 feet March 31 was due to backwater from ice; minimum discharge estimated at 25 second-feet January 3–5 and 21–25.

1914–1917: Maximum open-water stage recorded, 10.6 feet at noon April 1, 1916 (discharge, 7,180 second-feet); discharge less at stage of 11.0 feet March 31, 1917, which was due to backwater from ice; minimum discharge January, 1917.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve used October 1 to September 30, well defined from 87 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 table, except for period in which stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice 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, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 2[a]	E. L. Williams	0.93	29	Mar. 22[a]	R. B. Kilgore	2.08	78
Feb. 11[a]	R. B. Kilgore	1.52	47	June 5	....do	2.05	561

[a] Complete ice cover.

Daily discharge, in second-feet, of Eau Claire River near Augusta, Wis., for the year ending Sept. 30, 1917.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	103	141	235	30	65	40	3,530	1,570	369	129	62	43
2	97	141	179	30	65	40	3,620	1,400	368	129	118	40
3	87	141	249	25	65	40	3,710	1,030	293	107	73	43
4	83	141	221	25	65	40	3,710	833	293	97	62	40
5	73	201	193	25	70	40	3,710	761	369	97	69	40
6	69	179	180	30	70	40	3,530	533	585	107	141	43
7	69	158	155	30	65	40	2,840	449	1,130	118	134	40
8	73	263	130	30	60	40	2,240	385	2,450	125	134	47
9	69	797	85	35	50	45	1,630	353	1,890	107	141	40
10	69	1,400	70	40	45	50	1,290	323	1,030	87	129	40
11	78	833	70	40	45	45	1,130	293	690	107	78	40
12	62	482	60	40	40	50	1,030	263	449	118	73	48
13	78	385	55	50	40	45	869	193	401	107	83	62
14	83	263	45	50	40	45	761	193	278	118	87	66
15	87	250	40	45	40	40	620	166	249	97	69	69
16	83	250	40	40	45	40	550	153	235	91	78	54
17	87	280	35	40	45	40	482	153	179	91	69	57
18	78	323	35	35	45	60	482	141	166	91	69	47
19	78	369	35	30	50	70	550	193	153	83	69	78
20	87	482	30	30	55	75	761	221	107	87	69	62
21	87	308	30	25	45	80	1,130	221	107	83	62	69
22	83	293	30	25	35	80	1,290	249	107	83	62	54
23	78	263	30	25	35	80	905	249	125	91	62	54
24	83	207	30	25	40	85	690	249	129	179	69	78
25	97	220	30	25	40	105	761	235	129	153	54	54
26	153	235	30	30	40	415	833	221	174	118	62	78
27	158	250	30	30	40	835	945	193	166	91	54	179
28	141	263	30	45	40	1,400	761	179	129	78	51	166
29	141	263	30	60	.....	2,100	985	153	118	69	47	78
30	141	249	30	60	.....	3,170	1,510	166	129	78	43	97
31	141	.....	30	65	.....	3,440	.....	221	.....	40	40	.....

NOTE.—Stage-discharge relation affected by ice, Nov. 15–17, 25–27, and Dec. 6 to Apr. 2. Discharge Sept. 14 interpolated.

Monthly discharge of Eau Claire River near Augusta, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	158	62	93.4	0.187	0.22
November	1,400	141	334	.668	.75
December	249	30	79.7	.159	.18
January	65	25	36.0	.072	.08
February	70	35	49.3	.095	.10
March	3,440	40	410	.820	.95
April	3,710	482	1,560	3.12	3.48
May	1,570	141	385	.770	.89
June	2,450	107	431	.862	.96
July	179	40	102	.204	.24
August	141	40	77.8	.156	.18
September	179	40	63.5	.127	.14
The year	3,710	25	301	.602	8.17

RED CEDAR RIVER NEAR COLFAX, WIS.

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

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

RECORDS AVAILABLE.—March 10, 1914, to September 30, 1917.

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, 4.94 feet at 10 a. m. April 3 (discharge 4,380 second-feet); minimum discharge recorded, 435 second-feet March 12.

1914–1917: Maximum stage recorded, 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.

REGULATION.[1]—The following dams and reservoirs are used to regulate the flow in the Red Cedar River. Owing to operation of these reservoirs the flow at the station is not natural.

Reservoirs used to regulate flow of Red Cedar River.

Dam.	Location.	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. One curve, well defined between 653 and 4,450 second-feet, was used during the year; curve extended and roughly approximate outside these limits. 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 ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes and weather records. Open-water records good; winter records fair.

Discharge measurements of Red Cedar River near Colfax, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 23	R. B. Kilgore	2.01	1,000	Mar. 20[a]	R. B. Kilgore	3.04	618
Jan. 11[a]	Williams and Kilgore	3.03	808	May 18	do	1.70	803
Feb. 19[a]	R. B. Kilgore	2.48	478	Aug. 11	do	1.31	575

[1] From data on file in Engineering Dept. of Railroad Commission of Wisconsin.
[a] Ice at control.

Daily discharge, in second-feet, of Red Cedar River near Colfax, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	820	720	785	585	610	460	3,000	1,120	1,040	610	585	560
2	925	690	890	610	605	445	3,640	1,210	820	585	560	535
3	960	720	750	635	600	445	4,310	960	750	535	535	512
4	960	690	635	635	600	445	4,030	820	1,210	585	585	535
5	1,000	635	690	660	620	450	3,380	785	1,040	560	535	560
6	960	635	690	690	645	460	2,880	690	820	662	512	560
7	1,040	635	690	690	630	470	2,640	635	1,120	662	635	560
8	925	890	690	720	610	475	2,640	720	960	662	690	560
9	960	890	635	750	580	510	2,530	690	750	635	635	560
10	750	820	470	820	555	540	2,200	690	925	635	585	490
11	662	720	470	810	565	490	2,090	635	785	690	560	535
12	635	690	470	795	575	435	2,090	690	1,000	785	535	585
13	662	690	450	780	510	470	1,980	662	960	610	535	635
14	635	662	450	715	440	510	1,580	690	855	585	535	585
15	635	635	450	650	460	520	1,390	820	785	585	535	560
16	585	690	450	650	475	530	1,210	785	690	610	512	535
17	690	690	450	645	505	555	1,210	750	690	535	535	512
18	690	635	450	660	535	580	1,210	785	585	585	535	535
19	690	785	450	670	520	600	1,210	690	662	535	512	512
20	662	662	450	650	510	620	1,880	750	690	635	512	512
21	690	690	470	635	505	665	1,680	690	690	635	535	490
22	750	690	470	630	500	750	1,120	690	662	610	535	490
23	785	750	470	630	505	820	1,120	662	635	585	535	490
24	785	662	470	685	510	890	1,040	635	635	585	585	470
25	750	560	490	740	480	925	960	635	690	585	560	535
26	855	635	490	710	450	855	890	535	635	585	535	490
27	820	635	510	675	465	960	820	535	610	585	490	490
28	720	750	535	620	480	1,040	820	535	635	560	560	490
29	635	820	535	565	.....	1,210	890	535	635	512	535	470
30	610	785	560	590	.....	1,480	1,040	662	690	512	512	470
31	720	.....	585	610	.....	1,980	.....	1,000	.....	535	535	.....

NOTE.—Stage-discharge relation affected by ice Dec. 11 to Apr. 2.

Monthly discharge of Red Cedar River near Colfax, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 1,100 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,040	585	773	0.703	0.81
November	890	560	705	.641	.72
December	890	450	550	.500	.58
January	820	565	675	.614	.71
February	645	440	537	.488	.51
March	1,980	435	696	.633	.73
April	4,310	820	1,920	1.75	1.95
May	1,210	535	732	.665	.77
June	1,210	585	788	.716	.80
July	785	512	599	.545	.63
August	690	490	551	.501	.58
September	635	470	527	.479	.53
The year	4,310	435	753	.685	9.32

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, 1917.

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

DISCHARGE MEASUREMENTS.—No discharge measurements 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, 5.9 feet April 3 and 4; minimum stage, 0.0 foot, 5 p. m. March 11.

1909–1917: 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 the power plant above the gaging station, modify the flow.

ACCURACY.—Gage read twice daily to half-tenths. No measurements have been made, but stage-discharge relation believed permanent. Considerable diurnal fluctuation is observed, so that mean daily gage height 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, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.9	2.75	3.0	2.42	2.5	2.5	5.05	3.3	3.1	2.4	2.25	2.45
2	3.0	2.58	2.72	3.0	2.5	2.5	5.65	3.25	3.72	2.5	2.3	2.1
3	3.0	2.58	1.6	3.0	2.5	2.4	5.85	3.15	3.92	2.38	2.2	1.55
4	3.0	2.58	3.08	2.9	1.45	1.4	5.9	2.85	3.32	2.3	2.3	2.6
5	2.75	1.72	3.0	2.75	2.55	2.5	5.6	2.7	3.3	2.45	2.0	2.5
6	2.75	2.62	3.0	2.68	2.55	2.5	5.05	2.5	3.4	2.42	2.3	2.55
7	2.7	2.62	3.0	1.5	3.0	2.45	4.65	2.95	3.32	2.4	2.35	2.68
8	1.9	2.98	2.72	2.95	2.8	2.3	4.55	2.75	3.28	2.6	2.4	2.5
9	2.72	3.02	2.72	3.0	2.8	1.85	4.65	2.4	3.55	2.7	2.35	1.6
10	2.72	3.08	1.6	2.9	2.85	2.5	4.35	2.25	3.15	2.55	2.3	2.45
11	2.75	3.02	2.72	3.0	1.5	1.2	4.15	2.4	3.42	2.6	2.25	2.5
12	2.75	2.38	2.72	3.0	2.5	2.5	4.15	2.3	3.3	2.45	1.9	2.5
13	2.75	2.98	2.72	2.75	2.7	2.5	4.1	2.15	3.35	2.4	2.5	2.55
14	2.75	2.58	2.72	1.65	2.5	2.5	3.95	2.4	3.55	2.45	2.55	2.65
15	1.9	2.58	2.68	2.85	2.4	2.3	3.45	2.4	3.4	2.3	2.5	2.6
16	2.75	2.78	2.62	3.1	2.4	2.5	3.55	2.75	3.1	2.65	2.55	2.35
17	2.75	2.72	1.55	3.0	2.1	1.9	3.35	2.68	2.3	2.75	2.5	2.5
18	2.78	2.72	2.62	2.9	1.4	1.4	3.4	2.6	2.25	2.45	2.55	2.55
19	2.8	1.82	2.68	2.8	2.7	1.45	3.48	2.5	2.35	2.35	2.0	2.45
20	2.75	2.78	2.68	2.85	3.0	2.7	3.55	2.3	2.3	2.4	2.45	2.45
21	2.52	2.78	2.62	1.55	2.45	2.8	3.45	2.4	2.45	2.4	2.3	2.6
22	1.8	2.72	2.62	3.0	2.5	2.4	3.15	2.6	2.4	2.0	2.3	2.55
23	2.75	2.72	2.68	3.0	2.5	2.5	3.55	2.52	2.2	2.2	2.35	2.0
24	2.75	2.72	1.52	2.5	2.5	2.6	3.25	2.52	1.9	2.4	2.3	2.55
25	2.58	2.72	1.52	2.8	1.4	1.4	3.3	2.25	1.85	2.55	2.35	2.5
26	2.58	1.6	3.0	2.9	2.5	3.05	3.18	1.98	2.38	2.4	2.0	2.55
27	3.0	2.8	2.9	2.8	2.6	3.35	3.15	1.85	2.65	2.2	2.35	2.5
28	2.68	2.72	2.95	1.4	2.4	3.6	2.75	2.68	2.6	2.3	2.45	2.45
29	1.9	2.8	2.88	2.75	.....	3.85	2.68	2.3	2.4	2.0	2.5	2.4
30	2.75	1.6	2.95	2.8	.....	3.95	3.25	2.3	2.45	2.25	2.4	2.0
31	3.0	.....	2.05	2.6	.....	5.25	.....	2.68	.....	2.45	2.6	.....

RED CEDAR RIVER AT MENOMONIE, WIS.

LOCATION.—In sec. 21, T. 28 N., R. 13 W., about 900 feet below power house of Wisconsin & Minnesota Light & Power Co., Menominie, Dunn County, 13 miles above the 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, 1917.

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

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year about 6.3 feet April 3 (discharge, 8,300 second-feet); minimum stage recorded 1.92 feet at 1 p. m. November 20 (discharge, 394 second-feet).

1907–8 and 1913–1917: 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 the gage section is caused by the operation of the power plants of the 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. Ice does not affect the stage-discharge relation at this station owing to relatively warm water coming from service reservoir. Rating curve well defined between 610 and 1,910 second-feet, and between 3,910 and 9,220 second-feet. Curve extended outside these limits and roughly approximate only. Operation of water-stage recorder satisfactory except for brief periods. Daily-discharge record October 1 to September 30 except for brief periods obtained with discharge integrator. Records good except for periods when gage was not in operation, for which they are only roughly approximate.

Discharge measurements of Red Cedar River at Menomonie, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Feb. 21	2.52	864	Apr. 2	6.05	7,550
Apr. 2	5.78	6,840	Aug. 8	2.70	1,000

Daily discharge, in second-feet, of Red Cedar River at Menomonie, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	745	1,130	1,050	1,000	940	850	5,240	1,580	1,450	870	910	1,210
2	920	950	1,310	1,280	960	800	6,900	1,900	1,630	970	730	870
3	1,300	1,010	810	1,430	920	810	7,340	1,570	1,150	1,080	760	650
4	1,350	1,060	1,060	1,400	750	650	7,640	1,600	1,870	880	810	780
5	1,280	700	1,280	1,050	890	680	6,880	1,260	1,670	930	710	1,040
6	1,110	840	1,230	880	980	780	5,690	1,010	1,600	1,260	600	1,140
7	1,200	1,030	1,390	660	1,180	910	4,500	1,580	1,810	1,080	880	1,090
8	660	1,270	1,040	1,060	1,370	880	4,160	1,420	1,480	940	1,070	1,060
9	760	1,370	1,090	1,240	1,170	760	4,560	1,120	1,370	1,450	1,140	530
10	900	1,380	770	1,290	970	800	3,860	1,000	1,360	1,310	1,190	840
11	1,130	1,340	910	1,240	800	610	3,200	1,120	1,550	1,330	1,220	930
12	1,250	900	1,160	1,300	830	770	3,080	1,100	1,510	950	780	1,060
13	1,120	1,190	1,160	1,210	1,030	920	2,810	680	1,330	1,190	900	1,020
14	1,100	1,140	1,230	800	910	800	2,880	1,070	1,330	960	950	960
15	600	1,090	1,120	880	930	800	2,110	1,240	1,220	890	950	890
16	880	1,180	940	1,320	780	710	2,180	1,160	1,080	1,000	940	800
17	1,020	1,110	680	1,460	750	660	1,840	1,280	1,820	1,140	990	830
18	1,180	1,020	750	1,450	680	480	1,890	1,200	1,430	1,020	920	1,110
19	1,030	840	970	1,330	860	680	1,710	1,100	1,150	990	730	1,120
20	1,130	800	1,040	1,430	980	700	2,160	760	1,210	1,020	940	900
21	870	1,040	900	1,010	1,000	890	2,240	1,140	1,140	950	880	870
22	650	1,190	860	920	940	930	1,480	1,230	1,040	880	980	890
23	740	1,160	830	1,190	940	1,290	1,920	1,200	1,200	850	940	630
24	970	1,170	610	1,280	1,000	1,250	1,600	1,080	770	1,020	1,120	740
25	1,050	1,010	640	1,290	840	1,070	2,140	1,020	740	1,300	840	970
26	930	720	910	1,260	870	1,680	1,420	1,000	780	1,110	760	1,010
27	1,010	930	1,210	1,300	940	1,950	1,590	640	780	1,080	800	990
28	1,230	1,150	1,380	900	940	2,760	1,520	940	910	940	890	920
29	710	1,000	1,340	910	.....	3,000	1,010	1,130	920	830	900	890
30	1,010	780	1,180	1,240	.....	3,130	1,810	740	950	810	1,030	660
31	1,130	.....	1,190	1,380	.....	4,830	.....	1,250	.....	780	1,000	.....

NOTE.—Recording gage not in operation Oct. 1–3; determinations of discharge based on one gage reading a day, records of Red Cedar River at Cedar Falls, and interpolation. Discharge Nov. 29, 30, and Jan. 7 based on average gage height for less than 24 hours.

Monthly discharge of Red Cedar River at Menomonie, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 1,810 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,350	600	999	0.552	0.64
November	1,380	700	1,050	.580	.65
December	1,390	610	1,030	.569	.66
January	1,460	660	1,170	.646	.74
February	1,370	680	934	.516	.54
March	4,830	480	1,220	.674	.78
April	7,640	1,010	3,250	1.80	2.01
May	1,900	640	1,170	.646	.74
June	1,870	740	1,280	.707	.79
July	1,450	780	1,030	.569	.66
August	1,220	600	912	.504	.58
September	1,210	530	913	.504	.56
The year	7,640	480	1,240	.685	9.35

ZUMBRO RIVER AT ZUMBRO FALLS, MINN.

LOCATION.—Near east border of sec. 31, T. 110 N., R. 14 W., at highway bridge at Zumbro Falls, about 1,500 feet below mouth of Spring Creek, 6½ miles below mouth of South Branch.

DRAINAGE AREA.—1,120 square miles.

RECORDS AVAILABLE.—June 8, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Chain attached to the upstream handrail of bridge near left end; read by A. H. Sugg.

DISCHARGE MEASUREMENTS.—Made from the bridge or by wading.

CHANNEL AND CONTROL.—Bed of stream is fine sand; shifts considerably; a slight riffle a few hundred feet below gage acts as a partial control during low stages; right bank is fairly low and is overflowed during high flood stages; left bank not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 19.04 feet at 4.50 p. m. March 25 (discharge, about 14,800 second-feet); flood peak was increased somewhat by going out of dam at Mazeppa, about 6 miles upstream, during the afternoon of March 25. Dam created a head of 22 feet and had a pond area of about 150 acres. Minimum discharge estimated 150 second-feet January 13 to February 15.

1907–1917: Maximum stage recorded March 25, 1917; minimum open-water stage recorded, 4.50 feet at 8 a. m. January 10 and 21, 1914 (discharge, about 128 second-feet); 106 second-feet was measured by current meter January 27, 1915.

High-water of June, 1908, which reached a stage of 26.7 feet above datum of present gage, is marked by a spike in a telephone post near the railroad station at Zumbro Falls; high water of April, 1888, reached a stage of approximately 29.7 feet, as shown by a mark not so well defined as that of the flood of 1908.

ICE.—Stage-discharge relation not seriously affected by ice except during and after extremely cold weather, when ice forms below the gage and causes backwater for short periods. A short distance above the gage the river receives about 8 second feet of spring water from Spring Creek, which is warm enough to keep it free from ice for a considerable distance during most winter weather.

REGULATION.—The slight artificial regulation at the power plants above Zumbro Falls is not observable at the gage.

ACCURACY.—Stage-discharge relation not permanent; change occurred during high-water of March. Rating curve used October 1 to March 22 and May 29 to September 30, poorly defined; curve used March 23 to May 28 poorly defined throughout. Gage read to hundredths twice daily. 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 effect of ice by means of discharge measurement, observer's notes, and weather records. Open-water records good except those for flood stages, which are subject to error; winter records fair.

Discharge measurements of Zumbro River at Zumbro Falls, Minn., during the period Oct. 1, 1916, to Oct. 6, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1917.		*Feet.*	*Sec.-ft.*	1917.		*Feet.*	*Sec.-ft.*
Jan. 11[a]	S. B. Soulé	4.92	160	June 8	S. B. Soulé	9.05	2,080
Feb. 20[a]	do	4.86	167	Oct. 6	R. B. Kilgore	5.24	235
Mar. 28	R. B. Kilgore	10.46	3,580				

[a] Ice at control section.

Daily discharge, in second-feet, of Zumbro River near Zumbro Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	210	233	220	170	150	180	1,850	1,030	2,160	680	318	224
2	206	233	220	170	150	180	1,470	1,030	1,550	740	318	210
3	210	233	210	170	150	180	1,240	880	1,020	580	302	224
4	206	222	210	170	150	180	1,240	758	870	520	302	224
5	208	222	210	170	150	180	1,410	690	820	500	302	210
6	200	233	210	170	150	180	1,410	622	1,020	520	335	210
7	202	245	210	160	150	191	1,240	555	1,370	600	406	210
8	202	282	210	160	150	195	1,030	510	2,220	680	820	210
9	202	308	210	160	150	197	880	490	1,550	600	700	224
10	204	366	210	160	150	200	805	450	1,120	500	520	210
11	210	322	210	160	150	210	735	430	870	740	388	224
12	222	308	200	160	150	202	690	410	560	920	352	224
13	233	257	200	150	150	189	622	370	640	820	335	224
14	233	245	200	150	150	169	600	390	560	680	318	210
15	510	235	200	150	150	210	532	370	500	580	302	210
16	510	235	190	150	160	222	555	350	443	540	318	210
17	206	235	190	150	160	179	510	330	443	500	286	196
18	206	235	190	150	160	189	555	350	406	462	286	210
19	222	220	190	150	160	210	578	430	388	424	270	224
20	233	220	190	150	170	222	735	490	370	424	270	270
21	222	220	190	150	170	257	1,030	510	388	406	318	462
22	222	220	190	150	170	1,270	1,240	600	370	406	302	443
23	222	220	190	150	170	9,670	880	758	424	388	286	352
24	233	220	180	150	170	8,970	805	735	540	481	270	302
25	257	220	180	150	170	14,000	780	555	1,490	443	254	270
26	257	220	180	150	170	8,690	805	510	1,270	388	224	254
27	257	220	180	150	170	5,050	880	578	1,020	352	224	352
28	257	220	180	150	170	3,550	780	622	820	352	224	318
29	257	220	180	150	.....	1,920	735	580	820	318	224	286
30	245	220	170	150	.....	2,340	780	620	820	302	210	270
31	245	.....	170	150	.....	2,060	.....	2,360	.....	318	224	.....

NOTE.—Stage-discharge relation affected by ice Nov. 14 to Mar. 6.

Monthly discharge of Zumbro River near Zumbro Falls, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 1,120 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	510	200	242	0.216	0.25
November	366	220	243	.217	.24
December	220	170	196	.175	.20
January	170	150	156	.139	.16
February	170	150	158	.141	.15
March	14,000	169	1,990	1.78	2.05
April	1,850	510	913	.815	.91
May	2,360	330	625	.558	.64
June	2,220	370	895	.799	.89
July	920	302	521	.465	.54
August	820	210	329	.294	.34
September	462	196	256	.229	.26
The year	14,000	150	546	.488	6.63

96719°—19—WSP 455——7

SOUTH BRANCH OF ZUMBRO RIVER NEAR ZUMBRO FALLS, MINN.

LOCATION.—In sec. 22, T. 109 N., R. 14 W., at Woodville Bridge, 1½ miles above mouth of river, 6 miles below mouth of Middle Branch, and 6 miles southwest of Zumbro Falls, Wabasha County.

DRAINAGE AREA.—821 square miles.

RECORDS AVAILABLE.—June 16, 1911, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage attached to the downstream handrail of bridge near center of river; read by W. M. Whipple.

DISCHARGE MEASUREMENTS.—At high and medium stages made from downstream side of the bridge; at low stages made by wading.

CHANNEL AND CONTROL.—Bed of stream consists chiefly of sand and gravel. Control consists of cobble stones and rock at a well-defined riffle a short distance below the gage; fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.1 feet at 6 p. m. March 23 (discharge, about 12,100 second-feet); minimum discharge estimated, 100 second-feet February 11–24.

1911–1917: Maximum stage recorded March 23, 1917; minimum stage recorded, 1.80 feet December 26, 1914 (discharge, 62 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, observer's notes, and weather records.

REGULATION.—Effects of operation of small power plants above the station not noticeable at gage.

ACCURACY.—Stage-discharge relation fairly permanent except as affected by ice. Rating curve fairly well defined. Gage read to quarter-tenths twice daily. 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 ascertained by applying to rating table mean daily gage height corrected for effect of ice, by means of discharge measurements, observer's notes, and weather records. Open-water records good except those for extreme flood stages, which are subject to error; winter records fair.

Discharge measurements of South Branch of Zumbro River near Zumbro Falls, Minn., during the period Oct. 1, 1916, to Oct. 6, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1917		*Feet.*	*Sec.-ft.*	1917		*Feet.*	*Sec.-ft.*
Jan. 10[a]	S. B. Soulé	2.28	119	June 9	S. B. Soulé	4.46	1,510
Feb. 20[a]	do	2.22	102	Oct. 6	R. B. Kilgore	2.05	163
Mar. 27	R. B. Kilgore	6.79	3,210				

[a] Made through complete ice cover.

Daily discharge, in second-feet, of South Branch of Zumbro River near Zumbro Falls, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	150	145	150	125	110	110	1,480	678	2,530	594	269	177
2	154	140	145	125	110	110	973	678	1,480	594	256	170
3	148	150	142	125	110	110	882	650	412	488	247	166
4	158	150	142	125	110	110	852	540	735	388	230	170
5	154	150	145	125	110	110	1,097	514	678	364	243	170
6	145	148	140	125	110	140	973	488	912	437	273	166
7	140	154	142	125	110	273	793	462	2,130	462	341	173
8	150	150	142	125	110	282	735	437	1,480	437	852	173
9	142	300	132	120	110	256	622	388	1,360	462	622	170
10	142	282	125	120	110	230	488	341	973	388	388	166
11	135	222	125	120	100	189	462	314	706	622	314	162
12	142	210	125	115	100	189	488	296	650	973	314	162
13	145	177	125	110	100	145	462	269	488	706	278	162
14	150	158	125	110	100	120	412	264	412	540	252	162
15	148	150	125	110	100	201	388	269	412	462	234	170
16	145	154	125	110	100	140	359	278	388	388	230	170
17	148	170	125	110	100	140	346	264	412	327	226	173
18	142	150	125	110	100	150	364	269	359	355	234	170
19	142	150	125	110	100	170	388	309	336	336	222	243
20	142	162	125	110	100	145	462	388	327	323	230	650
21	148	158	125	110	100	218	594	462	314	309	278	514
22	148	158	125	110	100	1,980	1,040	567	309	304	234	359
23	142	150	125	110	100	4,520	764	622	388	296	218	300
24	150	150	125	110	100	7,060	594	514	488	341	201	264
25	181	154	125	110	110	7,720	540	437	678	323	189	226
26	177	166	125	110	110	5,320	622	412	1,480	300	185	269
27	181	154	125	110	110	3,720	594	488	1,220	278	189	412
28	177	145	125	110	110	2,710	540	540	706	264	193	252
29	166	145	125	110	.....	2,060	488	488	882	243	181	226
30	154	142	125	110	.....	1,620	622	622	706	239	177	210
31	162	.....	125	110	.....	1,620	.....	1,760	.....	247	173	.....

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

Monthly discharge of South Branch of Zumbro River near Zumbro Falls, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 821 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	181	135	152	0.185	0.21
November	300	140	166	.202	.23
December	150	125	130	.158	.18
January	125	110	115	.140	.16
February	110	100	105	.128	.13
March	7,720	110	1,350	1.64	1.89
April	1,480	346	647	.788	.88
May	1,760	264	484	.590	.68
June	2,530	309	812	.989	1.10
July	973	239	413	.503	.58
August	852	173	273	.333	.38
September	650	162	232	.283	.32
The year	7,720	100	408	.497	6.74

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, 1917.

GAGE.—Chain gage attached to downstream side of bridge; read by J. Johnson and F. E. Shappee.

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

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

EXTREMES OF DISCHARGE.—Maximum discharge 1,640 second-feet, March 30 and 31; minimum discharge about 120 second-feet, January 21–23.

1914–1917: Maximum stage recorded, 8.35 feet, June 9, 1914 (discharge, 3,340 second-feet); minimum discharge, January 21–23, 1917.

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

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

ACCURACY.—Stage-discharge relation not permanent. Two rating curves used as follows: October 1 to March 31, fairly well defined between 196 and 1,800 second-feet; April 1 to September 30, well defined between 191 and 1,800 second-feet, and fairly well defined between 1,800 and 3,080 second-feet. Gage read to quarter-tenths 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 obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good, except at extreme flood stages, for which they are fair; winter records fair.

Discharge measurements of Trempealeau River at Dodge, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 3[a]	E. L. Williams	2.59	153	Mar. 23[a]	R. B. Kilgore	5.35	643
Feb. 12[a]	R. B. Kilgore	3.16	210	June 6	do	2.37	388

[a] Complete ice cover.

Daily discharge, in second-feet, of Trempealeau River at Dodge, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	296	348	322	145	190	225	1,600	721	383	358	248	181
2	270	296	322	145	210	220	1,600	721	383	358	236	171
3	270	309	322	155	235	220	1,600	642	358	333	236	162
4	270	309	296	165	235	220	1,390	564	358	333	213	202
5	257	296	309	160	235	220	1,090	459	383	383	260	162
6	244	296	322	160	220	230	955	459	408	459	260	153
7	257	309	322	160	205	245	903	433	590	383	284	171
8	244	452	309	165	210	260	799	433	537	358	308	171
9	257	618	270	170	215	270	721	408	511	358	308	181
10	270	590	255	175	215	285	669	383	433	408	260	153
11	270	534	245	170	215	300	669	383	383	485	236	181
12	283	426	230	170	210	310	616	383	358	459	248	171
13	322	374	220	170	210	320	616	358	333	358	260	191
14	296	374	210	165	210	330	564	333	308	333	236	191
15	296	478	195	165	210	335	537	333	308	308	236	181
16	270	478	175	165	215	330	511	308	284	284	224	181
17	270	534	155	160	220	320	511	308	284	260	213	162
18	270	506	145	160	220	335	511	296	260	248	181	171
19	270	478	135	160	220	355	669	408	260	236	181	202
20	309	452	125	155	220	375	825	408	260	236	181	284
21	296	452	120	155	225	400	877	459	260	236	171	236
22	283	452	120	155	230	445	799	590	248	260	191	236
23	270	452	120	155	240	645	695	564	383	296	181	236
24	296	452	125	160	235	850	616	408	564	284	181	191
25	374	452	125	160	230	1,090	616	358	590	284	181	191
26	374	426	125	160	225	1,360	616	358	642	260	181	236
27	400	426	125	180	220	1,470	590	358	485	236	181	284
28	374	452	135	195	220	1,550	537	333	433	213	181	260
29	348	400	135	200	.....	1,590	642	358	408	202	181	248
30	322	374	135	210	.....	1,640	669	383	358	202	171	213
31	348	.....	135	200	.....	1,640	.....	408	.....	181	171	.....

NOTE.—Stage-discharge relation affected by ice Dec. 10 to Mar. 31.

Monthly discharge of Trempealeau River at Dodge, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 633 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	400	244	296	0.468	0.54
November	618	296	426	.673	.75
December	322	120	203	.321	.37
January	210	145	167	.264	.30
February	240	190	219	.346	.36
March	1,640	220	592	.935	1.08
April	1,600	511	800	1.26	1.41
May	721	296	430	.679	.78
June	642	248	392	.619	.69
July	485	181	309	.488	.56
August	308	171	219	.346	.40
September	284	153	198	.313	.35
The year	1,640	120	354	.559	7.59

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 about a mile above gage and Cunningham Creek, also from left, about 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, 1917.

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; water will not overflow the banks at the gage section.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.35 feet at 8 a. m. April 4 (discharge, 7,200 second-feet); minimum discharge estimated, 25 second-feet December 25–31. Owing to diurnal fluctuations at such low stages it is likely that the absolute minimum was somewhat less.

1905–1909 and 1913–1917: Maximum stage recorded, 19.8 feet June 6, 1905 (discharge, about 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, about 20 second-feet).

REGULATION.—Several dams on Black River and 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 from 48 to 14,300 second-feet; fairly well defined below 48 second-feet and extended above 14,300 second-feet. Gage read to quarter-tenths twice daily. 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 height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good, except for extremely low stages, for which they are fair; winter records poor.

Discharge measurements of Black River at Neillsville, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 2[a]	E. L. Williams	2.70	27	Mar. 15[a]	R. B. Kilgore	3.79	51
Feb. 10[a]	R. B. Kilgore	3.30	34	June 8	do	7.60	3,190

[a] Complete ice cover.

Daily discharge, in second-feet, of Black River at Neillsville, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	315	374	181			40	4,850	3,360	260	165	54	42
2	260	438	187			40	5,160	2,960	334	104	59	41
3	192	416	173			40	5,800	2,260	354	90	47	42
4	160	416	170			40	6,940	1,640	315	84	43	40
5	122	585	157			40	5,800	1,220	610	86	40	42
6	108	510	145			40	5,640	950	1,080	102	45	43
7	102	416	130			50	5,160	770	2,960	84	63	43
8	97	890	120		35	50	4,290	660	3,260	63	94	43
9	97	2,860	100			50	3,680	535	2,460	47	108	43
10	86	2,660	90			50	3,060	460	1,640	49	112	54
11	84	1,800	85			50	2,860	416	1,150	68	110	47
12	87	1,290	70			50	2,960	334	770	86	92	46
13	108	890	65			50	2,760	296	585	87	416	47
14	104	485	60			50	2,260	260	395	104	170	59
15	116	395	50			50	1,720	241	278	69	97	53
16	122	438	40	30		50	1,290	184	225	58	70	59
17	112	438	40			60	1,080	198	181	56	54	47
18	110	296	35			60	1,010	184	157	60	47	63
19	104	296	35			70	1,800	204	125	57	47	64
20	118	260	30			70	2,460	210	120	56	44	71
21	134	228	30			85	4,290	260	110	48	43	64
22	104	198	30		40	100	4,030	374	97	81	46	57
23	100	185	30			145	2,860	395	104	187	52	47
24	98	185	30			230	2,160	354	120	173	59	43
25	142	170	25			415	1,640	260	134	142	50	48
26	122	170	25			660	1,500	231	122	102	58	50
27	296	170	25			2,070	2,070	198	83	78	43	47
28	334	170	25			3,060	2,070	173	120	58	42	50
29	315	176	25		.....	3,680	2,560	154	120	53	40	108
30	315	192	25		.....	4,290	3,160	154	134	52	39	97
31	355	.....	25		.....	4,560	.....	204	.....	48	41	.....

NOTE.—Stage discharge relation affected by ice Nov. 23–28, and Dec. 6 to Apr. 1. Braced figures show mean discharge for period included.

Monthly discharge of Black River at Neillsville, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 774 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	355	84	159	0.205	0.24
November	2,860	170	600	.775	.86
December	187	25	72.8	.094	.11
January	30	30	30.0	.039	.04
February	40	35	37.3	.048	.05
March	4,560	40	655	.846	.98
April	6,940	1,010	3,230	4.17	4.65
May	3,360	154	648	.837	.96
June	3,260	83	613	.792	.88
July	187	47	88.8	.108	.12
August	416	39	75.0	.097	.11
September	108	40	53.3	.069	.08
The year	6,940	25	519	.671	9.08

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 & Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 22, 1913, to September 30, 1917.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge at medium and high stages; at low stages made by wading.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.4 feet, at 5 p. m. March 24 (discharge, about 2,850 second-feet); minimum discharge, 130 second-feet, January 14.

1913–1917: Maximum stage recorded March 24, 1917; minimum discharge, 130 second-feet, November 17, 1914, and January 14, 1917.

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

REGULATION.—Diurnal fluctuation at low stages amounting to 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 212 and 2,300 second-feet. Gage read to quarter tenths twice daily. 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 height corrected for effect of ice 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, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 4[a]	E. L. Williams	1.90	211	Mar. 24	R. B. Kilgore	5.98	2,000
Feb. 13[a]	F. B. Kilgore	2.47	214	May 17[b]	E. L. Williams	1.56	309

[a] Ice at control. [b] Made from the bridge; very poor measuring section at this stage.

Daily discharge, in second-feet, of La Crosse River near West Salem, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	308	308	288	200	240	175	461	638	328	371	328	244
2	288	288	288	200	220	185	438	658	328	416	573	241
3	288	288	248	195	205	185	416	638	350	416	862	241
4	288	288	288	210	145	165	394	484	416	328	461	234
5	244	248	268	195	205	205	394	416	394	288	371	248
6	248	288	268	205	185	210	371	350	438	328	350	268
7	234	268	268	160	165	185	288	371	616	328	328	268
8	212	328	268	195	200	225	268	328	749	308	350	288
9	248	328	268	190	200	250	308	328	749	328	371	288
10	241	350	255	185	185	250	328	328	654	288	328	288
11	248	328	248	180	170	250	308	308	560	308	308	268
12	248	308	248	180	200	330	288	308	466	328	328	248
13	248	328	240	170	190	340	288	288	371	288	416	230
14	288	350	230	130	175	365	288	288	371	288	416	268
15	248	308	210	170	250	355	248	288	328	248	371	288
16	288	308	205	160	235	335	288	288	328	288	328	234
17	248	371	200	175	200	330	268	288	288	268	308	248
18	241	394	195	160	165	280	528	288	308	268	308	248
19	234	328	195	165	225	300	2,060	328	288	248	268	288
20	268	308	185	155	225	270	1,600	350	288	248	288	308
21	288	288	185	145	230	330	1,000	394	288	248	268	328
22	308	288	180	175	205	695	715	438	288	551	268	288
23	328	288	180	160	195	1,910	638	461	371	1,150	248	248
24	308	288	180	175	195	2,480	461	394	416	1,230	268	268
25	328	270	180	175	165	1,510	438	350	461	835	268	248
26	350	248	185	185	220	1,090	461	328	484	506	244	248
27	371	328	185	195	210	916	461	371	438	371	248	268
28	371	288	185	165	200	715	416	416	394	328	244	234
29	328	288	185	220	.....	595	438	371	416	308	248	234
30	328	288	195	215	.....	506	551	328	438	308	241	219
31	328	.....	195	215	.....	461	.....	328	.....	288	244	.....

NOTE.—Stage-discharge relation affected by ice Nov. 25, Dec. 10 and Dec. 13 to Mar. 24. Gage not read June 10–12; discharge interpolated.

Monthly discharge of La Crosse River near West Salem, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 412 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	371	212	284	0.689	0.79
November	394	248	306	.743	.83
December	288	180	223	.541	.62
January	220	130	181	.439	.51
February	250	145	200	.485	.50
March	2,480	165	529	1.28	1.48
April	2,060	248	514	1.25	1.40
May	658	288	379	.920	1.06
June	749	288	420	1.02	1.14
July	1,230	248	397	.964	1.11
August	862	241	337	.818	.94
September	328	219	261	.633	.71
The year	2,480	130	336	.816	11.09

ROOT RIVER NEAR HOUSTON, MINN.

LOCATION.—In sec. 34, T. 104 N., R. 6 W., at highway bridge 1 mile east of Houston, Houston County, 1 mile above mouth of South Root River.

DRAINAGE AREA.—1,560 square miles.

RECORDS AVAILABLE.—May 28, 1909, to Sept. 30, 1917, when station was discontinued.

GAGE.—Vertical staff bolted to the downstream side of the stone abutment, right end of bridge, read by Olaf Larson. Prior to June 28, 1913, gage was attached to piling just above the right abutment. The datum of the present gage was changed slightly on date of installation to allow for slight slope in river between the two points.

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

CHANNEL AND CONTROL.—No well-defined control. Bed of stream is silt and fine sand that scours during floods and gradually fills in afterwards. Banks subject to overflow at stage of about 8.5 feet, the overflow at the gage attaining at times a width of about 5,000 feet. Floods on the South Root, which enters the main Root about a mile below station, at times produce considerable backwater at the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, about 11.95 feet March 24 (discharge estimated, because of ice, about 17,000 second-feet); minimum discharge estimated during period river was frozen over was 280 second-feet Feb. 12 to 22, 24 and March 4.

1909–1917: Maximum stage recorded March 24, 1917; minimum stage recorded during open water period, 0.80 foot July 17, 1911 (discharge 267 second-feet); a discharge of 231 second-feet was measured by current meter on January 23, 1914.

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

REGULATION.—Nearest dam above station is at Rushford. As the flow is ample at all times for the power generated at that point, it is not held back during certain parts of the day, and the dam has no influence on the flow at Houston.

ACCURACY.—Stage-discharge relation not permanent; change occurred in control section between June and September. Rating curve used October 1 to June 30 well defined between 500 and 10,500 second-feet. Daily discharge July 1 to Sept. 30 determined by shifting-control method. Daily discharges during remainder of period obtained by applying mean daily gage height to rating table except during period when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Records fair except those for winter, which are subject to error.

Discharge measurements of Root River near Houston, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 19[a]	R. B. Kilgore	2.82	320	Apr. 28	S. B. Soulé	2.63	759
Feb. 21[a]	S. B. Soulé	3.12	282	June 12	do	3.72	1,170
Mar. 28	do	5.44	2,090	Sept. 27	R. B. Kilgore	2.08	416

[a] Made through complete ice cover.

Daily discharge, in second-feet, of Root River near Houston, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	468	468	474	335	300	305	1,370	888	933	2,230	602	407
2	437	468	503	335	300	295	1,270	978	1,170	1,920	602	437
3	468	468	471	330	300	310	1,170	1,020	1,070	1,580	567	379
4	437	468	471	330	290	280	1,120	933	978	1,370	602	407
5	437	468	468	330	290	290	1,070	843	888	1,270	602	407
6	437	437	465	325	290	315	1,020	799	1,220	1,270	567	407
7	407	468	468	325	290	325	978	716	1,580	1,320	567	437
8	437	602	462	325	285	345	933	716	1,750	1,320	567	500
9	437	638	462	325	285	335	888	676	1,920	1,320	602	533
10	437	638	410	325	285	370	799	638	1,480	1,170	567	468
11	437	602	405	325	285	400	799	638	1,270	1,270	567	437
12	407	567	395	325	280	435	757	602	1,220	1,580	567	437
13	468	567	390	320	280	535	716	567	1,530	1,420	567	437
14	468	500	385	320	280	500	676	567	1,220	1,370	533	468
15	468	500	380	320	280	500	676	567	1,070	1,220	533	437
16	437	567	375	320	280	515	638	533	978	1,070	533	407
17	437	567	375	320	280	480	638	533	933	1,023	500	407
18	437	533	370	320	280	470	978	533	888	933	500	437
19	437	567	360	320	280	430	978	567	843	888	500	437
20	500	500	355	315	280	516	1,070	567	799	843	500	500
21	468	500	350	315	280	600	978	676	757	799	468	468
22	468	500	350	310	280	675	933	716	757	978	468	468
23	437	500	350	310	305	2,230	888	799	2,360	843	533	437
24	437	500	345	310	280	15,000	843	757	5,990	799	468	407
25	533	437	345	305	310	8,000	843	716	7,530	757	437	437
26	500	500	345	305	310	4,740	799	676	5,990	716	468	437
27	500	533	345	305	305	3,000	757	676	4,050	716	468	407
28	500	533	340	305	305	2,160	716	638	3,160	676	437	407
29	500	500	340	305	.....	1,750	799	638	3,250	638	437	437
30	500	500	340	305	.....	1,530	799	638	3,080	602	437	437
31	500	.....	340	305	.....	1,420	.....	757	.....	638	437	.....

NOTE.—Stage-discharge relation affected by ice Dec. 1 to Mar. 25.

Monthly discharge of Root River near Houston, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 1,560 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	533	407	459	0.294	0.34
November	638	437	520	.333	.37
December	503	340	395	.253	.29
January	335	305	318	.204	.24
February	310	280	289	.185	.19
March	15,000	280	1,580	1.01	1.16
April	1,370	638	897	.575	.64
May	1,020	533	696	.446	.51
June	7,530	757	2,020	1.29	1.44
July	2,230	602	1,110	.712	.82
August	602	437	523	.335	.39
September	533	379	438	.281	.31
The year	15,000	280	773	.496	6.70

NORTH BRANCH OF ROOT RIVER NEAR LANESBORO, MINN.

LOCATION.—In sec. 6, T. 103 N., R. 9 W., at first highway bridge 1 mile above junction of North and South branches, 3 miles north of Lanesboro, Fillmore County, and about 5 miles below mouth of a small creek that enters from the west.

DRAINAGE AREA.—647 square miles.

RECORDS AVAILABLE.—March 9, 1910, to September 30, 1914; and July 16, 1915, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage on floor of bridge, downstream side, near right bank; read by Olaf Waage.

DISCHARGE MEASUREMENTS.—Made from the downstream side of the bridge, from the railroad bridge just above the junction with the South branch (at flood stages) or by wading just above the gage.

CHANNEL AND CONTROL.—Bed composed of sand and light gravel. A few hundred feet below the gage the channel is narrowed by a low island and there is a slight riffle that constitutes a control at low stages and is practically permanent. As there is more than 10 feet fall between the station and the mouth of the South Branch backwater from that stream is improbable. At a stage of 6 feet the river overflows into a former channel 1,000 feet back from the right bank. At extreme flood stages the right bank is overflowed to a width of a quarter of a mile.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.0 feet March 23 (discharge estimated, because of ice, about 12,000 second-feet); minimum discharge, during period river was frozen over, February 25–28, estimated at 90 second-feet.

1910–1917: Maximum stage recorded March 23, 1917; minimum open-water stage recorded, 1.71 feet July 4, 1911 (discharge, 38 second-feet).

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

REGULATION.—Several miles above the station is a power plant that is run under a varying load for light and power, but inspection of the morning and evening gage heights indicates that the diurnal fluctuation at the gage is slight.

ACCURACY.—Stage-discharge relation changed during high water of March. Rating curve used before change well defined between 186 and 1,350 second-feet; curve used after change fairly well defined between 155 and 3,400 second-feet. Gage read to quarter tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods in which the stage-discharge relation was affected by backwater from ice for which it was ascertained by applying to the rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Records fair except those for winter, which are subject to error.

Discharge measurements of North Branch Root River near Lanesboro, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 20[a]	R. B. Kilgore	2.73	113	Apr. 28	S. B. Soulé	2.56	307
Feb. 22[a]	S. B. Soulé	2.90	94	June 11	do	3.13	616
Mar. 27	do	4.01	1,120	Sept. 28	R. B. Kilgore	2.21	187

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of North Branch of Root River near Lanesboro, Minn., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	141	186	190	135	110	115	585	475	925	1,040	215	135
2	151	175	180	135	110	110	420	530	678	710	240	128
3	154	172	190	135	110	110	475	502	558	530	194	142
4	164	151	180	135	110	110	475	448	448	448	197	155
5	164	228	185	130	110	110	448	370	420	448	191	164
6	138	192	175	130	105	135	420	325	678	502	240	158
7	146	175	175	130	105	115	395	285	1,080	558	271	173
8	133	247	185	130	105	135	370	257	1,580	710	264	188
9	149	320	185	130	105	125	325	268	1,210	558	240	176
10	154	293	78	125	105	135	285	240	1,000	448	232	158
11	141	282	120	125	105	100	264	226	745	370	226	161
12	151	268	160	125	100	135	246	232	1,250	530	212	173
13	162	254	160	125	100	160	257	226	1,210	780	226	158
14	192	221	155	120	100	245	268	212	710	558	206	155
15	146	164	155	120	100	170	246	206	395	502	206	148
16	159	181	150	120	100	185	229	194	305	395	191	138
17	181	192	150	120	100	165	257	182	305	395	182	130
18	154	261	145	120	100	190	278	191	325	348	173	122
19	162	133	145	120	95	180	305	226	305	305	161	135
20	141	192	145	115	95	180	348	250	285	285	150	161
21	175	198	145	115	95	130	395	305	232	250	155	179
22	154	231	145	115	95	2,260	420	502	197	236	150	173
23	167	189	145	115	95	10,500	370	448	850	271	155	158
24	175	203	140	115	95	3,400	325	370	6,040	285	164	142
25	195	186	140	115	90	2,260	325	305	3,280	257	158	140
26	189	192	140	110	90	1,520	325	348	2,590	229	150	152
27	192	203	135	110	90	925	285	305	1,380	209	145	135
28	209	198	135	110	90	780	285	305	1,830	200	140	132
29	195	209	135	110	.....	710	305	325	1,780	218	128	122
30	192	154	135	110	.....	645	348	370	1,580	222	138	115
31	192	.....	135	110	.....	615	.....	645	.....	236	145	.....

NOTE.—Stage-discharge relation affected by ice Dec. 1 to Mar. 28. Gage not read Nov. 12; discharge interpolated.

Monthly discharge of North Branch of Root River near Lanesboro, Minn., for the year ending Sept. 30, 1917.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	209	133	165	0.255	0.29
November	320	133	208	.321	.36
December	190	78	153	.236	.27
January	135	110	121	.187	.22
February	110	90	100	.155	.16
March	10,500	100	860	1.33	1.53
April	585	229	343	.530	.59
May	645	182	325	.502	.58
June	6,040	197	1,140	1.76	1.96
July	1,040	200	420	.649	.75
August	271	128	189	.292	.34
September	188	115	150	.232	.26
The year	10,500	78	349	.539	7.31

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 (coming in from right), and about 3 miles downstream from power station of Rhinelander Power Co., 10 miles southwest of Rhinelander.

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

RECORDS AVAILABLE.—September 15, 1915, to September 30, 1917; December 1, 1905, to September 30, 1915, for station, about 3 miles upstream.

GAGE.—Stevens continuous water-stage recorder, on right bank, in wooden shelter, well and intake.

DISCHARGE MEASUREMENTS.—Made from a cable 150 feet upstream from gage.

CHANNEL AND CONTROL.—Bed of stream 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 4.15 feet at 10 a. m. April 25 (discharge, 2,900 second-feet); minimum stage recorded 0.86 foot at 8.30 p. m. August 19 (discharge, 232 second-feet).

1905–1917: Maximum stage recorded 5.61 at 10:00 p. m. April 22, 1916 (discharge 5,250 second-feet); minimum discharge recorded, at old station, zero during August and September, 1907, and June, 1908. Minimum flow caused almost entirely by regulation, and at the present station will never be zero discharge. Minimum discharge at new location, 1915–1917, 0.85 foot 5 p. m. August 20, 1916 (discharge 228 second-feet).

REGULATION.—Above the station are 14 reservoirs [1] 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 powerplants on river above this station, 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 October 17 to November 1, December 25 to March 9, and March 21–25. Daily discharge obtained by use of discharge integrator except for periods during which stage-discharge relation was affected by ice or gage was not in operation, for which it was obtained from discharge measurements, recording gage graph and observer's notes, and weather records and comparison of flow of Tomahawk River near Bradley and Wisconsin River at Merrill. Open-water records excellent, except those for periods when gage was not in operation, which may be considerably in error; winter records possibly poor.

Discharge measurements of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 30[a]	4.32	1,130
Mar. 3[a]	3.46	795
June 28	2.99	1,600

[a] Frazil and surface ice at control.

[1] 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 U. S. Geol. Survey 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, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,890	1,300	1,370				1,070	2,170	1,130	1,010	1,100	810
2	1,760	1,360	1,240				1,350	2,120	1,270	1,250	940	520
3	1,630	1,400	955				1,320	2,220	962	1,550	590	310
4	1,630	1,320	788				1,520	2,200	1,120	820	500	640
5	1,560	1,300	916			700	1,560	2,160	1,720	1,330	520	1,080
6	1,420	1,070	1,220				1,900	2,010	1,640	1,580	720	970
7	1,430	1,150	1,100				1,680	1,800	1,960	1,270	1,030	740
8	1,450	1,350	960				1,070	1,910	2,130	700	960	730
9	1,170	1,400	1,050				2,040	1,910	2,180	1,170	970	500
10	824	1,630	929			591	1,720	1,800	1,800	1,330	1,020	490
11	982	1,750	534			636	1,850	1,730	2,040	1,030	980	780
12	944	1,560	632			934	1,920	1,660	2,250	930	630	730
13	1,290	1,590	572			857	1,950	1,090	2,080	1,160	810	610
14	1,020	1,570	754			775	2,110	1,110	1,900	1,000	1,000	560
15	1,040	1,580	745		700	729	1,540	1,610	1,760	780	940	580
16	1,380	1,130	657	750		742	1,360	1,590	1,500	880	1,110	590
17	1,150	1,130	534			730	1,430	1,570	1,180	1,020	1,020	510
18	1,150	1,300	594			1,050	1,570	1,420	1,250	1,160	790	460
19	1,150	1,380	536			1,040	1,670	1,340	1,600	1,140	515	410
20	1,150	1,500	624			946	2,030	885	1,590	860	390	440
21	1,150	1,500	743				2,130	987	1,510	960	910	480
22	1,150	1,500	853			820	2,050	1,330	1,480	650	930	480
23	1,150	1,300	917				2,060	1,320	1,520	720	1,110	600
24	1,150	1,290	964				2,160	1,330	950	710	1,100	690
25	1,150	1,250				702	2,680	1,050	1,370	1,100	900	1,020
26	1,150	1,420				1,020	2,310	942	1,890	1,170	710	690
27	1,150	707	1,050			897	2,270	697	1,760	1,030	720	730
28	1,150	895				864	2,280	942	1,600	1,040	1,070	820
29	1,150	946			.....	772	2,300	1,110	1,570	745	1,160	870
30	1,150	1,340			.....	865	2,390	1,130	1,540	590	870	600
31	1,150	.....			.....	943	.....	1,190	.....	1,020	790	.....

NOTE.—Stage-discharge relation affected by ice Dec. 13 to Apr. 1. Braced figures show mean discharge for periods included. Recording gage not in operation Oct. 17 to Nov. 1; discharge estimated by comparison with records of flow of Tomahawk River near Bradley and Wisconsin River at Merrill.

Monthly discharge of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 1,160 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	.....	.....	1,250	1.08	1.24
November	1,750	895	1,330	1.15	1.28
December	1,370	.....	888	.766	.88
January	.....	.....	750	.647	.75
February	.....	.....	700	.603	.63
March	.....	.....	796	.686	.79
April	2,680	1,070	1,870	1.61	1.80
May	2,220	697	1,490	1.28	1.48
June	2,250	950	1,610	1.39	1.55
July	1,580	590	1,020	.879	1.01
August	1,160	390	865	.746	.86
September	1,080	310	648	.559	.62
The year	2,680	310	1,100	.948	12.89

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, 1917.

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 this date questionable.

DISCHARGE MEASUREMENTS.—Made from highway bridge a few feet upstream from the 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. Banks are fairly high and are rarely overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.8 feet at 9.30 a. m. April 21 (discharge, 10,700 second-feet); minimum stage recorded, 2.9 feet at 6 a. m. July 5 (discharge, about 400 second-feet).

1912–1917: Maximum stage recorded, about 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, about 389 second-feet).

REGULATION.—Above the gaging station are 17 reservoirs,[1] 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 about 6¼ billion cubic feet. In addition to the above reservoirs there are on the Wisconsin and Tomahawk rivers above the station eight dams operated for power.

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

Discharge measurements of Wisconsin River at Merrill, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 28[a]	E. L. Williams	5.78	2,180	Mar. 2[a]	E. L. Williams	5.20	1,390
Jan. 30[a]	do	5.18	1,480	July 3	R. B. Kilgore	6.14	3,740

[a] About one-half of stream frozen over.

[1] 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 U. S. Geological Survey Water-Supply Paper 405, p. 127.

Daily discharge, in second feet, of Wisconsin River at Merrill, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,690	3,720	2,420	1,720	1,620	1,580	3,230	8,850	2,730	3,320	1,740	1,840
2	3,320	3,810	2,630	1,480	1,640	1,410	3,560	8,950	2,380	2,150	1,870	1,940
3	3,130	3,840	2,410	1,320	1,600	1,470	4,590	8,160	2,840	2,960	1,880	1,420
4	2,540	3,910	2,020	1,500	1,620	1,520	5,330	7,760	2,120	3,060	1,890	1,720
5	2,890	3,460	2,030	1,640	1,560	1,180	5,100	7,110	3,370	1,520	2,250	2,440
6	2,700	3,000	1,930	1,300	1,500	1,410	5,350	6,590	4,950	2,610	1,520	2,360
7	2,340	2,990	2,470	1,400	1,740	1,470	5,840	5,590	6,640	2,940	2,110	2,010
8	2,620	4,640	2,420	1,240	1,520	1,430	5,880	5,370	7,510	2,410	2,450	1,990
9	2,540	4,640	1,810	1,220	1,630	1,320	6,550	4,630	7,300	1,590	2,100	1,990
10	2,520	5,020	1,890	1,410	1,640	1,360	7,480	4,300	6,320	2,630	2,080	1,600
11	2,010	5,050	1,740	1,580	1,530	1,410	6,410	4,000	4,600	2,270	2,020	1,360
12	2,180	4,940	1,650	1,500	1,490	1,570	7,300	3,720	4,750	2,420	1,890	1,800
13	2,190	3,810	1,570	1,520	1,470	1,630	7,880	3,340	4,670	1,980	1,550	2,000
14	2,140	3,470	1,630	1,420	1,480	1,680	7,230	2,790	4,250	2,250	2,050	1,930
15	2,200	2,950	1,680	1,450	1,490	1,970	5,840	3,060	3,960	2,080	1,990	2,150
16	2,040	3,380	2,060	1,350	1,430	1,720	4,770	3,240	3,420	1,850	2,170	2,010
17	2,800	2,850	1,860	1,630	1,420	1,810	4,810	2,920	3,040	2,050	1,930	1,470
18	2,430	2,610	1,530	1,370	1,390	1,770	5,030	2,920	2,900	1,700	1,880	1,660
19	3,190	2,920	1,460	1,760	1,530	1,780	6,100	3,100	2,940	2,230	2,970	1,910
20	2,930	2,920	1,800	1,580	1,570	2,080	7,440	2,930	3,140	1,840	1,420	1,750
21	3,490	3,430	1,520	1,370	1,630	2,520	9,480	2,600	3,190	2,050	1,580	1,830
22	3,140	2,880	1,450	1,350	1,590	2,090	9,920	2,750	2,840	1,760	1,700	1,770
23	2,690	3,240	1,480	1,440	1,650	2,490	9,140	2,980	2,860	1,350	1,830	1,920
24	3,320	2,600	1,470	1,620	1,530	2,690	7,820	2,790	2,690	1,920	2,040	1,240
25	3,120	2,180	1,740	1,630	1,590	2,760	7,310	2,680	2,460	1,780	1,830	1,250
26	3,570	2,510	1,530	1,510	1,460	2,310	7,540	2,540	3,770	1,770	1,720	1,990
27	3,420	2,990	1,450	1,560	1,590	2,460	6,520	2,460	3,810	1,660	2,190	1,720
28	3,770	2,240	1,980	1,560	1,560	2,540	7,040	1,460	3,370	1,920	1,900	1,570
29	3,450	2,130	2,020	1,320	.....	2,270	7,440	2,090	3,420	1,850	1,990	1,850
30	3,870	2,260	1,720	1,470	.....	2,480	8,180	2,200	3,190	1,740	1,950	2,000
31	3,550	.....	1,880	1,600	.....	3,120	.....	2,300	.....	1,750	2,040	.....

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Apr. 4. Discharge for Oct. 23, Nov. 14, Dec. 18, 20–23, 29, Jan. 4–6, Feb. 17, 18, Aug. 13–18, based on gage heights for less than 24-hour period.

Monthly discharge of Wisconsin River at Merrill, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 2,630 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,870	2,010	2,900	1.10	1.27
November	5,050	2,130	3,350	1.27	1.42
December	2,630	1,450	1,850	.703	.81
January	1,760	1,220	1,480	.563	.65
February	1,740	1,420	1,550	.589	.61
March	3,120	1,180	1,910	.726	.84
April	9,920	3,230	6,540	2.49	2.78
May	8,950	1,460	4,070	1.55	1.79
June	7,510	2,120	3,850	1.46	1.63
July	3,320	1,350	2,110	.802	.92
August	2,970	1,420	1,950	.741	.85
September	2,440	1,240	1,820	.692	.77
The year	9,920	1,180	2,780	1.06	14.34

WISCONSIN RIVER NEAR NEKOOSA, WIS.

LOCATION.—In sec. 15, T. 21 N., R. 5 E., 1½ miles below Nekoosa, Wood County. Tenmile Creek enters from left about 4 miles below station, and Big Roche a Cri Creek, also from left, about 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, 1917.

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 upstream from gage.

CHANNEL AND CONTROL.—Gravel; clean; practically permanent. Banks are high and are rarely overflowed.

EXTREMES OF DISCHARGE.—Maximum stage during year, 10.02 feet at 10 p. m. April 5 (discharge, 24,700 second-feet); minimum discharge, 835 second-feet January 10. 1914–1917: Maximum stage, as determined by levels run to high-water marks after water had receded, about 15.3 feet during the flood of June 6 to 9, 1914 (discharge, 54,600 second-feet); minimum stage 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 Wisconsin River between Nekoosa and Merrill. See "Regulation" in station description of Wisconsin River at Merrill (p. 111). 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 water-stage recorder satisfactory, except October 1 and November 22. Daily discharge ascertained by use of discharge integrator, except December 15 to March 29, for which it was obtained by applying to rating table, mean daily gage height corrected for effect of ice by means of discharge measurements, recording gage records, observer's notes, and weather records. Open-water records excellent; winter records fair.

Discharge measurements of Wisconsin River near Nekoosa, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 30[a]	E. L. Williams	3.55	1,580	Mar. 5[a]	E. L. Williams	3.17	1,520
Feb. 1[a]	do	3.56	2,220	July 10	R. B. Kilgore	2.51	3,860

[a] Complete ice cover.

Daily discharge, in second-feet, of Wisconsin River near Nekoosa, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	6,410	7,130	4,400	2,850	2,630	1,800	12,600	16,500	3,280	4,450	3,150	2,760
2	6,120	6,740	4,300	2,380	2,780	2,500	14,400	18,700	4,180	5,180	3,380	2,600
3	5,200	6,360	3,980	2,500	2,[illegible]50	1,960	15,800	19,000	4,480	4,570	3,040	3,220
4	4,890	6,480	4,070	2,450	2,790	2,450	17,800	17,500	4,600	3,430	2,500	2,630
5	4,750	6,530	4,220	2,440	3,100	2,060	21,200	15,000	4,680	4,370	2,460	2,800
6	3,960	6,580	4,210	2,300	2,320	2,070	23,600	12,900	5,080	4,240	2,860	2,450
7	3,960	6,380	3,620	1,720	2,550	2,050	22,400	11,000	8,480	3,450	1,740	2,990
8	4,120	5,430	3,860	2,330	2,880	2,400	20,400	9,700	13,100	3,060	2,380	3,730
9	3,780	6,630	3,640	1,430	2,820	3,160	20,200	8,470	18,100	3,[illegible]0	3,480	3,700
10	3,460	10,200	2,380	1,880	2,810	2,490	18,400	7,800	18,100	4,110	4,020	2,870
11	3,910	11,000	3,800	1,600	2,850	2,380	17,100	6,960	15,000	4,620	3,700	2,440
12	4,140	10,300	3,240	2,160	2,500	2,100	16,300	6,700	10,800	3,030	3,710	2,780
13	4,190	8,900	3,080	1,850	1,760	2,040	16,800	6,380	8,410	3,610	3,310	2,790
14	3,480	7,120	2,500	2,180	2,480	2,470	17,700	5,750	8,170	3,730	4,580	2,820
15	3,740	5,370	3,820	2,880	2,730	2,370	15,700	5,180	7,330	3,280	5,900	2,860
16	3,060	5,130	3,680	1,680	2,650	3,220	13,700	4,770	6,800	3,050	4,940	3,240
17	2,910	4,970	3,780	2,170	2,330	2,670	10,600	4,790	5,280	3,250	5,400	3,010
18	3,800	4,880	3,650	2,250	2,670	2,720	9,440	4,[illegible]00	5,700	3,550	4,390	3,160
19	3,490	5,340	3,440	2,370	2,120	3,300	10,500	4,570	4,700	3,370	3,740	3,030
20	4,290	5,430	2,930	1,940	1,670	2,550	13,700	4,580	4,960	3,420	3,400	2,680
21	4,300	4,920	3,370	2,250	2,270	2,760	16,100	5,250	4,400	2,640	3,190	2,520
22	4,590	4,970	3,370	2,660	2,530	3,060	18,000	4,970	4,640	2,410	3,280	2,160
23	5,050	5,340	3,170	1,[illegible]60	2,120	3,250	19,400	4,670	4,550	2,860	2,970	1,740
24	4,840	5,260	3,180	2,510	2,310	3,800	18,400	4,480	4,210	2,790	2,970	2,500
25	4,880	4,800	2,580	2,220	2,330	4,110	15,300	4,610	4,470	3,710	3,120	2,300
26	5,210	3,690	3,910	2,450	2,310	6,060	13,500	4,550	4,380	3,350	2,450	2,400
27	5,280	4,440	2,430	2,690	1,530	7,050	12,600	4,210	4,700	2,760	2,700	2,430
28	6,250	3,750	1,780	2,480	2,040	8,840	12,700	4,320	5,060	2,[illegible]00	2,290	2,660
29	6,330	5,040	2,730	2,710	.....	9,510	12,900	6,840	5,330	2,450	2,840	2,530
30	6,340	4,670	2,530	1,550	.....	10,000	14,500	3,560	4,[illegible]00	2,330	2,960	2,530
31	6,560	.....	2,560	2,090	.....	11,600	.....	3,600	.....	2,430	2,910	.....

NOTE.—Stage-discharge relation affected by ice Dec. 15 to Mar. 29. Gage not operating satisfactorily Oct. 1, Nov. 22; discharge partly estimated.

Monthly discharge of Wisconsin River near Nekoosa, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 5,500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	6,560	2,910	4,620	0.840	0.97
November	11,000	3,690	6,110	1.11	1.24
December	4,400	1,780	3,360	.611	.70
January	2,880	1,430	2,220	.404	.47
February	3,100	1,530	2,450	.445	.46
March	11,600	1,800	3,830	.696	.80
April	23,600	9,440	16,100	2.93	3.27
May	19,000	3,560	7,710	1.40	1.61
June	18,100	3,280	6,930	1.26	1.41
July	5,180	2,330	3,430	.624	.72
August	5,900	1,740	3,350	.609	.70
September	3,730	1,740	2,740	.498	.56
The year	23,600	1,430	5,230	.951	12.91

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 about half a mile below station, and Underwood Creek from left about 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, 1917. 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 about 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 about the same as that of present gage, sea-level elevation of which is 666.2 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 6.95 feet April 11 (discharge 32,800 second-feet); minimum discharge estimated 3,400 second-feet February 12.

1903 and 1914–1917: 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 stage recorded 0.7 foot December 2, 1914, and 5 p. m. July 24, 1915 (discharge about 3,140 second-feet).

According to the records of the United States Weather Bureau [1] (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 last part of 1915 considerable diurnal fluctuation has been observed at the gage. Owing to regulation by storage in the headwaters the flow at this station is not natural.

ACCURACY.—Stage-discharge relation not permanent; affected by ice. Rating curve used during 1917, fairly well defined between 5,200 and 45,000 second-feet. Gage read to quarter-tenths twice a day. 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 height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good, except for 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, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Jan. 6[a]	E. L. Williams	3.30	4,390
Feb. 15[a]	Hoyt and Williams	3.25	4,060
July 31	Kilgore and Entringer	2.11	7,230

[a] Complete ice cover.

[1] U. S. Dept. Agr., Daily river stages, pt. 10, p. 98.

Daily discharge, in second-feet, of Wisconsin River at Muscoda, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8,140	11,800	9,700	4,450	3,790	4,220	23,100	20,300	9,700	14,800	7,040	4,940
2	8,140	10,100	10,500	4,450	4,000	4,000	23,100	19,700	9,300	13,000	6,700	4,940
3	8,900	8,520	10,500	4,450	3,790	3,590	19,700	19,700	9,700	12,200	6,380	4,940
4	10,100	10,500	8,900	4,450	3,790	3,590	21,400	21,900	10,900	12,200	6,060	5,200
5	12,200	11,800	7,760	4,450	3,790	3,590	23,100	22,500	10,500	12,600	6,380	5,480
6	9,300	11,300	8,140	4,450	4,000	4,000	24,400	24,400	10,100	13,000	5,480	6,060
7	7,400	10,500	7,760	4,450	4,000	4,450	25,700	25,100	12,200	11,800	6,380	6,060
8	7,760	10,100	8,140	3,790	4,000	4,940	27,100	26,400	14,400	8,900	7,040	6,380
9	7,400	10,500	7,760	4,220	3,790	4,940	30,000	25,700	13,000	8,900	6,700	6,700
10	6,700	10,900	7,400	4,220	4,000	4,940	31,600	19,700	13,000	7,760	6,700	6,060
11	6,700	10,900	7,760	4,450	3,790	6,380	31,600	16,700	14,400	8,140	6,060	6,380
12	6,700	8,900	8,520	4,220	3,400	7,040	30,800	14,800	19,700	8,520	6,060	6,060
13	6,700	10,100	7,040	3,790	4,000	7,040	30,000	14,800	21,900	8,520	5,480	6,380
14	6,380	13,500	5,480	4,450	4,000	7,760	27,800	12,600	25,100	7,400	5,760	6,700
15	5,200	14,800	5,200	3,590	4,000	7,040	25,700	10,100	26,400	7,400	7,040	6,060
16	5,200	13,500	5,200	4,000	4,000	8,900	20,800	12,200	20,800	6,380	9,300	6,380
17	5,480	8,900	4,940	4,220	4,000	9,700	21,900	12,200	14,400	6,700	7,400	5,760
18	6,060	7,400	4,940	4,450	3,790	7,400	23,100	11,300	12,600	7,400	5,760	6,060
19	7,400	9,700	4,940	4,450	3,590	7,040	23,800	10,500	14,400	7,400	6,380	6,380
20	7,400	9,700	4,940	4,000	4,000	8,140	19,700	8,900	14,400	7,040	8,140	6,700
21	7,760	10,500	4,940	4,000	4,220	10,500	18,700	9,700	10,100	6,700	11,300	6,700
22	6,700	10,900	4,940	3,790	4,000	13,000	18,200	11,800	8,140	7,760	8,520	6,060
23	6,060	11,300	4,940	4,000	4,000	15,300	18,700	10,900	10,900	8,520	6,700	6,380
24	7,040	11,300	4,690	4,220	3,790	17,700	21,400	8,900	13,000	10,500	6,700	5,200
25	8,900	8,140	4,690	4,450	4,000	17,200	23,100	9,300	20,300	9,300	6,700	5,760
26	9,700	9,300	4,690	4,220	3,590	17,200	25,100	10,900	17,700	7,760	6,700	6,060
27	9,300	8,140	4,690	4,000	3,790	17,700	26,400	11,300	13,900	7,760	6,060	5,480
28	10,100	8,520	4,690	4,000	4,000	17,200	25,700	10,500	12,500	7,040	6,380	5,480
29	10,100	8,520	4,450	3,590	.....	17,700	25,700	10,900	14,800	7,040	5,760	4,940
30	8,900	8,520	4,450	4,220	.....	20,800	20,800	10,100	14,400	6,380	6,060	5,200
31	10,900	.....	4,450	4,000	.....	21,400	.....	9,300	.....	7,040	5,200	.....

NOTE.—Stage-discharge relation affected by ice, Dec. 15 to Mar. 25.

Monthly discharge of Wisconsin River at Muscoda, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 10,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	12,200	5,200	7,890	0.766	0.88
November	14,800	7,400	10,300	1.00	1.12
December	10,500	4,450	6,360	.617	.71
January	4,450	3,590	4,180	.406	.47
February	4,220	3,400	3,890	.378	.39
March	21,400	3,590	9,820	.953	1.10
April	31,600	18,200	24,300	2.36	2.63
May	26,400	8,900	14,900	1.45	1.67
June	26,400	8,140	14,500	1.41	1.57
July	14,800	6,380	8,900	.864	1.00
August	11,300	5,200	6,720	.652	.75
September	6,700	4,940	5,900	.573	.64
The year	31,600	3,400	9,810	.952	12.93

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 (coming in from right), and 8 miles above mouth of river.

DRAINAGE AREA.—422 square miles.

RECORDS AVAILABLE.—September 18, 1914, to September 30, 1917.

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

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

CHANNEL AND CONTROL.—Bed at gage and a short distance below, sandy and likely to shift. Control is formed by rapids about 2,000 feet below gage. Bed at cable section heavy gravel; permanent. When a head of 15 feet is maintained in Rice Lake storage dam, in sections 4 and 9, T. 35 N., R. 6 E., backwater will extend halfway up the rapids which are below the gage, and may affect the discharge relation. The maximum head maintained during year at the reservoir was 13 feet 1 inch, during July 21, which apparently did not affect the control for the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 4.31 feet at 7.25 a. m. April 22 (discharge, 927 second-feet); minimum stage, 1.72 feet at 6.45 a. m. September 12 (discharge, 229 second-feet).

1914–1917: Maximum stage recorded, 6.88 feet April 24, 1916 (discharge, 2,190 second-feet); minimum stage recorded, September 12, 1917.

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 in the 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. Rating curve well defined between 240 and 1,970 second-feet. Gage read to hundredths twice daily. 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 height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good except for extremely low stages for which they are fair; winter records fair.

Discharge measurements of Tomahawk River near Bradley, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 16[a].....	3.10	378	Mar. 7[a].....	3.32	506
Feb. 1[a].....	3.02	340	June 27.....	3.62	696

[a] Complete ice cover.

Daily discharge, in second-feet, of Tomahawk River near Bradley, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	516	604	566	350	340	295	640	815	460	604	243	265
2	488	604	589	365	340	310	650	850	474	574	240	258
3	474	589	546	360	345	325	610	850	460	530	246	252
4	460	559	502	355	360	320	575	815	460	502	248	248
5	447	544	488	350	380	320	582	780	488	474	273	246
6	434	516	516	340	365	310	589	746	516	488	278	246
7	434	516	488	340	350	305	596	713	619	516	295	243
8	421	589	474	345	350	315	604	681	697	516	322	242
9	421	666	474	350	355	325	619	650	713	502	328	237
10	421	681	516	355	360	330	681	619	713	474	322	234
11	421	681	502	350	360	340	798	589	666	460	308	232
12	421	666	502	340	360	350	780	559	604	474	293	232
13	474	559	516	325	360	360	763	559	574	474	285	268
14	488	295	502	310	345	380	746	516	544	460	280	345
15	488	396	490	300	335	395	681	488	530	434	293	384
16	502	604	475	290	340	380	650	474	502	408	320	384
17	574	666	445	320	345	370	634	460	488	396	316	349
18	589	666	420	350	350	370	681	460	516	372	300	328
19	589	604	410	360	350	370	763	474	544	338	300	326
20	589	574	395	375	340	365	850	488	544	332	280	324
21	589	559	385	350	330	360	923	488	544	318	275	320
22	574	502	385	330	330	385	923	474	530	300	268	314
23	559	502	370	340	330	410	923	447	544	293	268	310
24	544	502	370	345	330	410	886	421	574	293	271	304
25	589	475	370	340	330	415	291	408	634	293	271	304
26	619	475	370	330	340	400	798	396	681	282	278	340
27	619	460	370	345	345	390	746	384	681	271	308	384
28	619	460	370	355	320	480	730	372	681	261	326	396
29	619	502	370	350	.....	565	730	365	681	255	308	384
30	604	544	360	340	.....	595	798	363	650	249	284	384
31	604	.....	345	340	.....	625	.....	408	.....	246	268	.....

NOTE.—Stage-discharge relation affected by ice Nov. 25–27 and Dec. 15 to Apr. 5. Gage not read, discharge interpolated, Nov. 29, Dec. 1, 3, and Apr. 7.

Monthly discharge of Tomahawk River near Bradley, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 422 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	619	421	522	1.24	1.43
November	681	295	552	1.31	1.46
December	589	345	448	1.06	1.22
January	375	290	342	.810	.93
February	380	320	346	.820	.85
March	625	295	383	.908	1.05
April	923	291	708	1.68	1.87
May	850	363	552	1.31	1.51
June	713	460	577	1.37	1.53
July	604	246	400	.948	1.09
August	328	240	287	.680	.78
September	396	232	303	.718	.80
The year	923	232	452	1.07	14.52

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 about 5½ miles above mouth of river. Haymeadow Creek enters from left about 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, 1917.

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

DISCHARGE MEASUREMENTS.—At low stages made by wading; at medium and high stages from downstream side of bridge to which gage is attached.

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, 4.0 feet June 8 (discharge, 870 second-feet); minimum discharge about 80 second-feet January 11, 12, and 16.

1914–1917: Maximum stage recorded, 6.1 feet April 22, 1916 (discharge, 2,290 second-feet); minimum discharge, 72 second-feet, by discharge measurement January 4, 1915. Absolute minimum occurred during winter period 1914–15, 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 to half-tenths once a day. 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 height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records excellent; winter records good.

Discharge measurements of Prairie River near Merrill, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 28[a]	E. L. Williams	2.10	88	Mar. 2[a]	E. L. Williams	1.92	91
Jan. 30[a]	do	1.94	86	July 4	R. B. Kilgore	1.97	132

[a] Control partly frozen over.

Daily discharge, in second-feet, of Prairie River near Merrill, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	366	384	148	85	85	90	313	614	159	172	106	110
2	278	366	133	85	90	90	402	574	159	172	101	110
3	244	278	133	85	90	90	535	535	184	133	93	115
4	212	244	137	85	90	90	655	496	313	122	93	110
5	184	212	137	90	90	95	244	440	348	118	184	159
6	172	184	172	85	90	90	421	384	614	128	184	184
7	159	159	159	85	90	95	535	348	825	122	184	184
8	148	458	148	85	95	95	313	296	870	128	212	159
9	159	458	137	90	95	100	458	278	825	128	212	148
10	148	496	125	85	90	95	614	278	870	118	184	148
11	148	384	120	80	90	100	614	244	825	118	159	159
12	137	348	115	80	90	95	781	184	870	128	137	159
13	159	313	110	85	90	95	781	212	614	128	133	159
14	159	244	110	85	90	95	655	198	458	118	122	159
15	159	261	105	85	90	95	496	184	278	115	118	159
16	159	278	105	80	95	100	384	184	212	118	115	137
17	184	212	105	85	95	95	348	184	184	110	106	128
18	198	212	100	85	95	95	384	184	198	110	106	122
19	198	212	100	85	95	100	458	244	184	110	110	122
20	184	184	95	85	95	110	535	278	184	110	115	122
21	198	159	95	85	90	110	614	278	184	106	110	106
22	198	159	95	85	90	130	655	244	159	101	110	106
23	198	159	90	85	90	135	696	228	159	101	106	103
24	212	184	90	90	90	155	535	212	159	97	110	103
25	212	160	90	90	90	159	458	184	212	91	110	103
26	212	170	90	90	90	184	440	172	244	89	115	106
27	228	175	90	85	90	184	421	159	228	93	122	106
28	244	180	90	85	90	184	496	137	212	103	128	110
29	313	184	90	85	.....	184	574	137	212	103	133	106
30	348	159	90	85	.....	212	574	159	184	106	122	103
31	402	.....	95	85	.....	278	.....	159	.....	103	115	.....

NOTE.—Stage-discharge relation affected by ice Nov. 25–28 and Dec. 10 to Mar. 24.

Monthly discharge of Prairie River near Merrill, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 164 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	402	137	210	1.28	1.48
November	496	159	253	1.54	1.72
December	172	90	113	.689	.79
January	90	80	85.3	.520	.60
February	95	85	91.1	.555	.58
March	278	90	123	.750	.86
April	781	244	513	3.13	3.49
May	614	137	271	1.65	1.90
June	870	159	371	2.26	2.52
July	172	89	116	.707	.82
August	212	93	131	.799	.92
September	184	103	130	.793	.88
The year	870	80	200	1.22	16.56

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, about a 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, 1917.

GAGE.—Chain gage fastened to downstream side of highway bridge; read by W. 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, 3.22 feet at 10 a. m. April 4 (discharge, 1,310 second-feet); minimum discharge estimated 50 second-feet for several days in January.

1914–1917: Maximum stage recorded, 5.1 feet April 22 and 23, 1916 (discharge, 3,270 second-feet); mimimum open-water stage recorded, 0.45 foot, August 13, 14, 15, Oct. 2 and 3, 1914 (discharge, about 40 second-feet). Discharge January 14, 17, and 18, 1916, estimated at 40 second-feet; minimum for winter period probably somewhat below this figure.

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 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 height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Discharge for practically 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, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 29[a]	E. L. Williams	1.36	71	Mar. 3[a]	E. L. Williams	1.33	67
Jan. 31[a]	do	1.36	68	July 2	R. B. Kilgore	1.25	199

[a] Almost complete ice cover.

Daily discharge, in second-feet, of Eau Claire River at Kelly, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	358	499	210	60	65	70	670	990	193	176	102	93
2	300	443	204	60	65	70	677	990	213	193	114	94
3	252	390	196	60	70	65	990	862	228	171	104	94
4	227	340	188	65	70	65	1,290	677	244	139	93	102
5	182	340	155	65	70	65	1,290	587	263	139	94	142
6	199	340	199	65	65	70	1,210	488	416	147	96	252
7	185	340	216	55	65	70	1,210	390	1,130	139	114	204
8	176	365	213	55	65	70	1,070	340	1,210	147	210	177
9	168	647	216	55	65	70	925	320	1,210	155	213	153
10	132	647	183	50	70	70	800	300	914	139	193	129
11	152	617	150	50	70	70	862	267	617	129	158	129
12	155	458	171	50	70	70	862	250	528	132	300	114
13	158	300	155	50	70	70	769	236	340	129	443	129
14	158	284	155	55	70	75	617	221	300	129	390	145
15	144	255	140	55	80	75	530	221	255	116	210	145
16	129	284	130	50	80	80	443	210	238	104	168	150
17	158	267	115	50	70	80	416	204	216	129	150	155
18	160	261	115	55	80	80	443	199	193	104	129	129
19	182	236	105	55	85	80	617	207	188	104	116	116
20	179	210	105	55	85	85	738	222	185	94	104	116
21	224	224	100	50	80	85	990	238	165	104	104	106
22	224	216	95	50	80	95	990	235	150	116	112	104
23	224	221	95	50	80	110	990	227	155	129	116	94
24	235	210	85	50	80	110	862	216	163	119	100	85
25	238	188	80	50	80	160	738	179	171	104	93	85
26	340	202	80	50	85	215	647	182	177	93	106	89
27	390	215	75	55	80	325	617	222	179	93	119	93
28	443	207	75	55	80	310	708	261	171	85	124	85
29	457	207	70	60	.....	285	816	250	168	85	104	85
30	471	182	70	70	.....	380	925	196	158	85	89	85
31	528	.....	70	70	.....	660	.....	179	.....	87	85	.....

NOTE.—Stage-discharge relation affected by ice Dec. 13, to Apr. 2. No gage readings Oct. 1, 8, 15, 22, 29, Nov. 5, 12, 19, 23, Dec. 3, 10, 17, 24, Apr. 8, 15, 22, 29, May 6, 13, 20, 27, June 3, 10, 17, 24, July 1, 8, 15, 22, 29, Aug. 5, 12, 19, 26, Sept. 2, 9, 16, 23, 30; discharge interpolated.

Monthly discharge of Eau Claire River at Kelly, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 326 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	528	129	243	0.745	0.86
November	647	182	320	.982	1.10
December	216	70	136	.417	.48
January	70	50	55.6	.171	.20
February	85	65	74.1	.227	.24
March	660	65	135	.414	.48
April	1,290	416	824	2.53	2.82
May	990	179	341	1.05	1.21
June	1,210	150	358	1.10	1.23
July	193	85	123	.377	.43
August	443	85	150	.460	.53
September	252	85	123	.377	.42
The year	1,290	50	240	.736	10.00

BIG EAU PLEINE RIVER NEAR STRATFORD, WIS.

LOCATION.—In sec. 13, T. 27 N., R. 3 E., at highway bridge at a place known locally as Weber Farm, about 2 miles north of Stratford, Marathon County, about 1 mile above Chicago & North Western Railway bridge. Dill Creek enters from right about 5 miles above station.

DRAINAGE AREA.—223 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 24, 1914, to September 30, 1917.

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 the 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 stage recorded during open-water period of year 7.42 feet at 6.30 a. m. April 4 (discharge, 3,670 second-feet); minimum open-water discharge, 11 second-feet December 22–30.

1914–1917: Maximum recorded stage 8.85 feet at 6 p. m. April 21, 1916 (discharge, 5,540 second-feet); minimum discharge, 3.0 second-feet, by current-meter measurement February 5, 1915. 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 as affected by ice. Rating curve fairly well defined between 5 and 4,000 second-feet; gage read to quarter-tenths twice daily. Daily discharge obtained by applying mean daily gage height to rating table; estimated December 5–10, 31 and April 1–3 when stage-discharge relation was affected by ice. High-stage records good; records for medium and low stage fair.

Discharge measurements of Big Eau Pleine River near Stratford, Wis., during the year ending Sept. 30, 1917.

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 7	6.42	2,550
Aug. 24	1.70	20

Daily discharge, in second-feet, of Big Eau Pleine River near Stratford, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	162	280	57	3,000	1,110	47	25	18	12
2	120	223	49	3,000	840	60	27	31	12
3	81	192	49	3,000	470	63	19	27	12
4	61	403	49	3,090	327	69	17	19	12
5	57	310	45	1,810	241	310	15	55	24
6	57	230	45	1,810	182	642	18	83	25
7	57	188	45	1,810	145	2,210	22	55	22
8	49	1,260	45	1,330	123	1,490	19	195	19
9	49	1,570	45	1,040	105	720	17	134	17
10	49	780	43	840	83	382	15	69	15
11	49	518	34	1,110	75	215	17	44	15
12	49	310	28	840	60	175	22	31	13
13	55	230	22	694	55	112	19	44	15
14	57	162	22	470	47	75	17	33	15
15	57	162	22	327	40	60	15	27	25
16	49	132	18	260	40	44	15	24	22
17	49	103	18	247	33	36	15	19	18
18	49	87	18	327	31	33	15	18	18
19	40	77	14	694	36	31	19	22	15
20	40	77	14	1,040	40	27	27	40	15
21	40	73	14	1,040	44	25	19	31	15
22	40	67	11	780	63	22	24	24	13
23	40	73	11	494	63	22	182	22	12
24	40	98	11	344	55	22	123	18	12
25	87	81	11	295	50	27	55	18	12
26	272	57	11	269	33	31	31	18	12
27	205	55	11	566	31	27	24	17	12
28	167	55	11	694	29	22	18	15	12
29	180	57	11	780	25	22	17	15	12
30	239	67	11	1,110	25	18	13	15	12
31	217	.....	10	.....	36	.....	12	12	.....

Monthly discharge of Big Eau Pleine River near Stratford, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 223 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	272	40	89.1	0.400	0.46
November	1,570	55	266	1.19	1.33
December	57	10	26.8	.120	.14
April	3,090	247	1,100	4.93	5.50
May	1,110	25	146	.655	.76
June	2,210	18	235	1.05	1.17
July	182	12	28.8	.129	.15
August	195	12	38.5	.173	.20
September	25	12	15.5	.070	.08

PLOVER RIVER NEAR STEVENS POINT, WIS.

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

DRAINAGE AREA.—136 square miles.

RECORDS AVAILABLE.—January 5, 1914, to September 30, 1917.

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

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and small rock; permanent and free from vegetation. 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, 2.55 feet at 8 a. m. May 1 (discharge, 452 second-feet); minimum discharge estimated 45 second-feet, February 5–7.

1914–1917: Maximum stage recorded, 4.75 feet, June 5, 1914 (discharge, about 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 the station, but the plants have little pondage so that the flow at the gage, except for brief periods, is nearly natural.

ACCURACY.—Stage-discharge relation probably permanent, except as affected by ice. Rating curve used October 1 to April 2 well defined between 116 and 1,370 second-feet; curve used April 3 to September 30 fairly well defined from 105 to 1,370 second-feet. Gage read to quarter tenths twice daily. 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 was ascertained by applying to rating table mean daily gage height corrected for effect of ice by results of discharge measurements, observer's notes, and weather records. Open-water records fair, except for 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, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 1[a]	E. L. Williams	1.52	75	Mar. 6[a]	E. L. Williams	1.89	80
Feb. 2[a]	....do	2.14	86	July 9	R. B. Kilgore	1.25	128

[a] Complete ice cover.

Daily discharge, in second-feet, of Plover River near Stevens Point, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	173	144	178	75	60	90	360	438	144	144	124	144
2	153	184	194	70	70	90	405	357	118	144	155	144
3	153	184	178	70	70	90	357	357	189	124	144	134
4	134	184	163	95	55	95	383	284	189	144	124	144
5	144	173	148	120	45	90	383	332	189	124	124	134
6	144	216	134	110	45	80	383	260	260	134	114	144
7	116	173	134	95	45	80	383	248	284	124	124	134
8	134	184	134	90	50	75	357	212	284	134	124	124
9	134	205	117	80	50	80	332	212	308	144	155	144
10	144	216	100	80	60	85	357	212	284	134	118	124
11	125	216	95	75	70	90	308	189	166	124	166	114
12	134	194	95	70	75	90	332	189	260	144	144	124
13	173	194	90	70	70	100	308	212	212	134	166	114
14	144	185	85	65	70	115	284	118	212	124	357	105
15	134	175	85	60	75	130	224	189	189	124	332	105
16	144	165	85	60	80	145	236	166	118	124	284	124
17	134	145	100	60	80	140	236	189	166	134	200	124
18	134	125	110	65	80	130	260	189	166	124	144	134
19	125	163	105	60	75	110	260	189	134	114	124	105
20	163	163	100	60	70	95	357	189	144	105	124	105
21	153	168	110	65	70	140	332	189	88	105	134	134
22	153	173	125	70	75	185	357	118	144	124	144	124
23	163	163	120	60	80	230	332	189	166	124	88	105
24	153	153	115	55	85	215	308	166	96	124	166	144
25	173	163	100	55	80	240	189	144	166	124	155	134
26	163	173	85	55	75	260	189	166	212	114	124	144
27	153	178	85	50	80	250	189	166	200	124	75	134
28	173	184	85	55	90	240	284	144	144	96	80	105
29	194	174	80	60	.....	245	296	144	144	88	124	124
30	153	163	70	60	.....	250	357	144	144	88	134	124
31	153	.....	70	50	.....	305	.....	166	.....	105	144	.....

NOTE.—Stage-discharge relation affected by ice Nov. 14–17, Dec. 11 to Apr. 2.

Monthly discharge of Plover River near Stevens Point, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 136 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	194	116	149	1.10	1.27
November	216	125	176	1.29	1.43
December	194	70	112	.823	.95
January	120	50	69.8	.513	.59
February	90	45	68.9	.507	.53
March	305	75	147	1.08	1.25
April	405	189	311	2.29	2.56
May	438	118	209	1.54	1.78
June	308	88	184	1.35	1.51
July	144	88	123	.904	1.04
August	357	75	152	1.12	1.29
September	144	105	127	.933	1.04
The year	438	45	153	1.12	15.24

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, about 3 miles below creek rising near Devils Lake, coming 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, 1917.

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, about 17.5 feet March 26 (discharge, 4,200 second-feet); minimum discharge, 100 second-feet January 31.

1914–1917: Maximum stage recorded about 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 the station, there are four dams, and one at Reedsburg, 18 miles above the station. Smaller plants are also operated on the tributaries. The operation of these various plants causes diurnal fluctuation at the 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. Rating curve used October 1, 1915, to March 21, 1917, fairly well defined between 167 and 2,600 second-feet; extended and roughly approximate above and below these limits. Curve used March 22 to September 30, 1917, fairly well defined between 150 and 3,270 second-feet. 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 height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records roughly approximate.

Discharge measurements of Baraboo River, near Baraboo, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 26[a]	E. L. Williams	2.20	121	Mar. 28[b]	W. G. Hoyt	14.77	3,110
Jan. 26[a]	do	2.94	154	May 3	E. L. Williams	7.38	974
Feb. 28[a]	do	2.81	154				

[a] Complete ice cover.

[b] 1,720 feet of overflow section; velocity in overflow section estimated from a boat. Area of cross section determined with level May 3.

Daily discharge, in second-feet, of Baraboo River near Baraboo, Wis., for the years ending Sept. 30, 1915 and 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914–15.												
1	178	188	178				544	190	274	159	449	198
2	186	179	174				531	187	246	102	449	179
3	162	196	200				544	226	232	155	662	175
4	163	192	196				602	226	220	149	602	165
5	136	190	184				677	232	204	146	617	153
				115	225	360						
6	164	182	167				849	232	194	141	544	155
7	179	186	189				970	253	188	142	477	169
8	193	171	177				1,070	267	206	203	602	170
9	274	173	182				1,130	295	213	195	365	221
10	632	161	174				1,170	309	203	192	288	226
11	407	179	184			323	1,030	267	208	200	253	351
12	288	175	177			421	898	226	195	181	239	769
13	365	175	160			518	817	200	226	192	239	1,260
14	477	163				722	692	198	213	200	288	1,190
15	463	173				785	587	195	200	186	274	1,430
				250	565							
16	477	226	140			801	463	198	232	165	544	1,560
17	463	232				849	393	203	195	156	865	1,660
18	421					865	365	220	198	165	932	1,500
19	288					881	344	212	200	159	801	1,230
20	260					849	309	393	195	177	531	1,130
21	246	140				915	288	753	195	187	309	1,090
22	232					915	274	849	213	167	220	915
23	226					990	260	849	200	184	190	769
24	213					1,110	239	785	203	167	220	512
25	173				1,340	1,380	220	662	208	152	226	407
26	198	136	110	190		1,600	220	477	195	144	209	463
27	205	153				1,500	226	421	176	196	195	557
28	226	188				1,460	203	393	155	531	167	557
29	190	172				1,090	210	379	170	707	163	512
30	190	172				865	198	337	170	769	153	435
31	190	.....				722	.....	302	.....	722	175	.....
1916–17.												
1	378	572	364	130	215	230	1,050	890	440	1,010	231	150
2	273	497	364	200	185	225	799	1,050	671	1,130	186	144
3	259	378	308	215	215	205	703	970	1,390	970	180	142
4	252	329	294	205	130	160	623	832	1,260	890	168	174
5	246	226	336	215	200	240	575	623	1,110	671	186	168
6	232	266	294	175	190	225	545	470	1,290	455	174	151
7	196	287	287	150	240	310	470	383	1,660	355	299	168
8	188	364	301	155	230	330	411	369	1,600	327	440	174
9	184	497	280	215	175	340	383	355	1,520	313	313	180
10	174	482	246	120	155	390	369	313	1,520	299	341	186
11	213	407	226	200	125	425	341	271	1,460	299	285	186
12	213	392	232	190	190	515	299	250	1,110	257	218	192
13	226	364	220	190	190	703	285	218	687	244	218	192
14	213	364	245	140	200	783	257	218	703	231	231	212
15	213	308	230	155	205	703	250	271	575	205	238	198
16	273	315	240	170	180	671	250	250	425	218	257	186
17	239	294	185	200	205	591	285	192	313	231	244	186
18	232	294	190	200	220	591	299	186	285	231	205	174
19	213	308	125	190	205	500	455	285	278	218	180	198
20	252	329	120	155	195	623	1,010	313	257	205	180	192
21	308	378	185	130	205	1,110	1,320	383	244	180	174	212
22	294	364	180	170	225	1,630	1,340	671	231	397	192	212
23	392	422	150	195	225	2,570	1,340	767	1,240	1,010	152	174
24	422	617	105	190	215	2,850	950	799	1,990	1,030	186	180
25	572	602	95	175	185	3,670	623	639	2,080	930	168	180
26	707	497	145	175	225	4,200	530	455	2,150	850	154	205
27	677	467	145	165	220	3,390	500	639	1,840	671	162	192
28	617	452	205	140	185	3,200	500	783	1,390	383	162	192
29	527	392	205	205	.....	2,640	485	832	1,150	244	180	156
30	497	364	175	190	.....	2,150	545	703	890	205	174	149
31	557	.....	120	100	.....	1,440	.....	515	.....	231	162	.....

NOTE.—Stage-discharge relation affected by ice Dec. 13, 1916, to Mar. 10, 1917. Water above gage on Mar. 25 and 26, 1917; discharge based on stage as noted on bridge structure. Discharge record for the year ending Sept. 30, 1915, supersedes that published in Water-Supply Paper 405, p. 143, owing to a revision of rating curve above 500 second-feet.

Monthly discharge of Baraboo River near Baraboo, Wis., for the years ending Sept. 30, 1915 and 1917.

[Drainage area, 572 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914–15.					
October	632	136	273	0.477	0.55
November	222	.....	109	.295	.33
December	200	.....	146	.255	.29
January	.....	.....	185	.323	.37
February	.....	.....	665	1.16	1.21
March	1,600	.....	747	1.31	1.51
April	1,170	108	544	.951	1.06
May	849	187	353	.617	.71
June	274	155	206	.360	.40
July	769	141	237	.414	.48
August	932	153	395	.691	.80
September	1,660	153	670	1.17	1.30
The year	1,660	.....	380	.664	9.01
1916–17.					
October	707	174	330	.577	.67
November	617	226	394	.689	.77
December	364	95	219	.383	.44
January	215	100	174	.304	.35
February	210	130	198	.346	.36
March	4,200	160	1,210	2.12	2.44
April	1,340	250	593	1.04	1.16
May	1,050	186	513	.897	1.03
June	2,150	231	1,000	1.85	2.06
July	1,130	180	480	.839	.97
August	440	152	214	.374	.43
September	212	142	180	.315	.35
The year	4,200	95	465	.813	11.03

NOTE.—Monthly discharge record for the year ending Sept. 30, 1915, supersedes that published in Water-Supply Paper 405, p. 144, owing to revision of rating curve above 500 second-feet.

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, 1917.

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

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge at medium and high-water stages; low-water measurements made by wading a short distance downstream from gage.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.05 feet March 24 (discharge about 6,300 second-feet); minimum discharge, about 160 second-feet, February 10.

1914–1917: Maximum discharge recorded March 24, 1917; minimum discharge, about 100 second-feet, last part of January, 1915.

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

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

ACCURACY.—Stage-discharge relation not permanent. Rating curve used October 1 to March 20, well defined between 211 and 485 second-feet; fairly well defined between 485 and 1,340 second-feet; extended and subject to error above 1,340 second-feet. Curve used March 21 to September 30, poorly defined between 300 and 2,200 second-feet; extended and subject to error above and below these limits. Gage read to quarter tenths twice a day. 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 period it was ascertained by applying to rating table mean daily gage height corrected for effect of ice 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, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 5[a]	E. L. Williams	2.12	274	Mar. 22	W. G. Hoyt	7.65	1,980
Feb. 16[a]	do	2.43	260	Aug. 1	R. B. Kilgore	3.74	894

[a] Ice at control.

Daily discharge, in second-feet, of Kickapoo River at Gays Mills, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	355	405	368	225	190	265	680	820	455	1,170	680	345
2	355	330	355	225	245	265	640	920	580	995	945	360
3	325	355	310	265	215	310	580	660	895	640	680	360
4	310	355	310	295	185	325	565	550	680	535	515	345
5	295	340	300	275	235	325	565	515	550	515	495	375
6	280	325	300	265	175	340	550	475	770	550	475	375
7	280	325	300	235	255	325	515	475	1,300	565	495	515
8	295	368	300	265	170	485	475	445	1,600	515	610	515
9	280	350	295	320	250	525	455	435	1,420	535	580	455
10	280	350	235	260	160	520	455	420	720	465	475	390
11	280	350	235	260	240	820	445	390	595	455	465	390
12	280	350	235	260	220	850	445	375	580	455	475	375
13	295	350	265	260	190	820	405	375	595	455	610	390
14	310	251	265	260	210	640	390	375	515	435	595	475
15	310	280	265	260	235	525	390	345	475	435	495	435
16	295	295	280	260	255	520	375	360	465	435	475	375
17	280	325	295	260	265	470	360	345	445	405	420	360
18	265	355	295	260	265	430	390	330	405	375	435	345
19	280	355	295	260	265	405	640	640	420	405	390	360
20	295	355	280	295	265	545	1,200	515	405	360	405	435
21	430	368	295	215	270	870	1,640	420	390	345	390	435
22	470	330	230	215	275	2,130	970	515	465	3,500	375	405
23	368	355	265	300	230	2,950	580	550	945	4,700	495	375
24	340	392	250	240	230	3,500	535	435	1,560	3,200	550	345
25	440	265	265	280	280	3,300	550	375	1,990	2,020	475	345
26	485	310	265	220	280	2,800	595	375	1,740	770	445	345
27	450	392	295	275	235	2,100	565	625	970	610	375	345
28	392	330	295	200	290	1,390	515	530	640	570	375	360
29	430	368	230	205	.....	970	595	445	820	535	375	330
30	522	368	250	195	.....	870	770	402	700	515	360	315
31	478	.....	235	280	.....	770	.....	455	.....	475	360	.....

NOTE.—Stage-discharge relation affected by ice Dec. 10 to Mar. 20. Gage not read Nov. 9–13 and Dec. 5–8; discharge interpolated.

Monthly discharge of Kickapoo River at Gays Mills, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 629 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	522	265	347	0.552	0.64
November	405	251	347	.552	.62
December	368	235	283	.450	.52
January	320	195	255	.405	.47
February	290	160	240	.382	.40
March	3,500	265	1,010	1.61	1.86
April	1,640	360	594	.944	1.05
May	920	330	482	.766	.88
June	1,990	390	805	1.28	1.43
July	4,740	345	903	1.44	1.66
August	945	360	493	.784	.90
September	515	315	386	.614	.68
The year	4,740	160	514	.817	11.11

TURKEY RIVER AT GARBER, IOWA.

LOCATION.—In sec. 36, T. 92 N., R. 4 W., at single-span highway bridge at Garber, Clayton County, about 800 feet above mouth of Wayne Creek, which enters from right.

DRAINAGE AREA.—1,530 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—August 29, 1913, to November 29, 1916, except October 1, 1914, to March 30, 1915. Station discontinued November 30, 1916.

GAGE.—Chain gage attached to handrail on downstream side of bridge; read once daily by E. J. Prolow.

DISCHARGE MEASUREMENTS.—Make from bridge, or by wading.

CHANNEL AND CONTROL.—Bed is composed of sand and mud; channel shifting. Right bank high and not subject to overflow; left bank will be overflowed only at extreme high stage or at gage height about 21 feet.

EXTREMES OF STAGE.—The highest stage within the last 20 years probably occurred May 18, 1902, when a stage representing about 23.7 feet referred to the gage datum was reached, as indicated by the highwater marks on A. F. Grafe's residence in Garber.

ICE.—Stage-discharge relation affected by ice, observations discontinued.

REGULATION.—An electric-light plant and gristmill at Elkader probably cause a slight daily fluctuation.

Data inadequate for determining daily or monthly discharge.

The following discharge measurement was made by C. Herlofson:

November 23, 1916: Gage height, 3.86 feet; discharge, 302 second-feet.

Daily gage height, in feet, of Turkey River at Garber, Iowa, for the period Oct. 1 to Nov. 29, 1916.

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1	4.0	3.85	11	3.7	3.95	21	3.9	4.0
2	4.0	3.8	12	3.7	3.9	22	3.85	.....
3	3.85	3.75	13	3.7	3.9	23	3.9	.....
4	3.85	3.75	14	3.7	4.1	24	4.0	3.9
5	3.8	3.75	15	3.7	4.1	25	4.0	3.85
6	3.8	4.0	16	3.7	4.1	26	4.0	3.85
7	3.75	4.0	17	3.7	4.1	27	4.1	3.85
8	3.65	3.95	18	3.7	4.1	28	4.2	3.85
9	3.6	3.95	19	3.7	4.1	29	4.1	3.85
10	3.6	3.95	20	3.95	4.0	30	4.0	.....
						31	4.0	.....

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

LOCATION.—In the southwest corner of the NE. ¼ sec. 17, T. 84 N., R. 3 E., at Bridgeport Bridge, about 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, 1917, except October, 1914, to March 20, 1915, when station was temporarily discontinued.

GAGE.—Chain gage attached to downstream handrail of bridge 100 feet from right abutment; read by John Strodthoff.

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

CHANNEL AND CONTROL.—Bed of stream composed of sand; shifting. Two channels at all stages except above 12-foot stage above which there is overflow under pile-trestle approach on the left side.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.8 feet at 1.30 p. m., June 13 (discharge, 11,800 second-feet); minimum stage recorded, 1.65 feet, November 15 (discharge, 296 second-feet).

Prior to 1917: Maximum stage about 23.5 feet, probably in 1905 (discharge, about 24,300 second-feet).

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed probably during high water March 10-14. Rating curves used before and after the change well defined between 300 and 20,000 second-feet. Gage read once daily to hundredths. Daily discharge, except as noted below ascertained by applying daily gage height to rating table. Stage-discharge relation affected by ice December 14 to March 9; determination of discharge based on observer's notes and weather records. Open-water records good; winter records roughly approximate.

Discharge measurements of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, during the year ending Sept. 30, 1917.

[Made by C. Herlofson.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec-ft.*		*Feet.*	*Sec.-ft.*
November 24	2.10	438	September 17	1.97	366
June 24	3.35	906	17	1.96	360

Daily discharge in second-feet, of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.
1	422	439	422				577	615	504	655	419	309
2	405	422	422				558	697	577	615	402	324
3	388	422	439				540	741	1,650	577	386	324
4	388	422	439				504	655	1,170	540	370	615
5	372	405	405			400	504	615	1,280	540	370	469
6	372	405	422				504	578	1,600	540	355	540
7	372	388	422				469	540	3,030	504	370	615
8	356	422	439				469	504	2,770	504	1,380	832
9	325	456	405				469	469	2,320	577	615	504
10	310	456	325			7,080	435	469	2,130	540	504	453
11	356	439	356			7,530	419	469	1,710	540	435	402
12	372	422	388			5,390	435	435	1,380	540	402	386
13	372	439	340			2,770	435	419	11,200	504	402	370
14	372	356				7,720	402	419	4,750	577	386	386
15	356	296			250	2,640	386	419	2,640	469	386	370
16	372	340		250		2,700	386	386	2,010	469	386	370
17	340	372				1,950	402	386	1,540	469	386	370
18	372	405				2,260	402	386	1,330	469	355	339
19	372	439				1,380	402	386	1,120	435	324	339
20	422	456				1,430	469	386	1,020	419	338	339
21	456	439				3,370	435	370	927	402	355	339
22	439	439				4,050	435	419	832	469	339	339
23	422	439	300			3,160	435	469	832	504	339	309
24	388	474				2,070	419	469	927	1,170	324	339
25	590	372				1,620	419	435	927	1,540	324	309
26	550	372				1,170	402	419	1,070	832	324	309
27	530	439				975	402	419	879	655	339	339
28	474	492				832	386	419	741	577	309	339
29	474	456				741	419	402	786	523	309	339
30	474	439				655	435	435	655	469	309	324
31	456					615		540		469	309	

Monthly discharge of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 1,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	590	310	409	0.255	0.29
November	492	296	419	.262	.29
December	439		343	.214	.25
January			250	.156	.18
February			250	.156	.16
March	7,720		2,120	1.32	1.52
April	577	386	445	.278	.31
May	741	370	476	.297	.34
June	11,200	504	1,810	1.13	1.26
July	1,540	402	584	.365	.42
August	1,380	309	405	.253	.29
September	832	309	398	.249	.28
The year	11,200		659	.411	5.59

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, about 9 miles above Illinois State line. Bass Creek enters from right about 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, 1917.

GAGE.—Chain gage fastened to the downstream side of bridge; read by Albert Engelke.

DISCHARGE MEASUREMENTS.—Made from the 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, 8.90 feet at 4 p. m. April 1 (discharge, 8,910 second-feet); minimum discharge, 555 second-feet, February 11.

1914–1917: Maximum stage recorded, 9.88 feet at 4 p. m., September 13, 1915 (discharge, 10,300 second-feet); minimum stage recorded, 0.5 foot at 7 a. m. August 16, 1914 (discharge, about 459 second-feet).

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

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

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 638 and 10,500 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods of ice effect, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of Rock River at Afton, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 20[a]	E. L. Williams	3.63	1,470	Feb. 26[b]	E. L. Williams	3.04	855
Jan. 24[b]	do	2.96	914	May 22	Hoyt and Williams	3.76	2,410

[a] Control partly covered with ice. [b] Practically complete ice cover.

Daily discharge, in second-feet, of Rock River at Afton, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,170	2,310	2,310	880	770	755	8,470	3,800	2,400	8,040	1,740	756
2	1,140	2,400	2,400	880	640	785	8,470	4,040	2,670	8,330	1,660	802
3	1,460	2,490	2,400	855	660	820	7,470	3,920	2,670	8,470	1,620	894
4	1,140	2,400	1,580	885	620	715	7,330	4,160	3,240	8,470	1,500	955
5	1,140	2,310	2,220	880	640	890	7,190	4,160	3,140	8,470	1,290	1,010
6	1,320	2,400	2,140	810	790	940	7,050	4,400	3,680	8,470	1,360	1,000
7	1,200	2,400	2,220	720	745	1,180	6,770	4,040	3,560	8,330	1,460	1,000
8	1,060	2,310	2,310	790	735	1,300	6,630	3,800	4,160	8,040	1,360	1,320
9	1,430	2,580	2,140	715	735	1,230	6,490	3,450	4,520	7,900	1,230	980
10	1,260	2,490	1,980	765	695	1,360	5,810	3,340	4,400	7,620	1,290	1,170
11	1,140	2,400	2,060	780	555	2,670	5,420	3,240	4,520	7,190	1,230	852
12	1,060	2,400	2,060	740	615	2,490	5,420	3,040	4,520	7,050	1,360	990
13	1,170	2,400	2,060	810	665	2,940	5,290	3,240	5,810	6,490	1,260	1,050
14	1,040	2,220	2,060	700	710	2,400	4,900	2,670	5,290	6,070	1,260	1,040
15	1,000	2,220	1,900	730	705	2,760	4,520	2,400	5,030	5,680	1,290	1,070
16	1,400	2,220	1,900	815	705	3,240	4,400	2,220	4,640	5,550	1,290	1,000
17	1,170	2,310	1,620	805	690	2,760	4,160	2,060	4,400	5,160	1,140	941
18	1,140	2,140	1,580	690	660	2,850	3,920	1,900	4,400	4,640	875	970
19	1,140	2,140	1,500	725	705	3,040	4,040	2,140	4,160	4,160	746	980
20	1,360	2,220	1,430	815	695	3,920	4,160	2,140	4,040	3,920	894	1,090
21	1,430	2,140	1,320	720	630	4,160	3,920	2,060	3,920	3,560	894	1,170
22	1,290	2,140	1,230	855	750	4,520	3,920	2,400	3,920	3,240	990	1,200
23	1,500	2,220	1,100	720	725	4,900	4,280	1,980	3,920	3,140	875	970
24	1,580	2,220	1,040	860	640	5,290	4,280	1,900	4,160	2,850	1,010	941
25	1,820	1,900	980	835	650	5,810	4,160	2,140	4,900	3,040	848	1,070
26	1,980	1,980	1,060	785	715	6,630	4,400	2,400	5,810	2,490	820	1,100
27	1,980	2,140	1,030	795	770	7,190	3,800	2,670	6,350	2,490	903	1,360
28	1,700	2,310	1,080	775	705	7,900	3,800	2,580	7,050	2,220	852	1,170
29	2,060	2,490	980	775	.....	8,040	3,800	2,310	7,470	1,980	788	1,100
30	2,310	2,310	950	885	.....	7,900	3,920	2,140	8,330	1,900	894	1,030
31	2,310	.....	925	895	.....	7,900	.....	2,490	.....	2,060	970	.....

NOTE.—Stage-discharge relation affected by ice Nov. 11–14 and Dec. 14 to Mar. 8.

Monthly discharge of Rock River at Afton, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 3,190 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,310	1,000	1,420	0.445	0.51
November	2,580	1,900	2,290	.718	.80
December	2,400	925	1,660	.520	.60
January	895	700	796	.250	.29
February	790	555	690	.216	.22
March	8,040	715	3,530	1.11	1.28
April	8,470	3,800	5,270	1.65	1.84
May	4,400	1,900	2,880	.903	1.04
June	8,330	2,400	4,570	1.43	1.60
July	8,470	1,900	5,390	1.69	1.95
August	1,740	746	1,150	.361	.42
September	1,360	756	1,030	.323	.36
The year	8,470	555	2,560	.803	10.91

ROCK RIVER AT ROCKFORD, ILL.

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

DRAINAGE AREA.—6,520 square miles.

RECORDS AVAILABLE.—July 30, 1914, to September 30, 1917.

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, 7.8 feet June 21 to 23 (discharge, 13,700 second-feet); minimum stage, 1.70 feet at 5.30 p. m. September 30 (discharge, 1,180 second-feet).

1914–1917: 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 stage, 0.82 foot, August 9, 1914 (discharge, 483 second-feet).

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

REGULATION.—Operation of power plant at dam 2 miles upstream in city of Rockford causes slight fluctuation at gage.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve fairly well defined between 1,450 and 32,000 second-feet. Gage read to hundredths twice daily. Fluctuation at gage 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 determined from gage heights, observer's notes, weather records, and records of flow of Rock River at Afton, Wis. Open-water records good for medium and high stages; probably somewhat too large for low stages, as gage readings were taken during day when flow, owing to regulation at dam, is somewhat greater than during night; winter records poor.

The following discharge measurement was made by H. C. Beckman:

August 29, 1917; Gage height: 2.47 feet; discharge, 1,950 second-feet.

Daily discharge, in second-feet, of Rock River at Rockford, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,100	3,810	3,810				11,800	6,770	4,200	3,440	3,440	1,870
2	3,270	3,620	4,000				11,200	7,000	4,400	3,620	3,100	1,760
3	3,270	3,620	4,000				10,200	7,230	4,200	4,200	2,790	1,760
4	3,270	3,620	3,810				9,680	7,000	4,400	4,400	2,500	1,870
5	3,440	3,810	4,000			2,110	9,180	6,770	4,820	5,240	2,500	1,760
6	3,620	3,810	4,000	1,620	1,650		8,930	6,320	5,030	5,880	2,500	1,650
7	4,000	3,620	3,810				8,680	6,100	6,770	6,540	2,230	1,650
8	2,940	3,810	3,810			3,810	8,430	5,450	7,950	7,000	2,100	1,650
9	3,100	4,400	3,620			4,820	7,950	5,030	8,680	7,950	1,980	1,450
10	3,100	4,610	3,620			5,660	7,950	4,820	9,180	8,680	2,100	1,550
11	3,270	4,610	3,620			6,540	7,470	4,820	9,180	8,930	2,100	1,650
12	3,270	4,400	3,620			7,950	7,000	4,610	9,430	8,680	2,230	1,650
13	3,440	4,400	3,810			10,200	6,770	4,610	9,430	8,430	2,100	1,650
14	3,440	4,610	3,810			11,200	6,540	4,200	10,200	7,950	1,980	1,870
15	3,440	4,400	3,810	1,890	1,920	11,800	6,100	4,000	10,700	7,470	1,870	2,100
16	3,100	4,400				12,800	5,660	4,000	11,500	7,000	1,980	1,980
17	2,940	4,200				13,100	5,240	3,810	11,800	6,770	1,870	2,100
18	2,940	4,000				12,800	5,030	3,810	12,300	6,540	1,870	2,360
19	2,940	3,620				13,100	4,820	3,440	12,600	6,320	1,760	2,360
20	3,270	3,620				13,100	5,880	3,440	13,100	6,320	1,760	2,230
21	3,620	3,810				12,800	6,320	3,440	13,700	6,100	1,760	2,100
22	3,810	3,810				12,600	5,450	3,620	13,700	6,100	1,760	1,980
23	4,200	3,620	2,840			12,800	5,240	3,440	13,700	5,880	1,760	1,980
24	4,400	3,620				12,800	4,820	3,440	13,100	5,450	1,870	1,870
25	4,400	3,440			1,990	13,100	5,240	3,270	12,300	5,030	1,980	1,870
26	4,200	3,440		1,860		12,600	5,450	3,270	11,500	4,820	2,100	1,650
27	4,400	3,440				12,600	5,880	3,620	11,000	4,820	2,100	1,550
28	4,200	3,620				12,300	6,100	3,440	10,700	4,610	1,980	1,450
29	4,000	3,620				12,300	6,320	3,620	9,940	4,400	1,980	1,360
30	4,000	3,810				12,600	6,770	3,810	9,430	4,200	1,870	1,180
31	4,000					12,600		4,000		3,810	1,870	

NOTE.—Stage-discharge relation affected by ice Dec. 16 to Mar. 7. Sudden decrease in flow from June 30 to July 1 caused by regulation at dam upstream. Braced figures show mean discharge for periods included.

Monthly discharge of Rock River, at Rockford, Ill., for the year ending Sept. 30, 1917

[Drainage area, 6,520 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	4,400	2,940	3,560	0.546	0.63
November	4,610	3,440	3,910	.600	.67
December	4,000		3,310	.508	.59
January			1,790	.275	.32
February			1,840	.282	.29
March	13,100		9,060	1.39	1.60
April	11,800	4,820	7,070	1.08	1.20
May	7,230	3,270	4,590	.704	.81
June	13,700	4,200	9,630	1.48	1.65
July	8,930	3,440	6,020	.923	1.06
August	3,440	1,760	2,120	.325	.37
September	2,360	1,180	1,800	.276	.31
The year	13,700	1,180	4,570	.701	9.50

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; about 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, 1917.

GAGE.—Chain gage attached to bridge; read by John Shepard.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Gravel; may shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.2 feet March 14 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 12.6 feet at 7 a. m. June 14 (discharge, 21,400 second-feet); minimum stage recorded, 4.6 feet at 5 p. m. September 2 (discharge, 1,170 second-feet).

1915–1917: Maximum stage recorded, 18.0 feet January 22 and 23, 1916 (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 discharge recorded, 1,170 second-feet at 5 p. m. September 2, 1917.

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

DIVERSIONS.—Water is diverted at Sterling dam to feed Illinois and Mississippi canal; probably averages about 100 second-feet.

REGULATION.—Operation of power plant in city of Sterling causes fluctuation at gage. Fluctuations slight except during low stages.

ACCURACY.—Stage-discharge relation changed during March; affected by ice during winter. Rating curves well defined. Gage read to hundredths twice daily. Diurnal fluctuation at gage not large. 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 record of flow of Rock River at Rockford, Ill., and Afton, Wis. Records good for medium and high stages and fair for very low stages during open-water periods; poor for winter period.

Daily discharge measurements of Rock River at Lyndon, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Sept. 1	5.31	2,060
Do	4.82	1,430

Daily discharge, in second-feet, of Rock River at Lyndon, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,800	4,530	5,110				10,600	8,080	5,500	10,100	3,540	2,210
2	4,340	3,800	4,340				10,400	9,330	5,720	10,600	3,360	1,710
3	3,460	3,980	3,980				10,200	9,580	5,290	11,500	3,180	2,210
4	2,980	4,530	4,910				10,000	9,330	6,170	10,400	2,840	2,360
5	3,140	4,340	4,160				9,830	8,080	6,630	10,600	2,520	2,520
6	3,140	4,720	5,310	2,780	2,910	3,930	9,830	7,340	7,580	10,600	2,840	1,920
7	2,980	3,980	4,720				9,830	7,580	9,330	10,400	3,010	2,210
8	2,680	4,720	4,530				9,330	5,720	8,830	10,100	2,840	2,520
9	2,980	4,530	4,340				9,330	6,400	9,580	10,100	3,010	1,920
10	2,980	4,910	4,160				9,080	6,170	9,580	9,830	2,680	2,680
11	2,980	5,520					8,580	5,940	9,830	9,830	2,840	2,520
12	2,980	5,110					8,080	5,720	9,830	9,330	2,210	2,680
13	2,680	5,310					7,830	5,290	16,000	8,830	3,010	2,680
14	2,980	5,110					7,340	5,290	20,200	8,830	3,010	2,680
15	2,680	4,720					7,580	5,080	18,500	8,080	2,680	2,680
16	2,980	4,340	4,300	2,530	2,410	17,500	6,860	4,280	14,500	7,340	2,680	2,520
17	2,680	4,340					6,400	4,280	14,200	7,830	2,680	2,520
18	2,980	4,340					6,630	4,090	13,900	6,860	2,680	2,680
19	2,830	3,980					6,400	3,900	11,800	6,630	2,060	2,520
20	3,140	4,340					6,170	2,840	9,580	7,830	2,680	2,520
21	3,140	4,340				18,100	6,630	3,900	8,330	8,080	2,520	2,520
22	4,160	4,340				17,300	7,340	3,900	7,340	6,400	1,710	2,680
23	4,530	4,530				16,500	7,830	4,090	7,100	6,400	2,060	2,210
24	4,720	4,530				15,700	7,580	4,680	7,100	5,290	2,360	2,680
25	4,340	4,340			2,520	15,000	7,580	4,880	6,860	5,500	2,210	2,680
26	5,730	3,980	3,390	2,750		14,200	6,630	4,680	7,100	5,290	1,920	2,520
27	5,950	4,530				13,400	7,580	4,680	9,080	4,880	2,360	2,520
28	5,730	4,530				12,600	7,100	5,500	9,330	4,680	1,920	2,680
29	5,110	4,530				11,800	6,630	5,500	10,400	3,180	2,060	2,520
30	5,730	4,340				11,400	6,630	5,290	10,100	4,480	2,210	2,360
31	5,310	.....				10,900	.....	5,500	.....	3,360	1,920	.....

NOTE.—Stage-discharge relation affected by ice Dec. 11 to Mar. 20. Discharge Mar. 21–23, 25, 27, 28, 30, and Apr. 1, 3, 4, and 6 interpolated. Braced figures show mean discharge for period included.

Monthly discharge of Rock River at Lyndon, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 9,010 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	5,950	2,680	3,740	0.415	0.48
November	5,520	3,800	4,500	.499	.56
December	.....	.....	4,060	.451	.52
January	.....	.....	2,690	.299	.34
February	.....	.....	2,620	.291	.30
March	.....	.....	12,000	1.33	1.53
April	10,600	6,170	8,060	.895	1.00
May	9,580	2,840	5,710	.634	.73
June	20,200	5,290	9,840	1.09	1.22
July	11,500	3,180	7,840	.870	1.00
August	3,540	1,710	2,570	.285	.33
September	2,680	1,710	2,450	.272	.30
The year	.....	.....	5,520	.613	8.31

YAHARA RIVER NEAR EDGERTON, WIS.

LOCATION.—At highway bridge in sec. 3, T. 4 N., R. 11 W., 1 mile above mouth of Badfish River (coming in from right) and about 5 miles southwest of Edgerton, Rock County.

DRAINAGE AREA.—380 square miles (measured on map issued by Wisconsin and Geological History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—September 27, 1916 to November 23, 1917, when station was discontinued.

GAGE.—Friez water-stage recorder in a wooden well fastened to the right-hand downstream wing wall.

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

CHANNEL AND CONTROL.—Bed composed of gravel, control is head of rapids a short distance downstream. During the summer months grass grows in the channel and on the control affecting stage-discharge relation.

EXTREMES OF DISCHARGE.—Maximum stage recorded, 3.13 feet 2 a. m., June 13, 1917 (discharge, 1,390 second-feet); minimum stage, 1.64 feet 5 p. m., October 8, 1916 (discharge, about 118 second-feet).

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

ACCURACY.—Stage-discharge relation not permanent; affected by grass and ice. Rating curve well defined between 290 and 780 second-feet; extended and subject to error above and below these limits. Operation of water-stage recorder satisfactory throughout the year. Daily discharge ascertained by discharge integrator; shifting-control method used September 27 to October 8, 1916, and June 1 to October 31, 1917; discharge December 14 to March 21 ascertained from discharge measurements, gage heights, and weather records. Open-water records good; winter records subject to error.

Discharge measurements of Yahara River near Edgerton, Wis., for the period Sept. 28, 1916, to November 23, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1916.		*Feet.*	*Sec.-ft.*	1917.		*Feet.*	*Sec.-ft.*
Sept. 28[a]	E. L. Williams	2.38	260	Feb. 26[c]	E. L. Williams	3.11	155
Oct. 13	do	2.46	362	Mar. 26	W. G. Hoyt	2.84	695
Dec. 19[b]	do	2.75	194	May 22	Hoyt and Williams	2.57	421
				July 17[d]	W. G. Hoyt	2.22	214
1917.				Nov. 8	R. B. Kilgore	2.47	379
Jan. 23[c]	do	2.96	175				

[a] Grass growing in channel.
[b] Almost complete ice cover at control.
[c] Complete ice cover at control.
[d] Possible grass growth at control.

Daily discharge, in second-feet, of Yahara River near Edgerton, Wis., for the period Sept. 27, 1916, to Nov. 23, 1917.

Day.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916-17.													
1	.....	253	430	365	177	131	137	718	671	327	237	274	232
2	.....	240	466	331	186	125	141	618	554	380	227	283	253
3	.....	236	446	324	177	139	137	584	509	317	216	278	241
4	.....	239	414	318	183	158	129	599	500	332	218	315	242
5	.....	252	429	319	177	157	141	621	420	300	217	258	263
6	.....	257	373	301	193	160	145	527	429	371	224	284	251
7	.....	249	350	307	183	163	243	561	377	387	206	335	275
8	.....	460	414	324	179	151	247	638	375	372	201	308	227
9	.....	350	460	320	192	153	179	497	384	251	207	302	238
10	.....	334	445	324	189	147	245	535	362	332	196	323	246
11	.....	331	421	290	175	123	559	523	362	305	204	255	250
12	.....	354	450	350	160	154	367	513	348	325	200	291	235
13	.....	370	355	341	161	151	287	514	386	517	208	323	253
14	.....	339	433	210	155	141	342	452	311	346	210	331	232
15	.....	381	659	210	152	149	384	451	324	315	210	332	255
16	.....	355	531	210	158	150	395	414	306	291	210	321	238
17	.....	370	367	210	145	151	306	384	289	295	210	344	252
18	.....	372	352	210	150	120	396	446	306	235	215	275	242
19	.....	390	384	210	152	142	348	596	328	241	206	270	236
20	.....	523	346	210	144	132	529	487	346	238	209	294	241
21	.....	474	361	210	154	133	856	507	298	234	218	315	235
22	.....	452	335	210	158	129	972	421	412	223	228	393	223
23	.....	427	369	210	165	126	859	368	313	286	227	389	216
24	.....	416	387	210	170	132	841	400	335	255	235	280	233
25	.....	541	368	210	168	128	744	416	331	326	240	273	236
26	.....	500	410	210	162	155	728	412	308	270	248	285	235
27	213	526	336	210	165	158	705	396	346	222	253	294	230
28	270	424	378	210	161	146	672	425	283	241	263	275	245
29	255	507	396	210	160	.....	652	567	289	222	258	247	245
30	290	448	375	210	166	.....	666	488	302	224	278	240	251
31	.....	451	.....	210	141	.....	595	.....	306	.....	272	257	.....

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1917.			1917.			1917.		
1	233	315	11	240	372	21	262	320
2	242	304	12	232	356	22	262	329
3	246	331	13	229	343	23	310	321
4	225	330	14	257	341	24	278	.....
5	234	332	15	244	349	25	284	.....
6	246	328	16	256	352	26	345	.....
7	235	325	17	256	357	27	345	.....
8	237	327	18	250	339	28	337	.....
9	233	335	19	265	322	29	324	.....
10	235	353	20	266	325	30	337	.....
						31	300	.....

NOTE.—Stage-discharge relation affected by grass Sept. 27 to Oct. 8, 1916, and June 1 to Oct. 31, 1917; affected by ice, Dec. 14 to Mar. 31. Discharge partially estimated Sept. 29 and 30, 1916, Apr. 14, and May 26–27, 1917. No gage-height record July 14–17; discharge estimated.

Monthly discharge of Yahara River near Edgerton, Wis., for the period Oct. 1, 1916, to Nov. 23, 1917.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916-17.					
October	541	236	381	1.00	1.15
November	659	335	408	1.07	1.19
December	365	.....	258	.679	.78
January	193	141	166	.437	.50
February	163	120	143	.376	.39
March	972	129	450	1.18	1.36
April	718	368	503	1.32	1.47
May	671	283	368	.968	1.12
June	517	222	299	.787	.88
July	278	196	224	.589	.68
August	393	240	298	.784	.90
September	275	216	242	.637	.71
The year	972	120	313	.824	11.13
1917.					
October	345	225	266	.700	.81
November 1–23	372	304	335	.882	.75

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, about 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, 1917.

GAGE.—Chain gage fastened to downstream side of bridge; prior to August 2, 1916, vertical staff gage on left abutment. Gage read by W. C. Shadewaldt and S. A. Frank.

DISCHARGE MEASUREMENTS.—At low and medium stages made from upstream side of highway bridge about 400 feet above the gage; during extremely high water considerable water overflows to left of highway bridge and measurements are made from railroad bridge to which the gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and silt; undoubtedly shifting. Banks are only of medium height and are overflowed at flood stages. Except during extreme flood stages all the water passes under the bridge to which the gage is fastened. There is little fall in the river below the gage and no well-defined control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.6 feet at 7 a. m. March 15 (discharge, about 4,500 second-feet); minimum discharge, 260 second-feet January 20–22.

1914–1917: Maximum stage, 19.1 feet March 27, 1916, determined from flood marks by leveling (discharge, about 13,100 second-feet); minimum discharge, January 20–31, 1915 (estimated mean discharge 245 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Operation of dams at Argyle, on the East Branch of Pecatonica River, and at Darlington, on the West Branch of Pecatonica River, cause little if any diurnal fluctuation at the gage.

ACCURACY.—Stage-discharge relation changed somewhat during the period between June and September; also affected by ice. Rating curve used October 1 to June 30 well defined between 350 and 1,520 second-feet and fairly well defined between 1,520 and 6,000 second-feet; extension of the curve above 6,000 second-feet is based on the flow of Pecatonica River at Freeport, Ill. Discharge, June 14 to September 30 determined by shifting-control method; discharge for rest of open-water period ascertained by applying mean daily gage height to rating table; for period of ice effect determined by applying to rating table mean daily gage height corrected by means of discharge measurements, observers' notes, and weather records. Open-water records goods except those for July to September, which are only fair; winter records subject to error.

Discharge measurements of Pecatonica River at Dill, Wis., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 21[a]	E. L. Williams.....	1.40	279	Feb. 27[a]	E. L. Williams.....	1.77	296
Jan. 25[a]	.....do.....	1.78	279	May 23	Hoyt and Williams.....	2.04	585

[a] Complete ice cover.

Daily discharge, in second-feet, of Pecatonica River at Dill, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	390	474	438	265	270	300	524	537	630	565	356	290
2	390	474	438	270	270	325	524	698	809	551	367	290
3	402	474	426	270	270	350	498	846	1,840	486	356	290
4	390	474	426	270	275	400	486	630	1,800	456	356	290
5	390	450	438	270	275	450	486	551	1,160	438	356	295
6	378	450	438	270	275	565	474	524	1,320	426	356	314
7	378	462	402	275	275	700	474	486	1,560	438	414	325
8	378	474	402	275	275	1,120	474	462	1,600	426	462	356
9	367	537	414	275	270	1,480	474	462	1,280	414	414	367
10	367	537	390	270	270	2,100	438	462	1,000	402	335	325
11	367	511	390	270	270	2,510	450	450	846	402	312	305
12	402	462	365	270	270	2,830	426	450	809	390	325	302
13	390	450	355	270	270	2,880	426	438	2,880	390	312	320
14	402	426	345	270	275	3,230	414	426	1,970	378	323	378
15	390	402	335	265	275	4,430	402	426	1,240	367	320	356
16	402	462	325	265	275	4,280	414	426	735	390	316	321
17	378	486	315	270	270	4,030	414	426	630	414	311	320
18	378	486	305	270	280	3,230	426	414	596	367	304	335
19	378	450	300	260	280	2,560	1,200	426	551	356	307	345
20	414	426	290	260	280	1,880	1,000	426	498	345	304	367
21	551	414	280	260	285	2,460	630	438	498	345	298	345
22	596	402	270	260	285	3,280	551	450	498	414	298	320
23	474	426	270	265	290	3,280	511	511	551	524	307	305
24	438	462	275	265	285	2,240	486	486	630	524	307	300
25	551	474	275	275	295	1,240	450	426	565	511	304	302
26	846	390	280	275	300	772	474	414	664	498	304	305
27	630	498	270	275	295	630	474	462	664	414	304	323
28	596	474	275	270	295	630	474	772	524	378	300	323
29	486	414	275	275	.....	551	486	551	524	367	297	304
30	511	414	270	275	.....	524	498	511	551	378	293	300
31	486	.....	265	275	.....	498	.....	630	.....	367	293	.....

NOTE.—Stage-discharge relation affected by ice Dec. 12 to Mar. 19.

Monthly discharge of Pecatonica River at Dill, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 959 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	846	367	448	0.467	0.54
November	537	390	458	.478	.53
December	438	265	340	.355	.41
January	275	260	269	.280	.32
February	300	270	279	.291	.30
March	4,430	300	1,800	1.88	2.17
April	1,200	402	515	.537	.60
May	846	414	504	.526	.61
June	2,880	498	981	1.02	1.14
July	565	345	423	.441	.51
August	462	293	329	.343	.40
September	378	290	321	.335	.37
The year	4,430	260	558	.582	7.90

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, 1917.

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 is of only medium height and is overflowed during high water. At stages above about 16.0 feet part of the flow passes over the left bank and through East Freeport.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.0 feet at 8 a. m. March 16 (discharge, 6,140 second-feet); minimum stage, 3.5 feet August 31 and September 2 (discharge, 239 second-feet).

1914–1917: Maximum stage recorded, 19.4 feet March 28, 1916 (discharge, 17,000 second-feet); minimum discharge recorded August 31 and September 2, 1917.

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

REGULATION.—A dam and power plant three-fourths mile upstream regulate flow past gage. Only slight diurnal fluctuation is noticeable.

ACCURACY.—Stage-discharge relation changed, probably after high water in June; affected by ice during winter. Rating curve used to June 30 well defined; curve used August 21 to September 30 fairly well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used July 1 to August 20. Records good for medium and high stages and fair for low stages during open-water periods, winter records poor.

The following discharge measurement was made by H. C. Beckman:
August 31, 1917: Gage height, 3.50 feet; discharge, 233 second-feet.

Daily discharge, in second-feet, of Pecatonica River at Freeport, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	918	894	632				757	824	1,220	735	395	335
2	894	801	612				757	1,020	1,320	755	395	264
3	801	714	593				735	990	1,500	715	380	335
4	735	652	574				714	847	1,680	656	395	335
5	652	632	632				652	801	1,650	600	380	350
6	555	632	693	390	430	1,140	693	779	1,740	675	335	471
7	537	714	757				672	757	2,020	656	380	410
8	519	735	894				632	714	2,060	600	542	380
9	502	894	942				593	672	1,920	582	490	395
10	485	894	894				593	632	1,770	582	458	380
11	485	824	693			3,450	574	612	1,590	564	426	335
12	555	757	502			3,830	555	574	1,440	546	410	320
13	612	672	381			3,830	555	574	2,380	528	395	306
14	555	593	381			4,460	555	555	3,830	528	395	292
15	574	519		395	405	5,810	735	555	3,450	546	395	350
16	593	502				6,140	537	537	1,260	528	395	365
17	555	502				5,660	593	485	1,220	511	395	365
18	519	537				5,250	1,040	469	1,140	511	380	350
19	555	612				5,000	1,340	502	990	494	380	350
20	612	757				4,560	1,340	502	894	494	395	335
21	847	801				3,830	1,190	519	847	458	335	365
22	593	824	400			3,060	990	574	801	474	278	365
23	537	847				3,310	1,040	735	824	490	292	335
24	632	779				3,120	1,440	870	894	542	335	306
25	918	714			475	2,340	1,440	801	990	580	335	292
26	1,120	779		445		1,440	966	693	942	524	335	306
27	1,120	735				1,090	801	672	918	474	350	395
28	1,060	693				942	672	632	870	442	335	410
29	966	652				847	632	714	870	442	292	395
30	1,020	612				735	652	824	942	442	292	365
31	990	.....				714	.....	1,040	.....	426	335	.....

NOTE.—Discharge Dec. 15 to Mar. 10 estimated because of ice from gage heights, observer's notes, weather records, and records of flow of Pecatonica River at Dill, Wis. Braced figures show mean discharge for periods indicated.

Monthly discharge of Pecatonica River at Freeport, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 1,330 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,120	485	710	0.534	0.62
November	894	502	709	.533	.59
December	942	381	515	.387	.45
January	.....	.....	411	.309	.36
February	.....	.....	434	.326	.34
March	6,140	.....	2,610	1.96	2.26
April	1,440	537	815	.613	.68
May	1,040	469	693	.521	.60
June	3,830	801	1,470	1.11	1.24
July	755	426	552	.415	.48
August	542	278	375	.282	.33
September	471	264	352	.265	.30
The year	6,140	264	806	.606	8.25

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, about 12 miles above Illinois State line. Jordan Creek enters from right about 2 miles below station, and Little Jordan Creek, also from right, about 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, 1917.

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 the gage overflowed at stage of about 7 feet on the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.48 feet at 4.30 p. m. June 13 (discharge, 2,710 second-feet); minimum discharge about 85 second-feet February 11.

1914–1917: Maximum stage recorded, 11.4 feet, September 13, 1915 (discharge about 13,000 second-feet); minimum stage recorded, 0.4 foot at 10 a. m., Sunday, August 30, 1914, when water was undoubtedly being held at the dam (discharge, determined from extension of the rating curve, about 74 second-feet).

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation not permanent; control changed somewhat by floods. Two rating curves as used for 1917, both only fairly well defined between 228 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 of ice effect, for which it is ascertained by applying to rating table mean daily gage height corrected 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, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 21[a]	E. L. Williams	2.15	162	Feb. 27[a]	E. L. Williams	2.58	138
Jan. 25[a]	do	2.33	144	May 23	Hoyt and Williams	2.01	374

[a] Practically complete ice cover.

Daily discharge, in second-feet, of Sugar River near Brodhead, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	237	296	296	160	185	160	370	620	475	660	262	262
2	246	284	274	180	165	160	388	660	660	580	222	173
3	246	296	237	175	170	165	354	620	830	475	222	222
4	237	274	274	165	150	140	405	423	830	370	222	235
5	228	237	274	160	170	170	370	370	875	338	210	248
6	351	296	255	165	165	165	354	322	1,060	388	248	248
7	237	264	255	150	170	255	338	338	920	440	248	306
8	202	274	296	165	165	510	276	338	875	405	262	338
9	228	322	322	170	135	545	322	322	785	322	248	197
10	228	383	255	160	140	585	276	322	545	306	306	322
11	228	383	255	165	85	1,580	276	276	338	306	322	306
12	228	284	245	165	115	1,830	291	276	440	338	248	235
13	228	308	235	150	120	1,720	276	222	2,710	338	276	276
14	237	322	230	130	125	1,240	276	262	2,350	306	262	291
15	168	296	200	155	130	1,120	222	276	1,390	306	276	306
16	274	255	195	145	135	1,100	248	276	740	475	291	222
17	237	264	180	150	150	1,010	262	262	580	475	262	262
18	219	264	175	160	150	1,180	291	262	475	405	248	248
19	237	228	170	165	170	1,090	423	248	458	306	173	262
20	246	296	165	135	170	1,150	920	222	405	291	222	210
21	246	296	160	140	175	1,190	740	248	370	276	248	235
22	416	296	155	145	170	1,540	440	262	338	262	248	222
23	367	284	160	145	175	1,440	370	276	388	306	262	128
24	322	285	150	155	175	1,390	338	276	660	405	222	248
25	308	285	155	145	160	830	405	354	785	306	210	262
26	469	274	160	150	180	580	423	306	920	276	150	235
27	505	322	180	160	170	580	388	405	920	291	235	276
28	416	264	165	135	160	458	354	405	700	262	248	262
29	264	274	170	160	.....	405	440	338	580	222	248	262
30	335	264	150	185	.....	405	492	322	510	248	248	162
31	308	.....	145	155	.....	405	.....	338	.....	248	276	.....

NOTE.—Stage-discharge relation affected by ice Nov. 24, 25, and Dec. 11 to Mar. 20.

Monthly discharge of Sugar River near Brodhead, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 529 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	505	168	281	0.531	0.61
November	383	228	289	.546	.61
December	322	145	211	.399	.46
January	185	130	156	.295	.34
February	185	85	155	.293	.31
March	1,830	140	810	1.53	1.76
April	920	222	378	.715	.80
May	660	222	337	.637	.73
June	2,710	338	797	1.51	1.68
July	660	222	353	.667	.77
August	322	150	246	.465	.54
September	338	128	249	.471	.53
The year	2,710	85	356	.673	9.14

IOWA RIVER AT MARSHALLTOWN, IOWA.

LOCATION.—In T. 84 N., R. 18 W., at Third Avenue highway bridge, 1 mile north of Marshalltown, Marshall County, and about a 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, 1917; February 23, 1903, to August 8, 1903, for old site a 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 above 13 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.4 feet March 27 (discharge, 9,640 second-feet); minimum stage recorded, 2.32 feet October 9 (discharge, 56 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

ACCURACY.—Stage-discharge relation not permanent. One rating curve, well defined below 2,000 second-feet, used during 1917. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Open-water records good.

Discharge measurements of Iowa River at Marshalltown, Iowa, during the year ending Sept 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 11[a]	C. Herlofson	2.56	134	June 26	Bolster and Herlofson	4.24	769
June 26	Bolster and Herlofson	4.24	775	Sept. 13	C. Herlofson	2.78	209

[a] Measurement made from a boat.

Daily discharge, in second-feet, of Iowa River at Marshalltown, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	91	129	146	.....	1,960	1,260	590	590	163	69
2	100	129	129	.....	1,720	1,320	930	472	180	78
3	129	129	129	.....	1,460	1,420	1,020	472	129	97
4	113	113	129	.....	1,320	1,520	1,460	434	107	107
5	97	129	129	.....	1,320	1,620	2,160	415	100	129
6	94	113	146	.....	1,260	1,360	3,640	434	107	180
7	129	113	129	.....	1,260	1,160	7,100	415	81	180
8	97	129	129	.....	1,260	1,060	6,760	472	129	163
9	56	146	75	.....	1,220	975	6,980	472	180	268
10	84	129	87	.....	1,120	840	8,220	630	198	396
11	100	129	97	.....	1,520	750	8,110	670	180	286
12	97	163	129	.....	930	710	7,100	550	163	250
13	91	233	110	.....	930	670	6,660	453	233	198
14	84	180	97	.....	840	630	4,580	396	215	163
15	78	163	78	.....	795	590	3,730	377	198	129
16	72	146	69	.....	710	590	2,810	396	163	129
17	78	129	.....	.....	670	550	1,900	415	146	113
18	84	129	.....	1,420	795	453	1,420	377	146	107
19	87	113	.....	1,160	840	511	1,220	377	163	97
20	91	129	.....	3,640	840	415	1,060	322	146	91
21	87	129	.....	4,580	840	434	975	377	113	84
22	91	146	.....	7,320	930	511	930	340	87	81
23	113	163	.....	7,320	930	550	885	340	113	87
24	94	180	.....	7,100	975	590	840	590	113	91
25	129	129	.....	9,520	930	590	795	434	129	97
26	129	146	.....	8,000	840	550	750	359	146	107
27	129	146	.....	9,460	750	550	750	340	146	100
28	129	163	.....	5,900	710	434	710	286	146	97
29	163	163	.....	4,480	1,120	472	670	268	69	91
30	146	163	.....	3,380	1,160	511	630	233	75	97
31	146	.....	.....	2,580	.....	511	.....	198	84	.....

Monthly discharge of Iowa River at Marshalltown, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 1,380 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	163	56	103	0.075	0.09
November	233	113	143	.104	.12
December 1–16	146	69	113	.082	.05
March 18–31	9,640	1,160	5,430	3.93	2.05
April	1,960	670	1,060	.768	.86
May	1,620	415	778	.564	.65
June	8,220	590	2,850	2.06	2.30
July	670	198	416	.301	.35
August	233	69	140	.101	.12
September	396	69	139	.101	.11

IOWA RIVER AT IOWA CITY, IOWA.

LOCATION.—In T. 79 N., R. 6 W. at highway bridge about 500 feet below Chicago, Rock Island & Pacific Railway main-line bridge; about 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, 1917, at present site; June 11, 1903, to July 21, 1906, for 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 Ray Stramp, C. P. McGrath, and 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 the left end of the approach at extremely high stage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.8 feet June 7 (discharge, 6,950 second-feet); gage not read during high water June 9–22. Minimum stage recorded, −.50 foot December 26 (discharge, about 10 second-feet). Maximum stage ever recorded, about 15 feet (old gage) night of June 2–3, 1903 (discharge, about 20,000 second-feet); minimum discharge, about 10 second-feet December 26, 1916.

ICE.—Stage-discharge relation affected by ice; observations discontinued during winter.

REGULATION.—Considerable diurnal fluctuations at low stages owing to operation of power plant above station.

ACCURACY.—Stage-discharge probably permanent during year. Rating curve well defined between 142 and 11,000 second-feet. Gage read once daily to half-tenths. Daily discharge, except as noted below, ascertained by applying daily gage height to rating table. No gage readings available October 1–3, March 15 to April 10, and June 9–22; discharge estimated from record of discharge at Marshalltown. Records for periods in which discharge was estimated and in which it was less than 142 second-feet fair; records for periods of low water with marked diurnal fluctuation are of doubtful value; other records excellent.

Discharge measurements of Iowa River at Iowa City, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 21	C. Herlofson	0.39	193	June 23	C. Herlofson	5.02	3,190
28	Students, University of Iowa	.78	340	Sept. 16	do	.96	458
28	do	.78	334				

Daily discharge, in second-feet, of Iowa River at Iowa City, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug	Sept.
1	75	261	280		2,520	1,120	1,500	445	280
2	180	280	300		2,360	2,440	1,310	340	218
3	150	236	280		2,210	3,620	1,240	422	490
4	112	236	236		2,140	3,620	1,240	422	422
5	56	236	261		2,210	5,000	1,180	300	300
6	86	236	261	2,800	2,360	6,730	1,120	340	1,060
7	207	236	261		2,360	6,950	1,060	735	1,060
8	42	261	280		2,140	6,730	1,060	512	1,240
9	207	320	300		1,920		1,180	400	1,240
10	174	300	280		1,780		950	340	1,180
11	207	261	261	1,700	1,570		895	422	785
12	174	236	200	1,570	1,500		895	340	635
13	320	261	136	1,440	1,380		950	320	735
14	207	236	107	1,380	1,310		950	422	490
15	35	218	121	1,310	1,180		840	229	512
16	158	168	22	1,310	1,120	7,300	840	221	360
17	225	184	22	1,240	1,000		785	360	467
18	174	136	82	1,180	950		950	261	445
19	158	136	22	1,120	950		840	261	422
20	112	152	22	1,180	840		785	360	400
21	29	168	22	1,380	950		735	320	380
22	29	218	22	1,700	2,140		785	300	261
23	225	261	22	1,440	1,980	3,170	635	243	340
24	243	280	17	1,380	1,630	3,440	735	204	467
25	280	280	14	1,240	1,440	2,520	635	221	380
26	280	168	10	1,180	1,310	2,280	635	188	467
27	280	152	22	1,180	1,120	2,060	685	239	422
28	300	168	22	1,180	1,060	1,780	635	261	445
29	243	184	26	1,310	1,060	1,780	560	300	225
30	261	218	32	1,640	1,060	1,500	610	280	261
31	243	.....	30	.....	1,240	.....	610	261	.....

Monthly discharge of Iowa River at Iowa City, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 3,140 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	320	29	177	0.056	0.06
November	320	136	223	.071	.08
December	300	10	128	.041	.05
April	.....	1,120	1,840	.586	.65
May	2,520	840	1,570	.500	.58
June	.....	1,120	5,230	1.666	1.86
July	1,500	560	898	.286	.33
August	735	188	331	.105	.12
September	1,240	218	546	.174	.19

IOWA RIVER AT WAPELLO, IOWA.

LOCATION.—In sec. 27, T. 74 N., R. 3 W., at highway bridge about 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, 1917.

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 might break or be overtopped at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.2 feet, March 29 (discharge, 52,000 second-feet); minimum discharge, 400 second-feet December 15–17. Maximum known stage prior to 1917, about 14.3 feet about April 3, 1912 (discharge, about 58,000 second-feet). The flood of June, 1892, was much higher.

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

ACCURACY.—Stage-discharge relation nearly permanent; one rating curve used during 1917, well defined throughout. Gage read once daily to hundredths. Daily discharge, except as noted below, ascertained by applying daily gage height to rating table. Stage-discharge relation affected by ice December 14 to March 9; discharge ascertained from one discharge measurement, observer's notes, gage heights, and weather records. Open-water records excellent; winter records fair.

Discharge measurements of Iowa River at Wapello, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 20	C. Herlofson	0.52	1,680	Mar. 29	Davis and Herlofson	12.9	50,200
Jan. 3[a]	do	.54	650	Sept. 18	C. Herlofson	.94	2,260

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Iowa River at Wapello, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,700	1,630	1,770	650	1,000	1,000	30,200	10,500	5,510	13,900	3,790	1,840
2	1,630	1,770	1,770	650	900	1,000	24,200	11,500	6,220	13,200	3,400	1,840
3	1,630	1,770	1,700	650	800	1,000	19,600	10,800	9,880	10,200	3,210	2,210
4	1,560	1,770	1,700	650	700	1,000	18,000	9,880	12,200	9,260	2,850	3,030
5	1,440	1,770	1,700	650	700	1,000	12,800	11,200	14,600	8,360	3,030	3,990
6	1,370	1,630	1,700	650	700	1,000	14,600	11,200	21,700	8,070	2,850	4,620
7	1,370	1,630	1,700	650	600	1,000	10,500	10,500	24,700	7,510	5,060	5,980
8	1,310	1,630	1,700	700	600	1,000	9,570	9,260	25,600	7,510	5,280	9,570
9	1,370	1,770	1,630	800	600	1,500	9,260	8,660	26,500	8,070	3,990	6,980
10	1,370	1,770	1,500	800	600	3,400	8,960	8,660	26,500	6,980	3,030	4,840
11	1,370	1,840	1,370	900	600	4,400	8,660	7,510	25,600	5,980	2,850	4,190
12	1,370	1,840	1,250	900	600	5,510	8,360	6,720	26,000	4,840	2,850	3,210
13	1,310	1,840	830	900	600	7,510	7,790	6,470	27,400	6,720	3,030	2,850
14	1,310	1,910	500	800	600	15,700	7,510	5,740	32,700	6,470	3,030	2,850
15	1,310	1,910	400	700	600	19,200	6,980	5,510	43,500	5,980	3,030	2,680
16	1,310	1,840	400	700	600	15,700	6,980	5,060	41,200	5,510	3,030	2,680
17	1,250	1,910	400	700	600	16,900	6,980	4,840	38,500	5,510	2,850	2,680
18	1,250	1,500	500	700	700	19,200	6,470	4,620	33,200	5,510	2,680	2,520
19	1,310	1,500	500	700	700	15,700	6,470	4,620	25,600	5,510	2,680	2,210
20	1,370	1,560	600	700	700	13,500	6,470	4,400	21,300	5,060	2,680	2,140
21	1,440	1,630	600	700	800	12,200	6,720	4,400	17,700	4,840	2,680	2,060
22	1,440	1,770	600	800	1,000	9,880	6,470	6,720	12,800	5,060	2,680	1,980
23	1,370	1,980	700	900	1,000	10,500	6,470	10,800	10,500	5,280	2,520	1,980
24	1,560	1,980	700	800	1,000	13,200	6,470	8,960	11,800	5,510	2,360	1,980
25	1,630	1,840	700	700	1,000	15,000	6,470	7,240	10,500	5,060	2,210	1,910
26	1,980	1,910	700	700	1,000	15,700	6,470	6,220	9,260	4,840	2,210	1,840
27	1,910	1,700	700	700	1,000	18,000	6,470	5,740	8,360	4,840	2,140	1,770
28	1,840	1,630	700	800	1,000	24,700	6,220	5,510	8,660	4,840	1,980	1,770
29	1,770	1,630	650	900	.....	48,300	6,470	5,060	9,880	4,620	1,910	1,910
30	1,700	1,630	650	1,000	.....	45,900	7,240	5,510	12,200	4,190	1,910	1,770
31	1,630	.....	650	1,000	.....	35,800	.....	5,060	.....	3,790	1,910	.....

Monthly discharge of Iowa River at Wapello, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 12,480 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,980	1,250	1,490	0.119	0.14
November	1,980	1,500	1,750	.140	.16
December	1,770	400	999	.080	.09
January	1,000	650	760	.061	.07
February	1,000	600	761	.061	.06
March	48,300	1,000	12,800	1.03	1.19
April	30,200	6,220	9,860	.790	.88
May	11,500	4,400	7,380	.591	.68
June	43,500	5,510	20,000	1.60	1.78
July	13,900	3,790	6,550	.525	.61
August	5,280	1,910	2,890	.232	.27
September	9,570	1,770	3,060	.245	.27
The year	48,300	400	5,690	.456	6.20

CEDAR RIVER AT JANESVILLE, IOWA.

LOCATION.—In sec. 35, T. 91 N., R. 14 W., at Illinois Central Railroad bridge about 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, 1917.

GAGE.—Chain gage attached to upstream guardrail of bridge about the middle of left span; read by James Townsend.

DISCHARGE MEASUREMENTS.—Made from upstream side of railroad bridge.

CHANNEL AND CONTROL.—Bed composed of gravel; slightly shifting. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.6 feet 8 a. m., March 24 (discharge, 21,200 second-feet); minimum stage recorded, 0.78 foot December 10, (discharge, 181 second-feet.)

1905–06 and 1915–1917: Maximum discharge, 22,600 second-feet March 28, 1906; minimum stage recorded, 0.75 foot, November 3, 1915 (discharge, 173 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 well defined throughout. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Records excellent.

Discharge measurements of Cedar River at Janesville, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 28	C. Herlofson	7.34	4,940
June 25	Bolster and Herlofson	12.55	17,000
Sept. 15	C. Herlofson	1.14	292

Daily discharge, in second-feet, of Cedar River at Janesville, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	291	281	264	.....	2,090	1,390	1,630	2,650	1,060	316
2	284	291	258	.....	1,880	1,450	2,650	2,160	654	288
3	251	267	255	.....	1,280	1,510	2,740	2,020	559	334
4	264	261	264	.....	1,390	1,280	2,400	1,950	451	334
5	245	239	258	.....	1,280	1,060	2,020	1,450	451	316
6	251	248	251	.....	1,340	955	1,750	1,230	493	295
7	242	267	255	.....	1,390	852	2,320	1,120	471	306
8	236	258	261	.....	1,280	802	3,310	1,230	451	211
9	236	258	302	.....	1,230	703	4,280	2,020	493	288
10	232	302	181	.....	1,120	654	3,620	1,750	654	248
11	236	390	267	.....	1,060	630	2,400	1,390	752	264
12	232	410	261	.....	955	654	2,240	1,340	606	245
13	242	334	.....	.....	955	679	2,160	1,280	583	264
14	242	300	.....	.....	903	583	1,950	1,390	606	288
15	223	250	.....	.....	852	514	1,750	1,450	537	313
16	211	250	.....	.....	802	471	1,390	1,280	559	334
17	245	250	.....	.....	679	451	1,120	1,120	903	274
18	232	250	.....	.....	728	451	955	852	654	284
19	220	267	.....	.....	728	471	903	1,010	606	298
20	211	302	.....	.....	903	630	752	852	471	306
21	232	316	.....	.....	903	606	728	559	410	306
22	271	313	.....	.....	955	752	703	852	371	316
23	236	306	.....	10,400	1,280	728	752	852	410	352
24	232	267	.....	21,200	1,170	703	1,690	679	390	559
25	275	258	.....	16,600	1,120	852	5,520	752	334	430
26	251	220	.....	9,440	1,060	802	14,260	802	288	410
27	284	267	.....	6,700	1,010	802	5,780	703	316	410
28	281	288	.....	4,760	903	752	4,760	852	334	371
29	291	309	.....	3,410	1,010	802	2,920	583	316	334
30	268	271	.....	2,740	1,010	852	2,480	583	334	514
31	288	.....	.....	2,320	.....	752	.....	654	306	.....

Monthly discharge of Cedar River at Janesville, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 1,660 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	298	211	250	0.151	0.17
November	410	220	283	.170	.19
December 1–12	302	181	257	.155	.07
March 23–31	21,200	2,320	8,620	5.19	1.74
April	2,690	679	1,110	.669	.75
May	1,510	451	793	.478	.55
June	14,200	703	2,730	1.64	1.84
July	2,650	559	1,210	.729	.84
August	1,060	288	510	.307	.35
September	559	211	327	.197	.22

CEDAR RIVER AT CEDAR RAPIDS, IOWA.

LOCATION.—In T. 83 N., R. 7 W., in central part of Cedar Rapids, Linn County, about half a mile below dam, between electric-railroad bridge and Seventh Avenue combination railroad and footbridge.

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, 1917.

GAGE.—Inclined staff gage fastened to posts driven in right bank of the river in rear of plant of the Iowa Windmill & Pump Co.; 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 the gage, according to the stage.

CHANNEL AND CONTROL.—Bed composed of rock and gravel; free from vegetation and practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.2 feet at 6 p. m., March 26 (discharge, 54,200 second-feet); minimum open-water stage recorded during year, 2.9 feet October 9–17 (discharge, 740 second-feet); minimum winter discharge much less.

1902–1917: Maximum stage recorded, 17.2 feet April 1, 1912, and March 26, 1917 (discharge, 54,200 second-feet); minimum open-water stage recorded, 2.5 feet July 24–28, 1911 (discharge, 410 second-feet); minimum during period of ice effect in December, 1916, probably much less. 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 the power plant keep the measuring section open.

REGULATION.—Power has been developed at the new dam above the gaging station during 1917. There is no direct evidence yet of effect on gage readings. There is no dam for a long distance below Cedar Rapids and no backwater at gaging station.

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. Stage-discharge relation affected by ice December 14 to March 18; discharge estimated as 70 per cent of discharge at Wapello. Open-water records excellent; winter records fair.

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

Discharge measurements of Cedar River at Cedar Rapids, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 22	C. Herlofson	3.31	1,300	Mar. 27	Herlofson and Davis	15.40	44,900
Jan. 5[a]	do	3.31	456	Sept. 16	Herlofson and Clyde	3.25	1,240

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet of Cedar River at Cedar Rapids, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,020	1,180	1,020		10,800	4,730	2,770	7,890	1,960	1,100
2	870	1,180	1,020		8,970	4,730	2,770	6,820	1,840	1,100
3	870	1,020	1,020		8,250	5,070	5,420	5,770	1,840	1,100
4	870	1,020	1,020		7,170	5,770	6,120	5,770	1,840	1,100
5	870	1,020	1,020		6,820	5,770	8,970	5,070	1,630	1,100
				900						
6	870	1,020	1,020		6,120	5,420	9,340	5,070	1,630	1,100
7	870	1,020	1,020		5,770	5,070	10,100	4,730	1,630	1,630
8	870	1,020	1,020		5,420	4,730	10,800	4,050	1,630	1,630
9	740	1,020	1,020		5,420	4,390	10,100	3,720	1,630	1,630
10	740	1,020	870		5,070	4,050	11,600	3,720	1,630	1,260
11	740	870	870	4,050	5,070	3,390	13,900	4,050	1,630	1,260
12	740	870	870	3,720	4,730	3,070	15,400	4,390	1,840	1,260
13	740	1,020	870	4,730	4,730	3,070	18,600	4,050	1,960	1,260
14	740	1,180		7,890	4,050	2,770	15,400	3,720	1,840	1,440
15	740	1,020		8,610	3,720	2,480	10,800	3,390	1,840	1,260
16	740	870		8,610	3,720	2,480	8,970	3,390	1,840	1,260
17	740	870		6,820	3,390	2,210	7,890	3,390	1,840	1,260
18	870	870		5,070	3,070	2,210	6,820	3,390	1,630	1,260
19	870	1,020		4,050	2,770	1,960	5,770	3,070	1,630	1,260
20	870	1,020		3,390	3,070	1,960	4,730	3,070	1,630	1,260
21	870	1,180		4,730	3,070	1,840	4,390	3,070	1,630	1,100
22	870	1,350	400	6,820	3,070	1,960	3,720	3,070	1,630	1,100
23	870	1,180		10,100	3,390	2,480	4,050	3,070	1,440	1,100
24	870	1,180		10,800	3,720	2,480	3,720	3,070	1,440	1,100
25	1,020	1,020		24,500	4,050	2,480	3,390	3,390	1,260	1,100
26	1,180	1,020		52,600	4,050	2,210	3,720	3,390	1,260	1,100
27	1,020	1,180		47,400	3,720	2,480	6,120	3,390	1,260	1,100
28	1,020	1,180		35,200	3,390	2,770	7,170	3,070	1,100	1,100
29	1,020	1,180		24,500	3,720	2,480	13,100	2,770	1,100	1,100
30	1,180	1,180		17,800	4,050	2,480	10,800	2,480	1,100	1,100
31	1,180	.....		13,900	.....	2,770	.....	2,210	1,100	.....

NOTE.—Braced figures show mean discharge for period included.

Monthly discharge of Cedar River at Cedar Rapids, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 6,640 square miles]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,180	740	886	0.133	0.15
November	1,350	870	1,060	.160	.18
December	1,020	.....	641	.097	.11
January	.....	.....	530	.079	.09
February	.....	.....	530	.079	.08
March	52,600	.....	10,100	1.52	1.75
April	10,800	2,770	4,810	.725	.81
May	5,770	1,840	3,280	.494	.57
June	18,600	2,770	8,220	1.24	1.38
July	7,890	2,210	3,920	.590	.68
August	1,960	1,100	1,600	.241	.28
September	1,630	1,100	1,220	.184	.21
The year	52,600	.....	3,070	.462	6.29

SHELLROCK RIVER NEAR CLARKSVILLE, IOWA.

LOCATION.—In T. 92 N., R. 16 W., at highway bridge 1¼ miles northwest of Clarksville, Butler County, and about 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, 1917.

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 during year about 14.7 feet, March 22 (probably affected by ice); minimum stage recorded since station was established 1.15 feet October 23, 1916 (discharge, 125 second-feet). In April, 1907, a stage of about 16.5 feet was reached (discharge, about 19,000 second-feet).

ICE.—Stage-discharge relation affected by ice November 14–18, 25–26 and December 9 to about March 22; observations discontinued during winter.

ACCURACY.—Stage-discharge relation practically permanent, except as affected by ice. 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; estimated for period of ice effect. Records excellent except those for extremely low, and high stages, which are fair; winter records roughly approximate.

Discharge measurements of Shellrock River near Clarksville, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Nov. 12	C. Herlofson	1.71	274
June 25	Bolster and Herlofson	5.01	2,660
Sept. 15	C. Herlofson	1.67	245

Daily discharge, in second-feet, of Shellrock River near Clarksville, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	188	165	165	.....	2,340	1,810	1,900	1,500	510	212
2	165	165	155	.....	2,160	1,900	1,570	1,340	510	212
3	165	165	155	.....	1,980	1,570	1,500	1,200	485	212
4	155	165	155	.....	1,900	1,340	1,340	1,140	485	200
5	175	165	145	.....	1,900	1,340	1,060	935	485	188
6	155	165	145	.....	1,900	1,280	2,440	870	485	188
7	145	165	145	.....	1,730	1,140	5,640	710	650	200
8	145	175	155	.....	1,570	1,000	3,820	1,280	935	212
9	145	225	130	.....	1,420	870	2,940	1,140	1,000	435
10	145	345	100	.....	1,280	805	2,240	1,060	510	345
11	145	308	100	.....	1,200	805	1,810	1,000	510	290
12	145	255	100	.....	1,060	740	1,500	1,000	485	272
13	145	225	100	.....	1,000	680	1,810	935	460	255
14	145	200	.....	.....	935	620	1,500	870	435	240
15	165	175	.....	.....	870	565	1,200	805	460	255
16	175	175	.....	.....	805	510	935	805	410	240
17	145	175	.....	.....	805	485	870	1,000	365	240
18	145	175	.....	.....	740	435	772	1,000	345	225
19	155	175	.....	.....	870	388	650	805	325	200
20	165	175	.....	.....	870	1,000	592	680	308	212
21	145	188	.....	.....	1,280	870	538	680	272	345
22	135	188	.....	.....	1,340	870	650	2,440	272	308
23	125	188	.....	.....	1,340	870	805	2,160	255	290
24	145	188	.....	.....	1,140	805	2,530	1,500	240	255
25	165	175	.....	.....	1,060	710	2,530	1,000	225	240
26	188	175	.....	.....	1,060	620	2,160	805	225	212
27	200	200	.....	.....	1,200	805	1,650	710	225	225
28	212	255	.....	3,360	1,140	1,140	1,650	650	225	325
29	200	175	.....	2,730	1,140	935	1,730	565	225	255
30	175	165	.....	2,530	1,650	805	1,570	510	225	225
31	175	.....	.....	2,440	.....	1,340	.....	510	212	.....

NOTE.—Observations of stage suspended Dec. 14 to Mar. 27 because of ice.

Monthly discharge of Shellrock River near Clarksville, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 1,660 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	212	125	161	0.097	0.11
November	345	165	195	.118	.13
December 1-13	165	.....	132	.079	.04
March 28-31	3,360	2,440	2,760	1.66	.21
April	2,340	740	1,320	.795	.89
May	1,900	388	937	.565	.65
June	5,640	538	1,730	1.04	1.16
July	2,440	510	1,020	.614	.71
August	1,000	212	413	.249	.29
September	435	188	250	.151	.17

SKUNK RIVER AT COPPOCK, IOWA.

LOCATION.—In T. 74 N., R. 8 W., at highway bridge one-eighth 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, 1917.

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; channel shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.5 feet June 14 (discharge, 15,700 second-feet); minimum discharge recorded, 52 second-feet October 17.

Maximum stage prior to 1917 about 24 feet (discharge, 30,000 second-feet) about the end of May, 1903.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

ACCURACY.—Stage-discharge relation changed during the year, requiring the use of three rating curves applicable October 1–11, October 15 to November 26, and November 30 to September 30. The second rating curve, used during the rebuilding of piers of the Chicago, Burlington & Quincy Railroad bridge below the station, is not well defined; the other two curves are well defined. Discharge interpolated October 12–14 and November 27–29. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Open-water records excellent.

Discharge measurements of Skunk River at Coppock, Iowa, during the year ending Sept. 30, 1917.

[Made by C. Herlofson.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 25 *a*	3.22	281	Sept. 19	2.76	144
July 13	4.56	771	19	2.77	144

a Stage-discharge relation affected by backwater caused by cofferdam used during construction of new piers at the Chicago, Burlington & Quincy Railroad bridge, one-eighth mile below gage.

Daily discharge, in second-feet, of Skunk River at Coppock, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	228	145	265	.....	1,120	7,360	1,360	1,760	422	157
2	203	135	250	.....	940	7,2'0	1,960	1,620	388	146
3	168	135	250	.....	885	3,8'0	5,470	1,420	355	310
4	157	120	238	.....	785	3,920	6,740	1,300	340	2,720
5	135	118	238	.....	835	5,260	8,810	1,180	325	785
6	125	116	214	.....	885	4,020	12,900	1,120	295	560
7	115	114	214	.....	785	3,290	14,200	995	480	520
8	119	116	238	.....	785	2,640	12,900	940	690	690
9	115	433	202	.....	785	2,330	11,000	940	340	370
10	111	469	190	.....	885	2,040	9,810	940	310	238
11	109	364	179	4,420	885	1,900	9,090	1,060	265	214
12	101	270	.....	2,500	835	1,620	8,670	885	265	226
13	92	242	.....	2,960	835	1,420	8,950	785	250	238
14	83	256	.....	7,230	785	1,300	15,400	690	250	214
15	75	270	.....	5,800	735	1,180	15,000	690	238	202
16	75	228	.....	3,830	735	1,120	13,900	600	226	179
17	52	178	.....	5,150	885	1,000	13,000	645	226	168
18	55	145	.....	4,020	885	885	12,200	785	214	157
19	58	125	.....	3,460	1,560	835	11,300	785	214	146
20	89	114	.....	4,020	1,680	785	9,960	940	214	146
21	77	112	.....	4,420	1,240	735	8,260	995	214	135
22	72	111	.....	3,040	1,300	6,260	6,620	785	202	135
23	69	156	.....	2,330	1,060	5,040	5,360	690	190	131
24	111	215	.....	2,720	995	3,920	4,120	995	190	129
25	770	331	.....	2,640	1,360	2,560	3,040	690	179	129
26	430	300	.....	2,640	1,240	2,040	2,480	690	179	135
27	93	288	.....	2,640	995	1,760	2,330	835	179	146
28	215	275	.....	2,640	885	1,560	2,040	735	179	129
29	202	268	.....	2,640	2,640	1,360	1,960	600	168	122
30	190	250	.....	1,760	2,960	1,240	2,100	520	168	118
31	167	.....	.....	1,300	.....	1,490	.....	460	157	.....

NOTE.—Stage-discharge relation affected by ice Dec. 12 to Mar. 10; data inadequate for determinations of discharge.

Monthly discharge of Skunk River at Coppock, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 2,890 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	770	52	150	0.052	0.06
November	469	111	213	.074	.08
December 1-11	265	179	225	.077	.03
March 11-31	7,230	1,300	3,440	1.19	.93
April	2,960	735	1,110	.384	.43
May	7,360	735	2,640	.913	1.02
June	15,400	1,360	8,030	2.778	3.10
July	1,760	460	906	.314	.36
August	690	157	268	.093	.11
September	2,720	118	323	.112	.13

SKUNK RIVER AT AUGUSTA, IOWA.

LOCATION.—In T. 69 N., R. 4 W., at highway bridge about one-third 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 4,200 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, 1917.

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 gage about 0.73 foot higher than that of chain gage; taken out by ice in spring of 1914.

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

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 permanent. The riffle at the dam causes a drop of 3 feet at medium low stage. Backwater from the Mississippi can not occur oftener than once in about 50 years.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 17.0 feet June 7; minimum stage recorded, 1.20 feet September 24.

Maximum stage prior to 1917 approximately 21 feet about June 1, 1903 (discharge, nearly 40,000 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 14 to March 12.

Data inadequate for determination of discharge.

Discharge measurements of Skunk River at Augusta, Iowa, during the year ending Sept. 30, 1917.

[Made by C. Herlofson.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 17	1.63	83	July 12	2.94	1,130
Jan. 19 [a]	2.10	140	Sept. 20	2.02	191
June 11	10.65	12,400			

[a] Measurement made under ice cover.

Daily gage height, in feet, of Skunk River at Augusta, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.18	1.95	2.45	2.4	.....	2.55	3.4	11.9	4.2	9.8	2.8	1.8
2	2.13	1.90	2.35	.....	2.85	2.6	3.4	10.9	5.1	3.6	2.7	1.75
3	1.93	1.90	2.17	2.10	2.8	2.55	3.35	9.3	5.5	3.5	2.55	2.35
4	1.73	1.87	2.13	2.4	2.8	2.00	3.25	6.8	8.9	3.4	2.65	2.4
5	1.68	1.85	1.97	.....	2.6	.....	3.1	8.0	14.0	3.15	2.65	4.4
6	1.63	1.90	1.92	2.3	2.5	.....	3.05	7.6	16.4	3.05	2.17	3.8
7	1.63	2.11	1.75	2.4	.....	.....	3.0	6.0	17.0	3.0	2.45	3.6
8	1.58	1.95	1.77	2.45	2.07	.....	3.25	5.6	16.6	2.95	2.5	3.6
9	1.53	2.75	1.72	.....	2.02	.....	3.3	4.8	16.2	3.15	3.1	3.0
10	1.58	2.85	1.72	2.5	2.02	.....	3.4	4.6	14.3	3.1	2.55	2.9
11	1.58	2.85	1.77	.....	2.02	2.4	3.4	4.3	11.5	3.05	2.5	2.45
12	1.48	2.75	1.70	3.1	.....	5.4	3.35	4.1	10.0	3.1	2.25	2.05
13	1.53	2.55	1.77	3.05	2.05	5.4	3.4	4.0	13.4	3.05	2.17	2.2
14	1.58	2.3	1.82	2.9	2.02	11.0	3.4	3.8	12.2	2.4	2.17	2.25
15	1.48	2.15	.....	.....	.....	10.0	3.3	3.6	12.8	2.7	2.17	2.2
16	1.43	2.05	1.87	2.75	2.02	8.4	3.15	3.5	14.6	2.6	2.17	2.25
17	1.48	1.95	1.77	2.5	2.02	7.6	3.6	3.4	14.2	2.55	2.17	2.2
18	1.53	1.95	1.82	.....	2.07	7.0	3.6	3.4	12.6	2.6	1.97	2.2
19	1.63	1.80	.....	1.95	2.2	6.5	3.6	3.4	12.2	2.95	1.97	2.15
20	1.65	1.97	1.87	1.82	2.12	5.2	4.1	3.1	10.0	3.0	1.87	1.85
21	1.68	1.96	.....	1.82	2.12	5.0	4.1	6.2	9.3	2.95	2.17	1.80
22	1.33	2.00	1.87	.....	2.17	4.8	4.0	10.0	8.6	2.95	1.97	1.55
23	1.58	2.05	1.87	5.2	.....	4.7	3.8	9.0	7.2	3.05	2.17	1.25
24	1.73	2.00	1.87	4.4	2.2	4.6	3.8	6.6	6.4	3.0	2.17	1.20
25	2.6	1.75	1.82	.....	2.4	4.6	4.3	5.2	5.8	2.95	2.3	1.25
26	3.05	1.85	.....	4.3	2.45	4.5	4.0	5.1	5.4	2.75	1.67	1.30
27	3.05	2.3	1.92	3.2	.....	4.4	3.8	5.1	4.6	2.7	2.17	2.00
28	3.0	2.45	1.97	2.95	.....	4.2	3.8	5.0	4.4	3.0	2.17	1.87
29	2.75	2.65	2.02	.....	.....	4.0	4.2	5.0	4.2	2.95	2.17	1.92
30	2.25	2.55	2.02	2.85	.....	3.6	5.6	4.1	4.2	3.0	2.3	1.90
31	2.03	.....	2.12	2.8	.....	3.5	.....	4.1	.....	2.55	2.17	.....

DES MOINES RIVER AT KALO, IOWA.

LOCATION.—In sec. 17, T. 88 N., R. 28 W., at highway bridge at Kalo, Webster County, about 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, 1917, 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.—At high stages made from bridge to which gage is attached; at low stages by wading.

CHANNEL AND CONTROL.—No well-defined control; channel consists 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 12.9 feet March 22 (discharge, 17,100 second-feet); minimum stage recorded since establishment of station, 0.25 foot October 12, 1916 (discharge, 66 second-feet).

1913–1917: Maximum stage recorded, 14.0 feet May 30, 1915 (discharge, 18,500 second-feet).

ICE.—Stage-discharge relation affected by ice November 14–18, 24–26, December 9 to March 21; observations discontinued during winter.

ACCURACY.—Stage-discharge relation permanent throughout year except as affected by ice. 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; estimated November 14–18, 24–26, because of ice. Records excellent except those below 200 second-feet, which are roughly approximate.

Discharge measurements of Des Moines River at Kalo, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Nov. 10	C. Herlofson	0.88	270
June 27	Bolster and Herlofson	4.22	2,880
Sept. 14	Herlofson and Clyde	.76	219

Daily discharge, in second-feet, of Des Moines River at Kalo, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	76	196	216	.....	6,400	4,110	3,100	2,520	742	160
2	128	216	196	.....	5,800	3,980	3,340	2,200	615	178
3	76	128	196	.....	5,210	3,850	3,340	1,640	445	160
4	76	100	196	.....	5,070	3,850	3,590	1,640	420	128
5	76	100	196	.....	5,070	3,550	3,850	1,640	585	144
6	76	160	178	.....	4,650	3,590	7,810	1,820	258	160
7	76	160	160	.....	4,510	3,220	9,820	2,000	525	370
8	100	370	160	.....	4,510	2,860	11,000	2,000	470	280
9	160	280	150	.....	4,510	2,630	9,990	2,630	498	302
10	196	347	.....	.....	4,510	2,410	8,970	2,630	555	236
11	76	302	.....	.....	4,370	2,200	8,290	2,300	498	236
12	66	236	.....	.....	3,980	2,000	7,650	2,000	498	236
13	76	196	.....	.....	3,720	1,820	7,330	1,820	470	178
14	76	150	.....	.....	3,460	1,730	6,700	1,640	128	196
15	196	100	.....	.....	3,220	1,640	5,950	1,640	445	196
16	160	100	.....	.....	2,980	1,480	5,210	1,560	280	178
17	128	100	.....	.....	2,860	1,480	4,650	1,480	302	160
18	128	300	.....	.....	2,740	1,320	4,110	1,460	325	160
19	88	325	.....	.....	2,630	1,320	3,590	1,320	280	160
20	88	280	.....	.....	2,630	1,180	3,220	1,180	280	178
21	76	280	.....	.....	2,630	1,400	2,980	1,110	280	178
22	100	258	.....	15,100	2,980	2,000	2,860	1,110	302	196
23	128	280	.....	14,860	3,100	2,520	2,740	1,040	280	196
24	100	250	.....	14,200	2,980	2,860	2,630	1,320	236	178
25	76	250	.....	13,300	2,860	3,100	2,740	1,910	236	178
26	160	250	.....	12,400	2,860	3,100	2,630	1,250	196	178
27	178	236	.....	11,500	2,740	2,860	2,860	1,040	178	178
28	160	236	.....	10,500	2,630	2,630	2,980	905	178	258
29	128	258	.....	9,480	2,980	2,630	3,100	840	196	196
30	100	236	.....	8,290	3,460	2,630	3,100	678	196	196
31	128	.....	.....	7,330	.....	2,630	.....	645	178	.....

Monthly discharge of Des Moines River at Kalo, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 4,170 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	196	66	111	0.027	0.03
November	347	100	215	.051	.06
December 1–9	216	150	183	.044	.01
March 22–31	15,100	7,330	11,700	2.81	.92
April	6,400	2,630	3,740	.897	1.00
May	4,110	1,180	2,540	.609	.70
June	11,000	2,630	5,000	1.20	1.34
July	2,630	645	1,580	.379	.44
August	742	128	357	.086	.10
September	370	128	198	.047	.05

DES MOINES RIVER AT DES MOINES, IOWA.

LOCATION.—In T. 78 N., R. 24 W., at Walnut Street Bridge at Des Moines, Polk County, about one-third 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, 1917, at the Walnut Street Bridge. From May 26, 1905, to July 20, 1906, records were collected at the Interurban Bridge near Highland Park, about 5 miles above present station. The United States Weather Bureau has maintained a gage at the Locust Street Bridge from July 1, 1897, to January, 1912; and at the Walnut Street Bridge from January, 1912, to September 30, 1917.

GAGE.—The original Weather Bureau gage is a staff gage at the Locust Street Bridge; one block above the Walnut Street Bridge. In January, 1912, a Friez water-stage recorder was installed by the United States Weather Bureau in and near the south end of the second pier from the east abutment of the 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 the 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 the 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 the low-water stage of the river a few feet and thus improving the appearance of the river through the park along the bank. The pooled water from this dam extends past the gage to the 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, 16.1 feet June 10; minimum stage recorded, 1.3 feet in January.

1897–1917; 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 the station is to improve the conditions of winter flow, but severe winters and occasional ice jams below the gage often seriously affect the stage-discharge relation.

REGULATION.—The Edison Power & Light Co.'s dam, about one-fourth mile above gage, causes slight diurnal fluctuation of stage. The 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.

Determinations of discharge withheld for additional data.

Discharge measurements of Des Moines River at Des Moines, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Nov. 9	C. Herlofson	2.00	362
June 28	Bolster and Herlofson	5.58	3,890
Sept. 12	C. Herlofson	2.37	359

Daily gage height, in feet, of Des Moines River at Des Moines, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.0	2.0	2.0	1.3	.....	.....	7.9	6.1	5.3	5.5	3.0	2.1
2	2.0	2.0	2.0	1.3	.....	.....	7.2	6.6	5.7	5.4	3.0	2.1
3	2.0	2.0	2.0	1.3	.....	.....	6.8	6.8	6.2	5.0	3.0	2.1
4	1.9	2.0	2.0	1.3	.....	.....	6.6	6.8	6.0	4.8	2.9	2.4
5	1.9	2.0	2.0	1.4	.....	.....	6.5	6.8	7.5	4.6	2.8	2.2
6	1.9	2.0	2.0	1.4	.....	.....	6.5	6.6	10.2	4.5	2.7	2.1
7	1.9	1.9	2.0	1.3	.....	.....	6.5	6.5	13.2	4.4	2.6	2.2
8	1.8	1.9	2.0	1.4	.....	.....	6.4	6.1	15.1	4.4	2.6	2.3
9	1.8	2.0	2.0	1.4	.....	.....	6.2	5.7	15.7	4.7	2.7	2.3
10	1.8	2.0	1.7	1.4	.....	.....	6.3	5.4	16.1	5.0	2.8	2.5
11	1.8	2.1	1.8	1.5	.....	.....	6.4	5.1	15.9	5.0	2.7	2.6
12	1.8	2.3	1.6	1.4	.....	.....	6.2	4.9	14.3	4.9	2.6	2.5
13	1.8	2.3	1.6	1.4	.....	4.8	5.9	4.7	13.0	4.7	2.7	2.4
14	1.8	2.2	1.6	1.3	.....	5.7	5.7	4.5	12.4	4.5	2.6	2.4
15	1.8	1.8	1.6	1.3	.....	5.0	5.6	4.4	10.5	4.4	2.6	2.4
16	1.8	1.9	1.7	1.3	.....	4.4	5.4	4.2	9.0	4.3	2.5	2.3
17	1.8	2.0	1.6	1.3	.....	4.0	5.2	4.1	8.2	4.3	2.5	2.3
18	1.8	2.1	1.6	1.3	.....	3.8	5.2	4.0	7.5	4.2	2.5	2.3
19	1.8	2.2	1.7	1.4	.....	3.5	5.0	3.9	7.0	4.0	2.4	2.3
20	1.9	2.1	1.7	1.4	.....	4.5	5.0	3.8	6.5	3.9	2.4	2.2
21	1.8	2.2	1.6	1.4	.....	5.6	5.1	3.9	6.2	3.8	2.3	2.1
22	1.9	2.2	1.6	1.4	.....	6.3	5.6	4.1	5.9	3.7	2.4	2.1
23	1.8	2.2	1.6	1.4	.....	9.2	5.6	4.8	5.7	3.6	2.4	2.0
24	1.9	2.2	1.6	1.4	.....	10.6	5.6	5.3	5.5	3.5	2.3	1.9
25	1.9	2.1	1.4	1.4	.....	12.0	5.4	5.4	5.4	3.5	2.4	1.9
26	1.9	1.9	1.4	1.4	.....	13.2	5.3	5.4	5.3	3.6	2.3	1.9
27	1.9	1.9	1.4	1.4	.....	13.0	5.2	5.4	5.5	3.6	2.2	1.9
28	2.0	2.0	1.4	1.4	.....	12.2	5.2	5.4	5.5	3.6	2.2	1.7
29	2.0	2.1	1.4	1.4	.....	10.9	5.4	5.2	5.6	3.4	2.1	1.7
30	2.0	2.1	1.4	.....	.....	9.8	5.7	5.1	5.6	3.3	2.1	1.6
31	2.0	.....	1.4	.....	.....	8.8	.....	5.1	.....	3.1	.....	.....

DES MOINES RIVER AT OTTUMWA, IOWA.

LOCATION.—At Market Street Bridge, Ottumwa, Wapello County. No large tributary within several miles up or down stream.

DRAINAGE AREA.—13,200 square miles (measured on 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 to September 30, 1917.

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.

CHANNEL AND CONTROL.—Channel probably fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 16.5 feet June 11; minimum stage recorded, 1.5 feet September 25–30.

Maximum discharge 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.

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

Data inadequate for determination of discharge.

Discharge measurements of Des Moines River at Ottumwa, Iowa, for the period Sept. 18, 1914, to Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1914.		*Feet.*	*Sec.-ft.*	1917.		*Feet.*	*Sec.-ft.*
Sept. 18	Bolster and Davis	10.60	24,400	June 29	Bolster and Herlofson	5.32	8,070
				Aug. 1	C. Herlofson	2.60	1,960
1915.				Sept. 6	do	4.48	6,200
June 1	A. Davis	15.96	56,300				

Daily gage height, in feet, of Des Moines River at Ottumwa, Iowa, for the year ending Sept. 30, 1917.

Day.	Mar.	Apr.	May.	June.	Aug.	Sept.	Day.	Mar.	Apr.	May.	June.	Aug.	Sept.
1	.....	8.3	7.6	4.7	2.6	1.7	16	.....	5.1	4.9	13.5	2.1	2.1
2	.....	7.1	7.5	6.5	2.6	1.6	17	.....	5.1	4.8	12.5	2.1	2.1
3	.....	6.5	6.5	8.9	2.5	1.6	18	.....	5.0	4.7	8.5	2.0	2.1
4	.....	6.1	7.6	8.4	2.5	1.6	19	.....	4.9	4.6	8.3	1.8	2.0
5	.....	6.0	8.3	10.7	2.3	1.6	20	.....	4.8	4.5	7.1	1.8	2.0
6	.....	5.8	7.5	11.7	2.3	3.0	21	.....	4.8	4.4	6.7	1.8	1.8
7	.....	5.3	7.7	13.3	2.3	5.0	22	.....	4.7	4.6	6.3	1.8	1.8
8	.....	5.3	6.9	13.8	2.2	4.8	23	.....	4.7	4.7	5.9	1.8	1.6
9	.....	5.3	6.2	13.9	2.2	3.8	24	.....	4.9	4.5	5.6	1.8	1.6
10	.....	5.3	5.6	16.0	2.2	2.8	25	.....	5.0	4.7	5.3	1.8	1.5
11	.....	5.2	5.5	16.5	2.2	2.4	26	.....	4.9	4.8	5.1	1.8	1.5
12	.....	5.2	5.3	15.6	2.1	2.3	27	.....	4.9	4.8	4.9	1.7	1.5
13	.....	5.1	5.2	16.2	2.1	2.3	28	9.9	4.9	4.7	5.5	1.7	1.5
14	.....	5.1	5.1	15.6	2.1	2.3	29	10.3	5.0	4.7	5.3	1.7	1.5
15	.....	5.1	5.0	14.6	2.1	2.2	30	10.1	5.8	4.7	5.3	1.7	1.5
							31	9.3	.....	4.7	.....	1.7	.....

DES MOINES RIVER AT KEOSAUQUA, IOWA.

LOCATION.—In sec. 36, T. 69 N., R. 10 W., at county bridge, 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 (revised measurements made from 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, 1917.

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 one-fourth mile below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 18.45 feet June 14 (discharge, 60,500 second-feet); minimum stage recorded, 0.10 foot, several days in October (discharge, 330 second-feet).

Maximum stage since 1850 and probably in the last century, 27.9 feet June 1, 1903 (discharge, 97,000 second-feet); maximum stage June 1, 1851, about 24 feet (discharge, about 80,000 second-feet).

1903–1917: Minimum stage recorded, zero, August 28 to September 6, 1911 (discharge, 160 second-feet).

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

ACCURACY.—Stage-discharge relation fairly permanent for low and medium stages. Two fairly well defined rating curves were used. Gage read once daily to half-tenths. Stage-discharge relation affected by ice December 13 to March 9; discharge estimated from observer's notes and weather records. Open-water records good; winter records roughly approximate.

Discharge measurements of Des Moines River at Keosauqua, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Nov. 8	Herlofson and Barber	0.38	630
June 30	Bolster and Herlofson	3.54	8,280
Aug. 2	C. Herlofson	1.02	2,030

Daily discharge, in second-feet, of Des Moines River at Keosauqua, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	485	529	725				17,900	19,900	5,500	8,050	1,930	1,190
2	485	588	858				14,100	17,200	11,200	7,780	1,930	1,190
3	540	588	790				11,800	12,900	27,700	7,240	1,840	1,110
4	660	588	790				10,600	20,300	27,300	6,700	1,930	1,190
5	725	564	790			600	9,430	21,300	41,900	5,640	1,930	1,110
6	660	529	725				8,850	18,900	46,700	5,380	1,930	1,420
7	600	529	725				8,280	16,600	41,100	4,880	1,930	6,700
8	660	600	725				8,280	14,100	40,000	4,630	1,930	6,160
9	790	725	600				8,280	11,800	41,500	4,390	1,760	4,630
10	660	725	564			1,290	8,280	10,000	45,900	4,390	1,670	3,010
11	540	725	540				1,770	8,000	8,850	50,800	4,390	1,670	2,110
12	485	660	540		350		2,300	8,000	7,720	48,900	4,630	1,670	2,110
13	430	660					3,940	8,280	7,160	55,800	4,880	1,670	2,110
14	430	660					9,430	7,720	6,320	58,100	4,630	1,670	1,930
15	380	995					12,300	7,160	5,770	51,200	4,390	1,590	1,670
16	330	1,220		400			11,500	6,600	4,970	37,500	4,150	1,590	1,590
17	330	790					12,000	6,600	4,710	29,200	4,150	1,590	1,500
18	388	725					10,900	6,040	4,190	19,200	4,150	1,500	1,420
19	430	725					9,720	6,880	3,940	16,200	4,150	1,500	1,420
20	380	725					7,160	6,040	3,700	13,700	3,680	1,500	1,420
21	330	790					5,500	5,500	3,460	12,100	3,440	1,500	1,270
22	330	790	300				7,720	5,500	12,900	10,600	3,440	1,420	1,190
23	330	858					11,800	5,500	7,160	10,300	3,440	1,420	1,190
24	330	925					12,900	6,600	4,710	9,430	3,010	1,590	1,110
25	430	858					17,900	6,880	6,600	8,320	3,440	1,500	1,190
26	430	790			500		19,900	6,600	6,600	7,780	3,010	1,500	1,270
27	540	790					22,000	6,600	6,320	7,240	3,220	1,420	1,110
28	485	790					24,100	6,040	6,040	10,300	3,010	1,420	1,110
29	518	660					25,500	10,000	6,040	8,590	2,800	1,340	1,110
30	540	660					25,200	14,100	6,040	8,320	2,700	1,270	1,110
31	540	.....			.....		22,000	.....	6,600	.....	2,200	1,190	.....

Monthly discharge of Des Moines River at Keosauqua, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 13,900 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	790	330	490	0.035	0.04
November	1,220	529	725	.052	.06
December	858	.....	454	.033	.04
January	.....	.....	400	.029	.03
February	.....	.....	382	.027	.03
March	25,500	.....	9,100	.655	.74
April	17,900	5,500	8,350	.600	.67
May	21,300	3,460	9,450	.679	.78
June	58,100	5,500	26,700	1.92	2.14
July	8,050	2,200	4,390	.316	.36
August	1,930	1,190	1,620	.117	.13
September	6,700	1,110	1,890	.136	.15
The year	58,100	.....	5,330	.383	5.17

RACCOON RIVER AT VAN METER, IOWA.

LOCATION.—In SW. ¼ sec. 22, T. 78 N., R. 27 W., at highway bridge about one-third 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, 1917.

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; subject to change. River divided into two channels at low and medium stages by an island; 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 extremely high stage this overflow will extend for several thousand feet beyond left end of bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.5 feet June 7 (discharge, 31,800 second-feet); minimum stage, 1.83 feet October 12 and 17 (discharge, 64 second-feet).

1915–1917. Maximum stage recorded, June 7, 1917; minimum stage recorded 1.8 feet August 29, 1916 (discharge, 60 second-feet).

ICE.—Stage-discharge relation affected by ice November 14–20 and December 10 to March 19. Observations discontinued December 13 to March 13.

ACCURACY.—Stage-discharge relation permanent throughout year. Rating curve well defined between 155 and 15,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying gage height to rating table; estimated November 14–20 because of ice. Open-water records excellent, except those for extremely low stages, which are fair.

Discharge measurements of Raccoon River at Van Meter, Iowa, during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Nov. 10	C. Herlofson	2.41	236
June 28	Bolster and Herlofson	5.22	2,360
Sept. 13	Herlofson and Clyde	2.87	457

Daily discharge, in second-feet, of Raccoon River at Van Meter, Iowa, for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	275	202	252	.....	2,290	3,080	1,520	1,840	375	140
2	222	134	214	.....	1,840	3,300	1,930	1,520	350	116
3	149	134	202	.....	1,600	3,400	2,200	1,280	350	107
4	149	134	198	.....	1,210	3,960	2,880	1,140	400	2,580
5	190	134	206	.....	1,440	4,200	6,400	1,060	375	1,280
6	143	119	190	.....	1,520	3,960	12,000	995	350	660
7	81	114	173	.....	1,600	3,400	31,800	995	325	790
8	72	183	155	.....	1,520	3,080	14,300	855	300	995
9	72	266	83	.....	1,520	2,580	15,600	855	350	995
10	75	244	.....	.....	1,680	2,290	28,000	925	425	1,060
11	72	275	.....	.....	1,760	1,930	15,400	995	375	758
12	64	325	.....	.....	1,680	1,680	11,200	855	325	565
13	72	300	.....	.....	1,600	1,520	14,300	855	375	425
14	74	.....	.....	.....	1,520	1,360	10,200	790	350	325
15	91	.....	.....	.....	1,210	1,210	6,680	725	300	325
16	69	250	.....	.....	1,210	1,060	4,810	725	300	266
17	64	.....	.....	.....	1,060	1,060	3,300	822	325	375
18	68	.....	.....	.....	1,060	995	3,300	725	275	325
19	72	.....	.....	.....	1,140	925	2,880	660	262	275
20	81	.....	.....	4,320	1,210	855	2,380	565	252	266
21	91	275	.....	4,810	2,110	855	2,200	535	218	206
22	104	266	.....	6,680	2,020	1,930	1,930	480	252	149
23	81	275	.....	9,540	1,930	3,080	1,840	628	325	155
24	91	210	.....	7,260	2,380	2,110	1,680	1,280	300	210
25	149	95	.....	7,700	1,930	1,760	1,520	995	275	190
26	119	275	.....	8,000	1,600	1,520	1,440	692	198	187
27	152	275	.....	8,450	1,440	1,360	1,360	595	101	172
28	162	230	.....	8,000	1,360	1,210	2,200	508	239	149
29	187	257	.....	6,400	2,980	1,140	2,480	452	226	190
30	266	222	.....	3,620	2,980	1,140	2,200	400	180	172
31	222	.....	.....	2,680	.....	1,360	.....	350	172	.....

Monthly discharge of Raccoon River at Van Meter, Iowa, for the year ending Sept. 30, 1917.

[Drainage area, 3,410 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	275	84	122	0.036	0.04
November	325	95	223	.065	.07
December 1–9	252	83	186	.055	.02
March 20–31	9,540	2,680	6,460	1.89	.73
April	2,980	1,060	1,680	.493	.55
May	4,200	855	2,040	.600	.69
June	31,800	1,360	7,000	2.05	2.29
July	1,840	480	842	.247	.30
August	425	101	298	.087	.10
September	2,580	107	480	.141	.16

ILLINOIS RIVER AT PEORIA, ILL.

LOCATION.—In sec. 2, T. 8 N., R. 8 E., at foot of Grant Street, Peoria, Peoria County, about 3½ miles above station formerly maintained at Peoria & Pekin Union Railroad bridge and 4½ miles above mouth of Kickapoo Creek.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 8, 1910, to September 30, 1917; also March 10, 1903, to July 21, 1906, for station at Peoria & Pekin Union Railroad bridge.

GAGE.—Vertical staff gage attached to wooden pile; read by employee of United States 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, is mud and may shift. Dam at Copperas Creek probably forms control for lowest stages; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 18.4 feet June 15–17 (discharge, 34,800 second-feet); minimum stage, 10.0 feet October 1–4, 7–8, 10–18, and 20 (discharge, 10,000 second-feet).

1910–1917: Maximum stage recorded, 23.2 feet January 25, 1916 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 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.

ACCURACY.—Stage-discharge relation practically permanent; seriously affected by ice during the winters. 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. Records good for open-water periods; poor for winter periods.

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

Discharge measurements of Illinois River at Peoria, Ill., during the years ending Sept. 30, 1916–17.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1916.		*Feet.*	*Sec.-ft.*	1917.		*Feet.*	*Sec.-ft.*
June 27	W. G. Hoyt	17.45	30,700	Mar. 31	H. C. Beckman	15.03	20,500
Aug. 22	H. C. Beckman	11.10	11,900	July 30	....do	12.67	14,700

Daily discharge, in second-feet, of Illinois River at Peoria, Ill., for the years ending Sept. 30, 1910–1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1910.												
1	.....	.....	.....	.....	.....	.....	19,600	16,200	19,600	11,300	8,460	8,040
2	.....	.....	.....	.....	.....	.....	19,000	17,200	19,600	11,100	8,460	8,040
3	.....	.....	.....	.....	.....	.....	18,400	18,400	19,600	10,900	8,320	7,900
4	.....	.....	.....	.....	.....	.....	17,800	19,600	19,600	10,800	8,320	7,900
5	.....	.....	.....	.....	.....	.....	17,200	21,100	19,600	10,600	8,320	7,900
6	.....	.....	.....	.....	.....	.....	17,800	22,500	19,000	10,400	8,320	8,180
7	.....	.....	.....	.....	.....	.....	16,900	23,700	19,000	10,300	8,040	8,320
8	.....	.....	.....	.....	.....	26,900	16,400	23,700	18,700	10,000	7,900	8,600
9	.....	.....	.....	.....	.....	29,000	16,200	22,900	18,400	9,860	7,770	9,020
10	.....	.....	.....	.....	.....	30,300	15,800	22,900	18,100	9,860	7,770	9,020
11	.....	.....	.....	.....	.....	30,800	15,600	22,900	17,500	9,720	7,770	8,880
12	.....	.....	.....	.....	.....	31,200	15,800	22,100	17,200	9,580	7,770	8,880
13	.....	.....	.....	.....	.....	31,200	15,000	21,400	16,600	9,440	7,770	9,160
14	.....	.....	.....	.....	.....	31,200	14,600	20,800	16,200	9,300	7,770	9,160
15	.....	.....	.....	.....	.....	30,300	14,200	20,200	15,800	9,300	7,510	9,020
16	.....	.....	.....	.....	.....	29,800	14,200	19,900	15,600	9,300	7,640	9,020
17	.....	.....	.....	.....	.....	29,400	13,800	19,000	15,000	9,300	7,770	8,880
18	.....	.....	.....	.....	.....	28,500	14,200	19,000	14,600	9,160	8,040	8,880
19	.....	.....	.....	.....	.....	27,700	14,200	18,700	14,400	9,160	8,040	9,020
20	.....	.....	.....	.....	.....	26,900	14,000	18,400	14,200	9,160	7,770	8,880
21	.....	.....	.....	.....	.....	26,500	13,800	18,100	13,800	9,160	7,770	8,880
22	.....	.....	.....	.....	.....	26,100	13,800	17,500	13,400	9,160	7,770	8,880
23	.....	.....	.....	.....	.....	25,300	13,800	17,800	13,000	9,300	7,770	8,880
24	.....	.....	.....	.....	.....	24,500	13,800	17,800	12,700	9,160	7,770	8,740
25	.....	.....	.....	.....	.....	23,700	13,800	17,800	12,300	9,160	7,640	8,880
26	.....	.....	.....	.....	.....	23,300	14,200	17,800	12,100	9,160	8,040	8,740
27	.....	.....	.....	.....	.....	22,100	14,200	18,400	11,900	9,160	8,040	8,880
28	.....	.....	.....	.....	.....	21,700	14,200	18,400	11,600	8,880	8,040	8,880
29	.....	.....	.....	.....	.....	20,800	14,600	19,000	11,600	8,880	8,040	8,880
30	.....	.....	.....	.....	.....	20,200	15,400	19,300	11,400	8,600	8,040	8,880
31	.....	.....	.....	.....	.....	19,900	.....	19,600	.....	8,600	8,040	.....
1910–11.												
1	8,880	8,320	8,040			17,800	11,600	14,000	11,400	9,440	8,320	8,040
2	8,880	8,320	7,900			17,200	11,400	14,000	11,400	9,300	8,320	8,040
3	8,880	8,320	7,770			17,200	11,600	14,000	11,300	9,160	8,320	8,180
4	8,880	8,320	7,770			16,900	11,400	14,200	11,300	9,160	8,320	8,040
5	8,880	8,320	7,770			16,400	11,300	14,200	11,300	9,160	8,320	8,040
6	9,160	8,320	7,770	7,250		16,200	11,100	14,200	11,100	9,020	8,320	8,040
7	8,880	8,180	7,770		12,600	15,800	11,900	14,200	10,900	8,880	8,320	8,320
8	9,020	8,320	7,770			15,400	12,300	14,200	10,800	8,740	8,320	8,460
9	9,160	8,180	7,640			15,000	12,700	14,200	10,600	8,460	8,320	8,460
10	9,160	8,320	7,510			15,000	13,000	13,600	10,400	8,740	8,180	8,320
11	9,160	8,180	7,510			14,400	13,200	13,200	10,300	8,600	8,040	9,020
12	9,160	8,180	7,510			15,000	13,400	13,200	10,300	8,880	8,040	9,160
13	9,300	8,180	7,380			14,600	13,400	13,200	10,300	8,880	8,180	9,300
14	9,300	8,180			12,500	14,200	13,800	12,800	10,200	8,740	8,600	9,300
15	9,160	8,180		9,500	13,400	14,600	13,400	12,300	10,000	8,600	9,020	9,440
16	9,160	8,180			15,000	14,600	13,600	11,900	9,720	8,740	9,160	9,860
17	9,160	8,180			16,400	14,200	14,000	11,600	9,720	8,600	9,160	10,300
18	9,020	8,180			17,800	14,400	14,000	11,400	9,720	8,460	9,160	10,600
19	8,880	8,180			19,000	14,200	14,400	10,900	9,720	8,320	9,160	10,900
20	8,880	8,040			19,600	14,000	14,800	11,300	9,720	8,460	9,160	11,600
21	8,880	8,040			20,200	13,800	15,000	11,300	9,580	8,460	9,020	12,700
22	8,600	8,040	7,250		20,200	13,800	15,000	11,100	9,440	8,320	8,880	13,200
23	8,740	8,040			20,200	13,400	15,000	11,100	9,440	8,320	8,790	13,400
24	8,600	8,040			19,600	13,000	15,000	11,400	9,720	8,320	8,690	13,400
25	8,600	8,040			19,000	12,500	15,000	11,600	9,720	8,320	8,600	14,600
26	8,600	8,040		12,700	19,000	12,100	14,600	11,900	9,720	8,320	8,460	14,600
27	8,600	8,040			19,000	11,800	14,400	11,900	9,720	8,320	8,320	14,200
28	8,460	8,180			18,400	12,300	14,200	11,900	9,720	8,320	8,600	14,800
29	8,600	8,040			.....	12,100	14,200	11,900	9,720	8,180	8,320	15,400
30	8,320	8,040			.....	11,900	14,200	11,800	9,720	8,180	8,320	15,800
31	8,320	.....			.....	11,800	.....	11,800	.....	8,180	8,180	.....

Daily discharge, in second-feet, of Illinois River at Peoria, Ill., for the years ending Sept. 30, 1910–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1911–12.												
1	16,400	16,600	21,100				42,800	26,900	19,900	12,300	11,600	12,300
2	17,800	16,600	21,100				42,800	28,500	19,300	11,900	11,600	12,100
3	18,100	16,200	21,400				42,800	30,300	18,700	11,900	11,800	11,900
4	18,700	16,000	20,500				42,800	31,200	18,700	11,800	11,600	11,800
5	19,900	15,800	19,900				42,300	32,100	18,400	11,600	11,600	11,600
				16,700								
6	20,200	15,800	19,600				41,800	33,000	17,800	11,600	11,600	11,600
7	21,400	15,800	19,300				41,800	33,000	17,500	11,400	11,400	11,400
8	21,400	15,600	19,000			13,000	40,300	32,100	16,600	11,300	11,400	11,300
9	21,100	15,400	18,700				38,800	31,600	16,200	10,900	11,400	11,300
10	20,800	15,400	18,400				38,800	30,300	15,800	11,100	11,300	10,900
					11,000							
11	20,800	15,200	18,400				37,800	29,400	15,400	11,300	11,300	10,900
12	20,500	15,000	19,000				36,300	29,800	15,000	11,100	11,300	10,800
13	20,200	15,600	19,600				35,300	28,100	15,000	10,900	11,300	10,600
14	19,600	16,200	19,900				33,900	28,500	14,600	10,900	11,400	10,600
15	19,000	17,500	19,900				32,600	28,100	14,200	11,300	11,400	10,800
				14,200								
16	18,400	18,400	20,200			12,700	32,100	29,800	14,200	11,300	11,300	10,600
17	18,400	18,400	20,200			12,700	32,100	30,300	14,400	10,900	11,300	10,600
18	18,100	19,000	20,200			14,600	31,200	29,800	14,400	10,900	11,300	10,400
19	18,400	19,900	20,200			16,900	29,400	30,300	14,200	10,900	11,300	10,300
20	18,400	20,800	20,200			21,400	29,400	28,500	14,200	10,900	11,400	10,200
21	18,100	22,100	19,600			26,900	29,400	28,500	14,200	11,800	11,300	10,600
22	17,800	22,100	19,600			30,300	29,800	27,300	14,200	12,100	11,300	10,400
23	17,200	22,900	19,600			31,200	29,800	26,100	14,200	11,900	12,300	10,300
24	17,500	23,300	20,200			33,000	29,400	26,100	14,000	11,800	12,300	10,300
25	17,200	22,900	20,800			33,000	29,400	25,300	13,800	11,800	12,700	10,300
					12,500							
26	17,800	22,900		12,500		33,900	26,900	23,700	13,400	11,800	13,000	10,300
27	17,800	22,500				35,800	28,500	22,100	13,400	11,800	13,200	10,200
28	17,800	22,500				37,800	28,100	21,400	13,000	11,600	12,800	10,300
29	17,500	22,100	20,100			39,800	29,000	22,100	12,700	11,600	12,800	10,300
30	17,200	21,400				41,300	27,700	20,800	12,300	11,600	12,700	10,200
31	17,200	.....				41,800	.....	20,200	.....	11,600	12,500	.....
1912–13.												
1	10,000	12,300	14,000		21,200		55,000	22,900	25,700	13,600	10,200	10,000
2	10,000	12,100	13,400		20,500		55,000	21,700	25,300	13,400	10,000	10,000
3	10,000	11,900	13,400		20,200		53,900	20,800	25,300	13,200	9,860	10,000
4	10,000	11,600	13,400		19,900		52,800	19,900	24,500	12,700	10,000	10,000
5	10,000	11,800	13,400		19,600		52,300	19,600	23,300	12,700	9,860	10,000
				10,100		15,900						
6	9,860	12,300	13,200				51,800	18,700	22,500	12,700	9,720	9,860
7	9,860	12,700	12,800				50,800	18,100	22,900	12,300	9,860	9,720
8	9,720	12,700	13,400				49,800	17,800	22,100	12,100	9,860	9,720
9	9,860	13,000	12,700				49,800	17,800	20,800	11,900	9,720	9,720
10	10,000	13,200	12,300				49,300	17,200	20,200	11,900	9,580	9,720
11	10,000	13,400	12,800			19,000	48,800	16,600	19,600	11,800	10,000	9,720
12	10,400	13,800	12,500			21,100	50,300	16,200	19,000	11,300	10,000	9,860
13	10,600	14,600	12,300		16,700	22,500	50,800	16,000	18,400	11,300	10,000	9,720
14	10,800	14,600	11,900			23,300	50,800	16,200	17,800	11,100	10,000	9,720
15	10,800	14,600	11,900			24,900	49,800	15,800	17,200	10,900	10,200	9,720
				10,300								
16	10,900	14,600	11,900			26,500	48,300	15,800	16,900	10,900	10,200	9,720
17	10,900	14,800	12,100			27,300	46,800	15,800	16,600	11,300	10,400	9,720
18	11,100	15,000	12,300			26,500	44,800	16,200	16,400	11,300	10,600	9,720
19	11,300	15,000	12,300			26,500	43,300	16,200	16,000	11,300	10,900	9,720
20	11,300	14,800	12,100			26,100	40,800	15,800	15,600	11,100	10,900	9,720
21	11,300	14,800	12,100		16,200	27,700	37,800	15,800	15,400	10,900	10,800	9,720
22	11,800	14,600	11,900		16,900	27,300	35,800	16,600	15,400	10,800	10,800	9,720
23	11,900	14,600	11,800		19,000	28,100	33,400	18,400	15,200	10,600	10,900	9,720
24	11,900	15,000	11,400		19,300	29,800	32,100	19,600	15,000	10,600	10,800	9,720
25	11,900	14,600	11,300		19,300	34,800	31,200	20,500	14,600	10,600	10,600	9,580
				16,600								
26	11,900	14,400	11,300		19,000	39,800	29,800	20,800	14,600	10,600	10,600	9,720
27	11,900	14,400	11,300		19,000	44,800	28,500	21,400	14,600	10,400	10,600	9,720
28	11,900	14,200	11,100		18,400	48,800	27,300	22,100	14,400	10,300	10,400	9,720
29	11,600	14,000	10,900		.....	51,800	25,300	24,100	14,200	10,300	10,300	9,720
30	11,900	13,800	10,900		.....	55,000	24,100	25,300	13,800	10,300	10,300	9,580
31	12,100	.....	10,900		.....	55,000	.....	25,300	.....	10,200	10,300	.....

Daily discharge, in second-feet, of Illinois River at Peoria, Ill., for the years ending Sept. 30, 1910–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1913–14.												
1	9,720	10,000	10,300				16,900	15,400	17,200	11,400	8,880	9,160
2	9,720	9,860	10,400				17,800	15,000	16,600	11,300	8,880	9,720
3	9,580	9,860	10,600				19,300	14,600	16,200	11,300	8,880	9,440
4	9,440	10,000	10,600				19,900	14,400	16,200	11,300	8,740	9,580
5	9,440	10,000	10,800	9,860	9,650		20,880	14,400	16,400	11,000	8,600	9,440
6	9,580	10,000	10,900				21,100	14,400	15,600	10,900	8,600	9,720
7	9,580	10,000	11,300				22,900	14,000	15,400	10,900	8,600	10,000
8	9,720	10,200	11,100				22,500	14,200	15,600	10,800	8,600	10,200
9	9,720	10,300	10,900			10,700	21,700	13,800	15,400	10,600	8,320	10,000
10	9,720	10,300	10,800				21,100	14,200	15,400	10,600	8,320	10,000
11	9,720	10,000	10,900				22,100	13,800	15,400	10,300	8,740	10,200
12	9,580	9,720	10,900				22,100	14,800	15,200	10,300	8,600	10,000
13	9,580	9,860	10,900				22,500	15,000	14,800	10,200	8,600	10,000
14	9,580	10,000	10,900				22,100	16,200	14,600	10,200	8,880	10,000
15	9,720	10,000	10,800	9,240	9,450		21,700	18,400	14,400	10,000	8,880	10,300
16	9,860	10,000	10,600			13,400	21,100	19,600	14,200	10,000	8,880	10,300
17	10,200	9,720	10,600			13,400	20,800	20,800	13,800	10,000	8,600	10,300
18	10,000	9,720	10,800			14,000	19,900	21,400	13,600	10,000	8,600	10,400
19	10,000	9,720	10,600			14,200	18,700	21,700	13,400	9,860	8,600	10,300
20	10,000	9,860	10,600			14,600	19,600	22,100	13,000	9,720	8,880	10,300
21	10,000	9,580	10,800			14,600	18,100	21,400	12,700	9,580	8,880	10,000
22	10,000	9,720	10,600			14,600	18,100	21,400	12,700	9,440	8,880	10,000
23	10,000	10,000	10,600			14,600	17,800	21,100	12,500	9,300	8,740	10,200
24	10,200	10,000	10,600			14,400	17,200	20,200	12,300	9,440	9,160	10,000
25	10,200	9,860	10,800		9,250	13,600	16,400	19,600	12,500	9,440	9,160	10,200
26	10,000	10,000	10,600	9,340		14,000	16,200	19,300	12,300	9,440	9,020	10,000
27	10,300	10,000	10,400			14,800	16,200	19,000	11,900	9,300	9,160	10,000
28	10,000	10,200	10,300			14,800	15,800	18,700	11,800	9,300	9,020	10,000
29	10,000	10,200	10,300		.....	15,000	15,600	17,800	11,800	9,160	9,160	9,860
30	10,000	10,200	10,300		.....	15,800	15,600	17,800	11,600	9,020	9,020	9,860
31	10,000	.....	10,300		.....	16,200	.....	17,200	.....	9,020	9,160	.....
1914–15.												
1	9,860	9,440	9,020			20,200	12,500	10,200	14,400	14,400	20,500	20,200
2	9,860	9,440	9,160			19,600	12,300	10,000	14,800	14,000	20,800	19,600
3	9,860	9,580	9,160			19,600	12,300	10,000	15,200	13,800	23,700	19,000
4	9,720	9,580	9,300			19,300	12,100	9,860	15,400	13,600	24,900	18,100
5	9,720	9,580	9,300	8,950	14,200	19,000	11,800	9,720	15,800	13,200	28,500	17,800
6	9,720	9,580	9,300			18,100	11,800	9,860	16,000	13,000	32,600	16,900
7	9,720	9,440	9,160			18,100	11,800	9,860	16,200	12,700	34,800	16,400
8	9,720	9,720				17,800	11,400	9,720	16,200	13,200	35,800	15,800
9	9,580	9,440				17,200	11,100	9,860	16,400	13,000	34,800	15,800
10	9,580	9,300				16,600	11,300	9,860	16,200	13,000	34,800	15,400
11	9,720	9,440				16,400	10,900	9,720	16,200	13,000	33,000	15,800
12	9,580	9,440				16,200	11,400	9,720	15,800	13,400	31,200	15,800
13	9,720	9,440				16,000	10,900	9,860	15,800	14,200	29,400	15,600
14	9,720	9,440	8,870			15,800	10,600	9,860	16,000	15,400	28,100	15,600
15	9,720	9,580		9,520		15,600	10,600	9,860	16,200	16,600	26,900	16,400
16	10,000	9,440			19,800	15,600	10,600	9,720	16,200	18,100	25,700	16,400
17	9,860	9,300				15,000	10,600	9,720	16,600	19,000	24,900	16,600
18	9,860	9,300				15,000	10,300	9,720	16,400	20,200	24,100	17,200
19	9,860	9,440				15,000	10,400	9,720	16,600	20,800	23,700	17,500
20	9,720	9,440				14,600	10,400	9,720	16,900	21,400	23,300	17,200
21	9,860	9,300				14,600	10,300	9,720	16,600	21,400	23,300	17,800
22	9,720	9,160				14,200	10,300	10,300	16,400	21,400	22,500	18,100
23	9,720	9,160			20,200	14,200	10,300	10,400	16,200	20,800	22,100	18,100
24	10,000	8,880			20,200	13,800	10,200	10,600	15,800	20,500	22,100	18,700
25	9,720	8,880			20,500	13,800	10,200	10,400	15,800	20,200	22,100	19,000
26	9,860	9,020	8,740	10,000	20,500	14,000	10,200	11,300	15,600	19,600	22,900	18,100
27	9,720	9,160			20,800	13,400	9,720	11,600	15,200	19,000	22,900	19,000
28	9,300	9,160			20,500	13,400	10,000	11,600	15,000	18,700	22,500	19,000
29	9,580	9,160			.....	13,000	10,200	13,200	14,800	18,700	22,100	19,000
30	9,580	9,020			.....	13,000	10,200	13,800	14,400	18,700	21,400	19,000
31	9,440	.....			.....	12,800	.....	13,800	.....	19,900	20,800	.....

Daily discharge, in second-feet, of Illinois River at Peoria, Ill., during the years ending Sept. 30, 1910-1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.												
1	19,300	12,700	12,100			22,100	32,600	17,800	20,200	28,100	13,400	10,600
2	19,000	12,500	12,300			22,100	33,900	17,200	20,800	26,900	13,000	10,600
3	19,000	12,500	12,300			21,100	34,800	16,900	21,100	26,500	12,700	10,300
4	18,700	12,100	12,700			20,200	35,300	16,600	21,100	25,700	12,300	10,200
5	18,700	12,100	12,700			19,900	35,300	16,600	21,100	24,500	12,300	10,000
				14,200	34,400							
6	18,400	12,100	12,700			19,300	35,300	16,200	21,400	23,700	12,100	10,300
7	18,100	11,900	12,300			18,700	34,400	16,200	20,800	22,900	11,900	10,300
8	17,800	11,800	12,500			19,000	34,400	16,200	20,200	22,100	12,100	10,400
9	17,500	11,800	12,700			17,800	32,100	15,800	21,400	21,400	11,900	10,300
10	16,900	11,400	12,700			18,400	30,800	15,400	22,900	20,800	11,600	10,300
11	16,000	10,400	13,000			17,800	28,500	15,400	25,300	19,900	13,000	10,300
12	16,200	11,300	12,700			17,500	28,500	15,600	26,500	19,300	13,400	10,300
13	16,000	11,400	12,700			17,200	27,700	15,800	27,700	18,700	13,400	10,300
14	16,000	11,400	12,500			17,200	26,900	15,800	27,700	18,100	12,800	10,300
15	15,800	11,300	12,300			16,900	26,100	15,800	28,500	17,500	12,700	10,400
				18,800	28,200							
16	15,400	10,900	12,300			16,200	24,500	16,200	28,100	17,200	12,700	10,300
17	15,200	11,300	11,900			15,800	24,100	17,200	28,500	16,600	12,500	10,600
18	15,000	11,100	11,900			15,800	23,300	18,700	28,500	16,400	12,300	10,400
19	14,800	11,100	11,900			15,800	22,100	19,600	28,500	16,000	12,300	10,300
20	14,800	10,900	11,900			15,200	21,400	20,800	27,700	15,800	12,100	10,200
21	14,600	11,300	11,600			15,400	20,800	21,400	28,500	15,800	11,900	10,200
22	14,400	11,300	11,300			16,000	20,800	21,400	28,500	15,400	11,800	10,200
23	14,000	11,300	11,300			15,200	20,800	21,700	29,400	15,200	11,600	10,200
24	14,000	11,300	11,400			15,000	19,900	22,100	30,300	15,000	11,300	10,200
25	13,600	11,300	11,600			15,000	19,600	21,400	30,300	14,800	11,300	10,000
				37,000	24,600							
26	13,400	11,800				16,200	19,600	21,100	30,300	14,600	11,300	10,000
27	13,200	11,800				18,100	19,300	21,400	30,300	14,200	11,300	9,860
28	13,200	11,900				19,900	18,400	21,100	29,800	14,200	10,900	10,200
29	13,200	12,300	11,200			23,700	17,800	20,800	29,000	13,800	10,800	10,200
30	13,000	12,100			.....	27,700	17,500	20,800	28,500	13,600	10,600	10,200
31	12,500	.....			.....	30,300	.....	20,500	.....	13,400	10,600	.....
1916-17.												
1	10,000	11,400	12,300				21,700	17,800	14,400	20,200	14,600	11,600
2	10,000	11,600	12,300				21,100	17,500	14,200	20,200	14,600	11,900
3	10,000	11,600	12,300			12,300	19,900	17,500	14,600	19,600	14,200	11,600
4	10,000	11,600	12,300				20,200	17,500	14,600	19,300	14,200	11,600
5	10,200	11,600	12,300				21,100	17,800	15,400	18,700	13,800	11,600
					12,100							
6	10,300	11,600	12,300			12,500	20,200	17,500	16,400	18,100	13,600	11,600
7	10,000	11,400	11,900			12,100	20,500	17,200	16,600	17,800	13,400	12,100
8	10,000	11,300	12,700			12,300	21,700	16,600	18,700	17,200	13,400	12,300
9	10,400	11,900	12,300			12,700	21,100	16,600	20,800	16,900	13,400	12,300
10	10,000	11,600	12,700			12,500	20,500	16,600	22,900	16,600	13,400	12,100
11	10,000	12,100				12,700	20,800	16,400	24,500	15,800	13,000	11,900
12	10,000	11,900				13,000	21,100	16,200	26,900	16,000	13,000	11,900
13	10,000	11,900				13,400	21,700	16,000	30,300	16,000	12,800	11,800
14	10,000	11,900				14,800	20,200	15,800	33,000	15,800	12,800	11,600
15	10,000	11,900				16,600	20,200	15,600	34,800	15,600	12,700	11,900
			12,600	12,500	11,700							
16	10,000	11,400				19,000	19,600	15,200	34,800	15,400	12,700	11,900
17	10,000	11,900				20,200	19,000	14,800	34,800	15,400	12,700	11,800
18	10,000	11,900				22,100	19,000	14,600	33,400	15,200	12,300	11,900
19	10,200	11,800				22,500	19,000	14,000	33,000	15,000	12,100	11,600
20	10,000	11,900				23,300	18,400	14,600	32,100	15,000	11,900	11,600
21	10,400	11,900				23,300	18,400	14,200	30,300	15,000	11,900	11,600
22	10,400	11,900				22,900	18,700	14,600	29,400	14,800	12,300	11,600
23	10,600	11,900				22,500	19,000	13,800	27,700	14,800	11,900	11,600
24	10,900	11,900				22,900	19,000	13,800	26,900	14,800	11,900	11,300
25	10,800	11,900			12,000	21,700	18,400	13,800	25,300	14,800	11,900	11,100
			12,500									
26	11,100	11,400				22,900	18,100	13,800	24,100	15,000	11,600	11,100
27	11,300	11,600				22,900	18,100	13,800	23,700	15,000	11,300	11,300
28	11,300	12,100				22,100	18,100	14,200	22,500	15,000	11,800	11,100
29	11,400	12,300			.....	22,100	17,500	13,800	22,100	14,800	11,800	11,100
30	11,600	12,300			.....	22,100	17,200	13,800	20,800	14,800	11,600	11,300
31	11,400	.....			.....	21,100	.....	14,000	.....	14,800	11,600	.....

NOTE.—Discharge for periods when river was frozen over, estimated from gage heights, weather records, and flow at other stations; braced figures show the mean discharge for periods indicated.

Monthly discharge of Illinois River at Peoria, Ill., for the years ending Sept. 30, 1910–1917.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
1910.			
March	31,200	19,900	20,600
April	19,600	13,800	15,400
May	23,700	16,200	19,700
June	19,600	11,400	15,700
July	11,300	8,600	9,610
August	8,460	7,510	7,950
September	9,160	7,900	8,710
1910–11.			
October	9,300	8,320	8,880
November	8,320	8,040	8,170
December	8,040	.....	7,440
January	.....	.....	9,910
February	20,200	.....	15,500
March	17,800	11,800	14,400
April	15,000	11,100	13,400
May	14,200	10,900	12,600
June	11,400	9,440	10,200
July	9,440	8,180	8,630
August	9,160	8,040	8,550
September	15,800	8,040	10,800
The year	20,200	.....	10,700
1911–12.			
October	21,400	16,400	18,700
November	23,300	15,000	18,700
December	.....	.....	19,900
January	.....	.....	14,400
February	.....	.....	11,500
March	41,800	.....	14,900
April	42,800	26,900	34,400
May	33,000	20,200	27,900
June	19,900	12,300	15,300
July	12,300	10,900	11,500
August	13,200	11,300	11,800
September	12,300	10,200	10,800
The year	42,800	10,200	17,500
1912–13.			
October	12,100	9,720	10,900
November	15,000	11,000	13,800
December	14,000	10,900	12,200
January	.....	.....	12,500
February	21,100	.....	17,800
March	55,000	.....	27,300
April	55,000	24,100	43,300
May	25,300	15,800	18,900
June	25,700	13,800	18,400
July	13,600	10,200	11,400
August	10,900	9,580	10,300
September	10,000	9,580	9,770
The year	55,000	.....	17,200
1913–14.			
October	10,300	9,440	9,840
November	10,300	9,580	9,960
December	11,300	10,300	10,700
January	.....	.....	9,480
February	.....	.....	9,460
March	16,200	.....	12,700
April	22,900	15,600	19,400
May	22,100	13,800	17,500
June	17,200	11,600	14,200
July	11,400	9,020	10,100
August	9,160	8,320	8,810
September	10,400	9,160	9,980
The year	22,900	8,320	11,800

Monthly discharge of Illinois River at Peoria, Ill., for the years ending Sept. 30, 1910–1917—Continued.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
1914–15.			
October	10,000	9,300	9,730
November	9,720	8,880	9,340
December	9,300	.....	8,900
January	.....	.....	9,510
February	.....	.....	17,900
March	20,200	12,800	15,800
April	12,500	9,720	10,900
May	13,800	9,720	10,400
June	16,900	14,400	15,800
July	21,400	12,700	16,900
August	35,800	20,500	26,000
September	20,200	15,400	17,500
The year	35,800	.....	14,000
1915–16.			
October	19,300	12,500	15,700
November	12,700	10,400	11,600
December	13,000	.....	12,000
January	.....	.....	23,800
February	.....	.....	29,200
March	30,300	15,000	18,600
April	35,300	17,500	26,200
May	22,100	15,400	18,400
June	30,300	20,200	26,100
July	28,100	13,400	18,600
August	13,400	10,600	12,100
September	10,600	9,860	10,300
The year	35,300	9,860	18,500
1916–17.			
October	11,600	10,000	10,400
November	12,300	11,300	11,800
December	.....	.....	12,500
January	.....	.....	12,500
February	.....	.....	11,900
March	23,300	.....	17,700
April	21,700	17,200	19,600
May	17,800	13,800	15,500
June	34,800	14,200	24,600
July	20,200	14,800	16,200
August	14,600	11,300	12,700
September	12,300	11,100	11,700
The year	34,800	10,000	14,800

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, 1917.

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.—Coarse gravel; practically permanent; river at gage divided into two channels by an island. Aquatic plants sometimes grow in bed of river during summer. Recent measurements show that there has been a change in the stage-discharge relation as expressed by the rating curve used prior to July 20, 1906.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.5 feet at 5 p. m., January 14 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 3.5 feet April 6 and 7 (discharge, 4,372 second-feet); minimum stage, 1.67 feet September 29 and 30 (discharge, 534 second-feet).

1905–6 and 1915–17: 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 permanent; seriously affected by ice during winter. Rating curve well defined below and fairly well defined above 3,100 second-feet. Gage read to hundredths twice daily until April 30 and once daily afterwards. Daily discharge ascertained by applying daily gage heights to rating table. Open-water records good; winter records roughly approximate.

Discharge measurements of Kankakee River at Momence, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Dis. charge.
	Feet.	*Sec.-ft.*
June 21	2.15	1,180
Aug. 11	1.83	761

Daily discharge, in second-feet, of Kankakee River at Momence, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	960	1,720	1,720				3,600	2,980	2,160	990	1,070	609
2	960	1,720	1,830				3,350	2,860	2,160	990	990	583
3	975	1,720	1,830				3,350	2,500	2,280	915	990	570
4	975	1,720	1,940				3,350	2,160	2,280	915	945	570
5	945	1,720	2,160			1,270	3,350	1,940	2,280	960	900	570
6	900	1,720	2,160	1,240	770		4,370	1,720	2,280	1,070	728	570
7	840	1,720	2,280				4,370	1,720	2,390	1,150	714	546
8	870	1,620	2,280				4,110	1,620	2,390	1,150	714	674
9	930	1,620	2,500			1,620	4,110	1,520	2,280	1,150	687	635
10	930	1,620	2,500			1,520	4,110	1,520	2,280	1,150	674	609
11	945	1,620	2,620			1,420	3,850	1,520	2,280	1,150	661	596
12	930	1,520	2,620			1,420	3,850	1,420	2,160	1,240	648	583
13	930	1,520	2,620			1,520	3,850	1,420	1,940	1,330	622	583
14	900	1,520	2,620			2,500	3,850	1,420	1,720	1,330	622	583
15	870	1,240				2,980	3,850	1,330	1,620	1,330	622	583
16	870	1,240		1,150	570	2,390	3,600	1,330	1,520	1,420	622	570
17	900	1,240				2,390	3,600	1,330	1,420	1,420	609	558
18	945	1,150				2,390	3,600	1,330	1,420	1,420	609	558
19	990	1,150				2,390	3,350	1,330	1,420	1,420	596	558
20	1,520	1,150				2,390	3,350	1,520	1,420	1,330	596	558
21	1,420	1,150				2,390	3,350	1,620	1,330	1,330	583	546
22	1,420	1,150	1,550			2,620	3,100	1,520	1,240	1,330	583	546
23	1,420	1,330				3,350	2,980	1,520	1,240	1,520	622	558
24	1,420	1,420				3,100	2,740	1,520	1,150	2,160	635	546
25	1,520	1,520			790	2,860	2,620	1,420	1,150	1,720	622	546
26	1,520	1,520		920		2,860	2,620	1,420	1,150	1,330	609	546
27	1,620	1,520				2,740	2,390	1,830	1,150	1,240	609	546
28	1,620	1,520				2,500	2,160	1,720	1,070	1,150	756	546
29	1,620	1,620			.....	2,500	3,350	1,720	1,070	1,150	687	534
30	1,620	1,720			.....	2,500	3,100	1,830	1,070	1,070	609	534
31	1,720	.....			.....	2,500	.....	1,940	.....	1,070	609	.....

NOTE.—Discharge Dec. 15 to Mar. 8 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, 1917.

[Drainage area, 2,340 square miles.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,720	840	1,160	0.496	0.57
November	1,720	1,150	1,490	.637	.71
December	2,620	.....	1,870	.799	.92
January	.....	.....	1,100	.470	.54
February	.....	.....	704	.301	.31
March	3,350	.....	2,100	.897	1.03
April	4,370	2,160	3,440	1.47	1.64
May	2,980	1,330	1,700	.726	.84
June	2,390	1,070	1,710	.731	.82
July	2,160	915	1,230	.538	.62
August	1,070	583	695	.297	.34
September	674	534	570	.244	.27
The year	4,370	534	1,480	.632	8.61

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, about 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, 1917.

GAGE.—Chain gage attached to bridge; read by J. H. Swords.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Solid rock strewn with boulders and gravel; right half of channel deep, with fissures in bed; left half shallow. May shift slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.8 feet June 9 and 10 (discharge, 15,000 second-feet); minimum stage, 5.0 feet at 5 p. m. September 18 and 19 (discharge, 470 second-feet).

1915–1917: Maximum stage recorded, 12.6 feet July 11, 1915 (discharge, 21,300 second-feet); 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 used to March 12 well defined above 1,820 second-feet and fairly well defined between 1,130 and 1,820 second-feet; extended below 1,130 second-feet; curve used after March 12 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. Records good for medium and high stages and fair for low stages during open-water periods; winter records poor.

The following discharge measurement was made by H. C. Beckman:
August 10, 1917: Gage height, 6.03 feet; discharge, 1,840 second-feet.

Daily discharge, in second-feet, of Kankakee River at Custer Park, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug	Sept.
1	955	1,670	1,670				3,680	2,880	3,270	2,150	1,440	1,510
2	1,010	1,670	1,670				5,640	2,880	4,390	1,980	1,140	1,280
3	1,070	1,670	1,670				6,720	2,880	4,630	1,740	1,280	1,140
4	1,070	1,520	1,740				7,290	2,690	4,150	1,580	1,140	1,000
5	1,130	1,520	1,820				7,880	2,600	3,470	1,440	1,000	875
6	1,130	1,520	2,060	1,670	1,140		9,720	2,410	5,640	1,360	1,000	940
7	1,130	1,380	2,060			1,540	9,720	2,410	12,300	1,440	1,280	940
8	1,130	1,380	2,240				9,720	2,320	14,300	1,820	1,980	1,070
9	1,130	1,380	2,460				8,480	2,320	15,000	2,150	2,150	1,440
10	900	1,320	2,690				7,290	2,230	15,000	2,410	1,740	1,900
11	1,010	1,450					6,440	2,230	13,300	2,060	1,580	1,740
12	1,070	.....					5,900	2,060	11,600	1,740	1,360	1,510
13	1,010	.....				2,500	5,130	1,820	10,700	1,580	1,210	1,280
14	1,010	.....				5,900	5,130	1,820	9,100	1,440	1,070	1,000
15	1,010	.....				7,000	4,630	1,740	7,000	1,360	1,000	1,000
16	955	.....	2,190	1,520	770		7,290	4,630	1,740	5,640	1,440	940	810
17	900	.....					7,290	4,390	1,600	4,630	1,580	875	875
18	1,010	.....					6,170	4,390	1,520	3,910	2,320	875	588
19	1,010	.....					5,640	4,390	1,520	3,270	2,320	745	611
20	1,010	.....					5,130	4,630	1,520	3,070	2,230	940	745
21	1,380	.....					4,390	4,390	1,450	2,600	2,060	745	1,000
22	1,520	.....					4,390	4,390	1,600	2,320	1,820	875	706
23	1,520	.....					4,150	3,910	1,600	2,150	2,410	706	719
24	1,520	.....					5,130	3,470	1,980	2,060	2,690	940	732
25	1,600	.....				900	4,880	3,270	2,320	1,980	2,230	940	745
26	1,670	.....	1,670	1,250			5,380	3,270	2,500	2,060	2,150	940	680
27	1,670	.....					4,630	3,470	2,500	1,980	2,150	940	706
28	1,600	.....					4,150	3,270	2,690	1,900	2,150	875	622
29	1,690	.....					3,680	2,880	2,320	1,980	1,820	940	680
30	1,670	.....					3,470	2,880	2,150	1,980	1,820	1,280	611
31	1,670	.....					3,270	.....	2,600	.....	1,660	1,660	.....

NOTE.—Discharge Dec. 11 to Mar. 12 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, 1917.

[Drainage area, 4,870 square miles]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,670	900	1,230	0.253	0.29
December	.....	.....	1,950	.400	.46
January	.....	.....	1,470	.302	.35
February	.....	.....	939	.193	.20
March	7,290	.....	3,640	.747	.86
April	9,720	2,880	5,370	1.10	1.23
May	2,880	1,450	2,160	.444	.51
June	15,000	1,900	5,850	1.20	1.34
July	2,690	1,360	1,910	.392	.45
August	2,150	706	1,150	.236	.27
September	1,900	588	948	.195	.22

DES PLAINES RIVER AT LEMONT, ILL.

LOCATION.—In sec. 20, T. 37 N., R. 11 E., at concrete highway bridge at Stephens Street, about 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, 1917.

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, 5.6 feet at 8 a.m. March 19 (discharge, 2,960 second-feet); minimum stage, 2.48 feet October 8, 10, 11, and 16, and September 5 (discharge, 9 second-feet).

1915–1917: Maximum stage recorded, 6.1 feet January 23, 1916 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 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 during a short period in February. Rating curve well defined between 120 and 2,220 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except those for very low stages, which are fair.

Discharge measurements of Des Plaines River at Lemont, Ill., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Dec. 9	H. C. Beckman	3.14	346
Mar. 15	G. J. Trinkaus	4.20	1,300
July 11	H. C. Beckman	2.86	155

Daily discharge, in second-feet, of Des Plaines River at Lemont, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	19	212	315	232	245	85	492	400	400	500	180	22
2	17	186	287	120	232	78	508	670	476	524	150	28
3	44	168	252	120	212	70	540	900	445	476	132	22
4	31	100	219	138	200	52	532	805	385	350	100	10
5	19	115	212	180	180	59	508	760	329	315	80	9
6	10	115	273	266	168	66	625	715	445	245	70	28
7	24	115	238	371	156	80	715	625	670	232	66	24
8	9	120	329	460	144	95	670	524	805	206	90	22
9	19	168	378	422	132	120	540	422	625	180	70	22
10	9	259	445	385	115	144	476	315	524	180	66	22
11	9	357	430	385	95	245	385	245	445	156	52	22
12	15	329	422	371	82	371	378	212	415	144	44	22
13	28	273	385	371	70	715	329	212	400	95	33	22
14	24	232	232	315	66	1,050	287	180	476	150	33	22
15	10	238	287	301	63	1,250	280	168	760	180	33	22
16	9	168	357	245	58	1,460	245	138	805	329	31	28
17	33	168	245	226	52	1,630	219	120	625	430	33	22
18	19	156	245	212	61	2,460	238	120	524	371	33	17
19	48	150	232	200	70	2,830	245	120	415	329	28	17
20	24	168	212	200	78	1,200	301	110	329	280	33	28
21	100	156	193	200	87	1,050	400	110	315	259	28	33
22	180	132	162	232	95	1,050	245	120	238	219	24	22
23	378	168	132	315	82	1,100	350	315	212	540	10	10
24	301	266	156	242	70	1,460	430	670	150	900	15	10
25	315	430	132	168	82	1,520	350	625	193	805	22	10
26	287	378	156	132	95	1,350	259	492	245	582	28	22
27	273	371	156	95	92	1,150	308	385	245	430	10	31
28	301	357	180	150	88	1,000	287	350	273	329	22	28
29	287	313	212	168	.....	805	301	329	430	259	22	28
30	233	315	232	200	.....	670	308	315	476	245	22	10
31	219	.....	200	258	.....	540	.....	329	.....	212	10	.....

NOTE.—Discharge interpolated for Dec. 22 and every alternate day from Feb. 11 to Mar. 10; estimated Feb. 1–10, because of 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, 1917,

[Drainage area, 705 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	378	9	106	0.150	0.17
November	430	100	224	.318	.35
December	445	132	255	.362	.42
January	460	95	248	.352	.41
February	245	52	113	.160	.17
March	2,830	52	831	1.18	1.36
April	715	219	392	.556	.62
May	900	110	381	.540	.62
June	805	150	436	.618	.69
July	900	95	337	.478	.55
August	180	10	50.6	.072	.08
September	33	9	21.2	.030	.03
The year	2,830	9	284	.403	5.47

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, about 1,200 feet upstream from Cass Street Bridge.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—December 3, 1914, to September 30, 1917; 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; probably permanent.

EXTREMES OF DISCHARGE.—Maximum mean daily discharge during days of record for the year, 10,600 second-feet July 24; minimum daily discharge, 6,340 second-feet January 1.

1914–1917: Maximum daily discharge during days of record, 13,200 second-feet June 10, 1916; minimum 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 sanitary district of Chicago at Lockport, which utilizes the flow of the Chicago Drainage Canal and, to a lesser extent, by the operation of the Economy Light & Power Co.'s plant, about 100 feet above gage.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curve well defined. Operation of the water-stage recorder satisfactory except for periods indicated in footnote to daily-discharge table. 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, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
July 12	6.75	[a] 13,700
12	3.65	6,210

[a] The flow in the Illinois & Michigan Canal, diverting water around the gage, was 506 second-feet, as measured by current meter.

Daily discharge, in second feet of Des Plaines River at Joliet, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8,340	7,760	8,360	6,340	8,820	7,960	8,150	7,970	8,470	9,890	9,400	(a)
2	7,590	7,880	8,360	8,050	9,080	8,200	8,120	8,170	8,060	9,430	9,180	(a)
3	7,590	8,130	7,760	8,100	8,000	7,870	8,110	8,340	8,520	9,780	b9,220	(a)
4	7,340	7,560	8,480	8,300	b6,920	7,660	8,460	8,970	8,470	9,800	9,200	(a)
5	7,050	8,020	8,540	8,110	8,000	7,930	8,800	9,120	8,520	9,600	9,200	(a)
6	7,130	8,310	8,360	8,130	8,100	7,940	8,760	8,690	9,400	9,560	9,300	8,940
7	6,670	7,400	7,950	7,100	8,130	8,470	8,370	8,480	8,500	9,280	9,290	9,240
8	6,770	7,860	8,390	8,780	8,150	8,310	8,500	8,580	9,070	9,710	9,000	9,720
9	7,230	7,920	(a)	8,660	8,340	8,040	8,190	8,260	9,100	9,420	9,010	9,200
10	7,250	8,170	(a)	8,670	b7,730	7,620	8,480	8,460	9,170	9,410	9,140	9,260
11	7,110	7,850	(a)	8,520	7,170	8,050	8,240	8,140	8,920	9,600	9,140	9,020
12	7,180	8,730	(a)	8,840	8,090	8,250	7,990	8,130	8,510	b9,700	9,520	8,900
13	7,740	8,970	(a)	b7,960	7,960	8,390	8,010	7,990	9,740	9,580	9,300	8,900
14	7,750	8,730	(a)	7,500	8,020	10,000	7,950	7,780	9,640	8,740	9,310	9,080
15	6,650	8,980	(a)	8,500	8,180	9,130	7,660	7,770	9,700	9,600	9,040	8,740
16	7,610	8,720	(a)	8,500	8,320	9,690	7,700	7,680	9,710	9,360	9,120	8,860
17	7,620	8,380	(a)	8,520	8,090	9,450	7,590	7,720	9,610	9,950	9,200	8,340
18	7,660	8,020	(a)	8,310	7,980	9,410	7,540	8,150	9,900	9,760	8,940	8,800
19	7,860	7,020	(a)	8,240	8,460	9,990	7,640	7,220	9,580	9,660	9,840	8,370
20	7,860	8,530	8,420	8,170	8,100	9,280	7,560	b7,980	9,420	9,920	9,220	8,420
21	b7,870	8,380	8,590	7,930	8,150	8,920	7,500		9,490	b9,630	9,400	8,850
22	7,530	8,540	8,640	8,220	7,710	8,560	7,980		9,540	9,670	9,260	7,940
23	8,060	8,500	7,830	8,630	7,760	8,540	8,190	8,500	9,380	10,100	9,140	8,660
24	8,260	8,600	7,060	8,110	8,000	(a)	8,220		9,470	10,600	9,120	8,950
25	8,190	8,440	b7,650	8,360	7,820	(a)	8,100		9,280	10,200	9,160	8,860
26	7,850	7,370	8,330	8,340	7,660	(a)	8,020	b8,860	9,260	9,930	9,260	8,810
27	7,910	8,590	7,890	7,520	8,130	(a)	8,040	8,920	9,320	10,100	8,960	9,410
28	7,620	8,710	8,170	6,980	8,390	(a)	8,320	8,700	9,540	b9,430	b9,200	(a)
29	7,360	8,380	8,470	8,430	.....	(a)	8,540	8,220	9,750	9,720	9,200	b9,020
30	8,100	7,230	7,800	8,520	.....	(a)	7,910	8,170	8,930	9,320	9,100	8,340
31	8,100	.....	6,650	8,660	.....	(a)	.....	8,340	.....	9,300	9,100	.....

a No record.
b Discharge partly estimated because of incomplete gage record.

NOTE.—Daily discharge in the above table does not include the flow in the Illinois & Michigan Canal (see "Diversions" in the station description). No gage height record Oct. 20, Jan. 14–16, Feb. 5, 6, May 21–25, Aug. 4–6 and 29–31; discharge estimated.

Monthly discharge in second-feet, of Des Plaines River at Joliet, Ill., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	8,340	6,650	7,580
November	8,980	7,020	8,190
January	8,840	6,340	8,160
February	9,080	6,920	8,040
March 1–23	10,000	7,620	8,590
April	8,800	7,500	8,090
June	9,900	8,060	9,200
July	10,600	8,740	9,670
August	9,840	8,940	9,210

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 measurement of flow in the canal made July 12.

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, about 100 feet above Public Service Co.'s dam and 500 feet above Crystal Lake outlet.

RECORDS AVAILABLE.—October 1, 1915, to September 30, 1917.

DRAINAGE AREA.—1,340 square miles (measured on map issued by U. S. Geological Survey; scale, 1 to 500,000).

GAGE.—Enamel staff gage attached to concrete abutment of bridge; read by Edward Pedersen.

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, 2.8 feet at 7 a. m. and 6 p. m. March 28 (discharge, 2,260 second-feet); minimum stage, 1.10 feet September 7 and 8 (discharge, 279 second-feet).

1916–17: Maximum stage recorded, 5.3 feet at 6 p. m., March 31, 1916 (discharge, 7,120 second-feet); minimum stage, 0.98 foot August 7 and 8, 1916 (discharge, 209 second-feet).

DIVERSIONS.—Water is diverted to operate grist mill at dam, which is run on average of about 4 hours a day, except Sundays, from September to March, inclusive, and one day a week during rest 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 permanent; not affected by ice. Rating curve fairly well defined. Gage read to hundredths twice daily As storage pond is large 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 table. Records good.

Discharge measurements of Fox River at Algonquin, Ill., during the years ending Sept. 30, 1916–1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1915–16.		*Feet.*	*Sec.-ft.*	1915–16.		*Feet.*	*Sec.-ft.*
Oct. 2[a]	William Kessler	2.82	2,730	Sept. 8	H. C. Beckman	1.22	368
2	do	2.84	[b] 2,350	8	do	1.22	353
12	do	2.29	[b] 1,420				
16	do	2.18	[b] 1,340	1916–17.			
27	do	1.88	[b] 979	Feb. 21[a]	do	1.20	380
Nov. 22[a]	do	1.46	639	Aug. 28	do	1.17	330
29	do	1.88	[b] 963	28	do	1.17	331

[a] Measurement made at C. & N. W. Ry. bridge 1.000 feet below gage; poor measuring section.

[b] Discharge supercedes that published in Water-Supply Paper No. 435. Vertical-velocity curves obtained in 1915 and 1918 indicate that a coefficient of 0.97 should have been applied to the mean of the velocities at 0.2 and 0.8 of the depth in order to obtain mean velocity. The coefficient had not been applied to discharge previously published for this measurement.

Daily discharge, in second-feet, of Fox River at Algonquin, Ill., for the years ending Sept. 30, 1916 and 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915–16.												
1	2,260	759	1,020	500	2,940	1,330	5,860	1,540	664	860	232	305
2	2,260	712	1,080	535	2,600	1,330	5,450	1,470	664	810	232	305
3	2,430	712	1,080	567	2,600	1,200	5,250	1,400	664	759	220	305
4	2,260	664	1,080	620	2,430	1,080	5,050	1,400	620	712	220	305
5	2,180	664	1,020	664	2,430	1,020	4,650	1,400	620	712	215	310
6	2,090	664	967	759	2,260	1,020	4,450	1,400	664	664	215	331
7	2,000	620	914	759	2,260	914	4,050	1,400	967	620	209	344
8	1,920	575	860	759	2,180	810	3,860	1,400	1,400	575	215	358
9	1,840	575	860	759	2,090	759	3,480	1,330	2,000	509	244	358
10	1,610	558	810	759	2,000	712	3,120	1,260	2,180	469	292	358
11	1,540	524	810	759	2,000	712	2,600	1,260	2,180	438	324	358
12	1,470	492	759	759	1,920	759	2,430	1,140	2,260	408	331	372
13	1,400	492	759	759	1,840	759	2,260	1,140	2,260	380	331	372
14	1,400	492	759	712	1,760	810	2,180	1,080	2,260	344	331	372
15	1,330	492	712	712	1,610	860	2,000	1,020	2,260	310	331	372
16	1,260	509	712	664	1,470	914	1,920	967	2,180	286	331	372
17	1,260	524	664	620	1,260	914	1,760	914	2,180	279	331	422
18	1,260	518	620	620	1,200	967	1,610	860	2,090	279	324	454
19	1,330	518	575	575	1,140	967	1,540	860	2,000	279	318	461
20	1,260	567	575	575	1,140	967	1,540	860	1,920	279	318	461
21	1,260	558	575	712	1,140	914	1,540	860	1,840	279	318	461
22	1,200	518	518	860	1,200	1,080	1,540	860	1,760	267	318	476
23	1,140	518	518	1,200	1,400	967	1,610	810	1,610	261	318	492
24	1,080	518	524	1,610	1,470	1,020	1,610	759	1,470	255	318	500
25	1,020	575	509	2,260	1,540	1,330	1,680	712	1,400	255	318	500
26	967	664	509	2,600	1,610	1,840	1,680	664	1,330	255	310	509
27	967	712	509	3,120	1,610	3,120	1,760	664	1,200	250	310	509
28	914	810	500	3,480	1,540	4,050	1,680	664	1,140	244	305	516
29	914	967	492	3,480	1,400	4,650	1,610	664	1,080	244	305	524
30	860	1,020	477	3,300	.....	5,050	1,540	759	1,020	238	305	524
31	810	.....	477	3,120	.....	6,070	.....	712	.....	238	305	.....
1916–17.												
1	542	967	914	415	365	351	2,090	1,330	860	860	664	305
2	558	967	967	423	365	354	2,090	1,400	860	967	664	298
3	575	1,020	967	430	358	358	2,000	1,470	860	967	664	292
4	620	1,020	914	446	358	358	2,000	1,540	810	1,020	664	292
5	620	1,020	860	461	358	358	1,920	1,540	810	1,020	620	286
6	620	1,020	810	477	358	362	1,840	1,540	759	1,020	620	286
7	620	1,020	810	477	358	365	1,760	1,470	712	1,020	620	279
8	620	1,080	810	461	351	380	1,680	1,400	712	1,080	620	279
9	620	1,080	860	446	351	394	1,610	1,330	759	1,080	575	292
10	620	1,080	860	430	351	454	1,400	1,200	810	1,020	575	305
11	620	1,080	860	415	344	567	1,260	1,080	860	1,020	575	305
12	620	1,080	914	415	344	712	1,080	1,020	914	967	558	318
13	620	1,020	914	415	331	810	1,020	1,020	967	967	542	318
14	620	1,020	860	408	331	967	914	914	1,020	967	525	331
15	575	967	860	408	324	1,080	860	860	1,080	914	509	344
16	575	967	810	401	318	1,330	860	810	1,080	914	492	351
17	558	967	759	401	312	1,680	810	712	1,080	860	477	358
18	558	914	712	401	312	1,840	810	664	1,020	860	461	358
19	575	914	664	394	316	1,840	810	620	967	810	446	358
20	664	860	620	394	319	1,920	810	620	914	759	430	365
21	712	810	542	401	324	1,920	810	620	860	759	415	365
22	759	759	477	401	328	2,000	810	664	860	712	401	372
23	759	759	415	387	331	2,000	860	664	810	712	387	372
24	810	712	394	387	334	2,000	860	712	810	712	372	380
25	810	712	394	380	338	2,090	967	712	759	712	358	387
26	860	712	387	380	341	2,180	1,020	759	759	712	344	394
27	860	759	401	372	344	2,180	1,080	759	712	712	331	401
28	914	860	415	372	348	2,260	1,080	759	759	664	318	401
29	967	860	415	372	.....	2,260	1,200	810	810	664	318	408
30	967	860	415	372	.....	2,180	1,260	810	810	664	312	415
31	967	.....	415	365	.....	2,090	.....	860	.....	664	305	.....

NOTE.—The above tables do 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 years ending Sept. 30, 1916 and 1917.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915–16.					
October	2,430	810	1,470	1.10	1.27
November	1,020	492	616	.460	.51
December	1,080	477	718	.536	.62
January	3,480	500	1,260	.940	1.09
February	2,940	1,140	1,700	1.34	1.44
March	6,070	712	1,580	1.18	1.36
April	5,860	1,540	2,710	2.02	2.25
May	1,540	664	714	.533	.61
June	2,260	620	1,530	1.14	1.27
July	860	238	412	.307	.35
August	331	209	287	.214	.25
September	524	305	410	.306	.34
The year	6,070	209	1,120	.836	11.36
1916–17.					
October	976	542	690	.515	.59
November	1,080	712	929	.693	.77
December	967	387	691	.516	.59
January	477	365	410	.306	.35
February	365	312	340	.254	.26
March	2,260	351	1,280	.955	1.10
April	2,090	810	1,250	.933	1.04
May	1,540	620	989	.738	.85
June	1,080	712	860	.642	.72
July	1,080	664	864	.645	.74
August	664	305	489	.365	.42
September	415	279	340	.254	.28
The year	2,260	279	764	.570	7.71

FOX RIVER AT WEDRON, ILL.

LOCATION.—In sec. 9, T. 34 N., R. 4 E., at highway bridge at Wedron, La Salle County, about 1,000 feet above Buck Creek.

DRAINAGE AREA.—2,500 square miles.

RECORDS AVAILABLE.—November 5, 1914, to September 30, 1917.

GAGE.—Chain gage attached to bridge; read by Nels Mathias.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed of 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, 11.6 feet at 4 p. m. March 14 (discharge, 10,200 second-feet); minimum stage, 5.90 feet at 4 p. m. September 4 (discharge 297 second-feet).

1915–1917: Maximum stage recorded, 15.4 feet March 14, 1916 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 13.8 feet March 29, 1916 (discharge, 16,700 second-feet); minimum stage, 5.62 feet November 20, 1914 (discharge, 105 second-feet, by current-meter measurement).

REGULATION.—Moderate diurnal fluctuation is caused by operation of power plants at and above Montgomery.

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

ACCURACY.—Stage-discharge relation changed slightly by high water in March. Rating curve used to March 10 well defined between 275 and 11,300 second-feet; curve used after that date well defined between 1,130 and 11,300 second-feet, and fairly well defined beyond these limits. Gage read to hundredths twice daily. Diurnal fluctuation only moderate. Daily discharge ascertained by applying mean daily gage heights to rating tables. Results good for medium and high stages, fair for very low stages, and poor for periods of ice effect.

The following discharge measurement was made by H. C. Beckman:

August 9, 1917: Gage height, 6.52 feet; discharge, 743 second-feet.

Daily discharge, in second-feet, of Fox River at Wedron, Ill., for the year ending Sept 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	751	1,410	1,260				2,720	2,170	2,040	1,500	730	378
2	675	1,410	1,310				2,720	2,720	1,910	1,500	690	343
3	997	1,360	1,220				2,570	2,430	1,670	1,440	690	366
4	790	1,310	1,220				2,570	2,300	1,500	1,380	690	308
5	790	1,310	1,410				2,570	2,300	1,550	1,280	652	544
				960	840	425						
6	830	1,310	1,310				2,720	2,040	2,870	1,380	615	580
7	790	1,460	1,220				2,430	2,040	2,570	1,790	652	544
8	830	1,220	1,220				2,170	2,040	1,910	1,550	769	510
9	751	1,460	1,360				2,040	1,790	1,910	1,380	690	402
10	954	1,410	1,310				1,910	1,790	2,170	1,440	652	384
11	830	1,460				2,040	1,670	1,670	2,040	1,380	652	477
12	871	1,410				3,330	1,610	1,550	1,910	1,380	580	580
13	954	1,310				6,460	1,550	1,440	5,520	1,380	580	402
14	997	1,310				9,620	1,550	1,330	5,080	1,280	615	366
15	871	1,310				4,870	1,380	1,330	3,860	1,230	615	414
			1,140	720	485							
16	790	1,260				4,870	1,280	1,180	3,170	1,180	580	414
17	830	1,220				4,450	1,330	1,080	2,720	1,380	615	343
18	830	1,180				3,020	1,280	940	2,300	1,230	510	446
19	638	1,220				2,720	1,380	852	2,040	1,230	477	652
20	954	1,080				3,020	1,440	1,230	1,790	1,380	446	477
21	1,710	1,310				2,870	1,440	985	1,670	1,080	652	477
22	1,710	1,220				2,870	1,280	1,330	1,550	1,030	652	510
23	1,260	1,360				3,680	1,230	1,440	1,500	1,330	510	544
24	1,360	1,710				4,050	1,500	1,380	1,440	1,550	477	446
25	1,410	1,310			440	3,020	1,500	1,130	1,330	1,280	477	544
26	1,410	1,260	915	685		3,330	1,670	1,230	1,550	1,180	414	510
27	1,410	1,040				3,170	1,670	2,170	1,500	1,030	378	544
28	1,410	1,180				3,170	1,610	1,670	1,380	940	378	544
29	1,310	1,220			.....	2,870	1,790	1,610	1,440	810	544	580
30	1,360	1,130			.....	3,330	1,670	1,610	1,550	730	414	544
31	1,560	.....			.....	2,870	.....	1,670	.....	810	390	.....

NOTE.—Discharge Dec. 11 to Mar. 10, estimated, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Fox River at Wedron, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 2,500 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,710	638	1,050	0.420	0.48
November	1,710	1,040	1,300	.520	.58
December	1,410	.....	1,110	.444	.51
January	.....	.....	785	.314	.36
February	.....	.....	599	.240	.25
March	9,620	.....	2,710	1.08	1.24
April	2,720	1,230	1,810	.724	.81
May	2,720	852	1,630	.652	.75
June	5,520	1,330	2,180	.872	.97
July	1,790	730	1,270	.508	.59
August	769	378	574	.230	.27
September	652	308	472	.189	.21
The year	9,620	.....	1,290	.516	7.02

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, about 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, 1917.

GAGE.—Chain gage attached to highway bridge; read by Mark Morse.

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, 11.8 feet at 4 p. m. June 6 (discharge, 5,750 second-feet); minimum stage, 0.52 foot at 9.30 a. m., October 1 (discharge, 1.3 second-feet).

1914–1917: 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 between 2,500 and 12,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for open-water periods, except for extremely low stages and for a period just before or after May 13, when the gage was probably read 1.0 foot in error; poor for period of ice effect.

Discharge measurements of Vermilion River near Streator, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Aug. 9	1.00	22.7
9	1.00	22.7

Daily discharge, in second-feet, of Vermilion River near Streator, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.3	6.9	19				332	716	228	278	45	16
2	2.5	7.3	18				434	716	216	252	27	15
3	3.0	6.5	25			240	783	684	304	204	19	16
4	1.8	7.3	23				854	684	278	193	17	9.4
5	3.0	5.2	22				891	684	464	146	24	8.6
				570	310							
6	3.8	5.2	22			105	1,130	684	5,750	102	19	11
7	2.5	7.3	30			102	2,270	652	5,400	88	16	109
8	1.5	10	42			96	930	652	4,680	77	17	318
9	1.6	15				88	891	652	4,680	72	16	304
10	1.6	22				88	854	652	4,680	67	16	318
11	1.8	24				193	818	620	4,600	56	15	318
12	5.2	24				182	749	620	3,720	48	14	318
13	5.2	11				5,400	716	304	4,520	47	12	278
14	5.2	11				2,210	588	304	3,640	13	7.7	150
15	5.2	12	25			2,210	495	291	3,560	27	4.7	34
				215	90							
16	5.2	12				2,150	464	291	3,560	16	5.2	30
17	2.5	12				1,850	419	291	1,600	240	6.0	27
18	5.6	12				1,170	652	291	1,170	111	2.5	22
19	5.6	12				749	749	278	818	107	4.7	16
20	7.3	15				1,090	818	278	783	105	3.8	10
21	15	18				1,050	854	265	716	93	3.6	8.6
22	15	15				1,010	854	252	464	85	3.8	9.4
23	12	24				1,010	818	252	464	81	25	11
24	15	25				970	818	252	464	81	22	9.4
25	14	30			145	930	783	252	375	81	32	9.0
26	11	29	20	350		854	783	240	332	133	28	8.1
27	9.4	26				749	749	240	252	131	26	6.0
28	9.4	15				684	749	240	265	133	24	16
29	5.2	18			.....	652	749	228	278	111	22	17
30	5.6	18			.....	526	716	228	278	88	32	18
31	5.6	.....			.....	318	.....	228	.....	80	28	.....

NOTE.—Discharge Dec. 9 to Feb. 28 estimated, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated. Gage probably read 1.0 foot in error for a period just before or after May 13, and computed discharge may be considerably in error.

Monthly discharge of Vermilion River near Streator, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 1,080 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	15	1.3	6.08	0.006	0.007
November	30	5.2	15.2	.014	.02
December	.....	.....	22.6	.021	.02
January	.....	.....	377	.349	.40
February	.....	.....	184	.170	.18
March	5,400	.....	891	.825	.95
April	2,270	332	790	.731	.82
May	716	228	420	.389	.45
June	5,750	216	1,950	1.81	2.02
July	278	13	108	.100	.12
August	45	2.5	17.4	.016	.02
September	318	6.0	81.4	.075	.08
The year	5,750	1.3	404	.374	5.09

SPOON RIVER AT SEVILLE, ILL.

LOCATION.—In sec. 24, T. 6 N., R. 1 E. fourth principal meridian, at Toledo, Peoria & Western Railway bridge about 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, 1917.

GAGE.—Chain gage attached to bridge; read to hundredths once daily by C. D. Bartlett. Elevation of zero gage above sea level, 467.78 feet.

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 the Toledo, Peoria & Western Railway.

EXTREMES OF STAGE.—Maximum stage recorded during year, 20.4 feet at 7 a. m. June 15; minimum stage, 2.10 feet at 7 a. m. October 11.

1914–1917: Maximum stage recorded, 26.0 feet January 23, 1916; minimum stage, 1.35 feet July 31, 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, 1917.

[Made by H. C. Beckman.]

Date.		Gage height.	Discharge.	Date.		Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 15	.....	17.05	9,400	Sept. 7	.....	4.39	594
18	.....	7.27	2,080	17	.....	3.19	177

Daily gage height, in feet, of Spoon River at Seville, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.80	3.1	3.3	4.5	7.5	4.1	4.0	10.7	5.5	6.8	3.85	2.87
2	2.50	2.90	3.2	4.3	6.7	4.1	4.0	9.2	5.5	6.5	3.65	2.56
3	2.45	3.0	3.2	3.9	5.5	3.7	3.85	7.1	4.9	6.2	3.55	2.46
4	2.40	3.0	3.2	3.7	5.0	3.8	3.65	7.0	4.6	5.1	3.30	3.8
5	2.25	3.0	3.2	4.7	4.5	3.6	4.0	7.0	18.2	5.1	3.3	3.95
6	2.20	3.0	3.1	6.5	4.5	3.3	4.15	5.3	15.1	5.0	3.25	.....
7	2.20	2.90	3.1	9.5	4.3	3.3	4.25	4.8	14.2	4.2	3.2	4.45
8	2.20	2.90	3.1	9.0	4.2	3.5	4.15	4.6	12.1	4.0	3.1	4.7
9	2.20	4.2	3.1	7.5	4.0	3.6	4.0	4.25	9.0	3.85	3.1	5.8
10	2.20	4.4	3.4	6.3	3.9	3.5	4.2	4.9	8.7	5.2	2.85	8.6
11	2.10	4.1	3.2	5.4	4.0	3.95	4.3	5.0	8.5	4.8	2.75	9.2
12	2.15	3.9	3.0	5.0	4.3	4.45	4.15	4.9	8.1	4.4	2.65	7.4
13	2.25	3.6	2.70	4.8	4.3	10.1	3.6	4.8	15.4	4.25	2.6	7.0
14	2.40	3.4	3.0	4.5	4.5	15.6	3.75	4.5	17.2	4.05	3.6	6.8
15	2.50	3.3	3.0	4.5	4.7	16.4	3.8	4.45	20.4	3.9	3.55	5.7
16	2.60	3.1	3.0	4.4	4.8	17.5	3.6	4.3	18.4	3.75	3.3	4.6
17	2.55	3.1	2.90	4.4	4.1	11.6	3.65	4.15	15.1	5.4	3.1	3.2
18	2.50	3.2	2.80	4.2	.....	7.3	4.7	4.1	12.2	5.1	3.0	4.4
19	2.50	3.2	2.70	4.0	.....	7.0	5.0	4.0	10.2	4.0	2.88	4.4
20	2.50	3.2	2.80	4.0	.....	6.6	8.6	3.85	8.1	3.05	2.72	4.5
21	3.8	3.1	2.80	4.0	3.8	6.6	7.7	3.75	6.4	2.47	2.43	4.45
22	4.3	3.2	2.80	8.0	3.8	6.5	6.0	3.95	6.2	3.2	5.2	4.35
23	3.5	3.4	2.80	11.6	3.8	8.6	5.6	4.15	6.1	3.1	4.15	4.3
24	3.6	3.7	2.80	8.8	3.8	8.6	6.1	4.0	6.1	4.15	4.0	4.2
25	3.7	3.6	2.80	7.8	3.8	6.3	6.5	3.9	5.8	6.2	3.85	4.1
26	3.8	3.4	2.80	6.2	3.9	4.7	6.3	3.85	5.8	5.1	3.7	3.95
27	4.0	3.4	5.3	5.3	4.0	4.45	6.4	4.0	5.6	4.5	3.5	3.95
28	3.9	3.4	7.9	5.1	4.0	4.2	6.6	3.7	6.5	4.05	3.1	3.9
29	3.6	3.4	6.3	6.0	.....	4.2	6.6	3.65	8.3	3.9	3.6	3.85
30	3.4	3.3	5.5	5.2	.....	4.1	7.2	3.55	5.8	3.75	3.5	3.8
31	3.3	.....	5.1	5.2	.....	4.0	.....	5.4	.....	4.05	3.25	.....

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

SANGAMON RIVER AT MONTICELLO, ILL.

LOCATION.—In sec. 12, T. 18 N., R. 5 E. third principal meridian, at Illinois Central Railroad bridge about 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, 1917.

GAGE.—Chain gage attached to downstream side of bridge; read by David Coay.

DISCHARGE MEASUREMENTS.—Made by wading or from downstream side of bridge and wooden trestle approach.

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, 12.0 feet at 5 p. m. June 9 (discharge, 2,530 second-feet); minimum stage, 1.7 feet, October 9–11, 14, and 16–17 (discharge, 8 second-feet).

Maximum stage recorded during periods of records, 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 during periods of records, 1.5 feet July 31, August 1 and 3, 1914 (discharge, 1 second-foot).

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

ACCURACY.—Stage-discharge relation changed slightly several times during year. Rating curve used from March 16 to August 4 fairly well defined above 51 second-feet; curves for remainder of year fairly well defined above 5 second-feet. Gage read to quarter-tenths once a day. Daily discharge ascertained by applying daily gage height to rating table. Open-water records good; winter records poor.

Discharge measurements of Sangamon River at Monticello, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
July 27	6.36	483
Aug. 13	3.24	88.8
Do	3.23	87.4

Daily discharge, in second-feet, of Sangamon River at Monticello, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	10	12	17			34	244	186	391	443	63	67
2	12	12	17			29	326	186	619	358	48	54
3	12	11	17			29	659	211	522	295	31	42
4	9.5	11	17			32	815	211	425	240	22	36
5	9.5	11	17			34	639	237	659	186	239	32
				20	25							
6	9.5	11	17			29	745	340	1,500	151	456	29
7	9.5	11	20			25	865	442	1,980	130	618	29
8	8.8	11	24			21	724	358	2,400	116	715	194
9	8.0	12	24			23	582	295	2,530	101	508	218
10	8.0	14	24			24	459	251	2,340	88	226	242
11	8.0	14				24	358	211	2,160	75	140	148
12	9.5	14				25	295	174	2,280	63	113	96
13	9.5	14				490	251	152	2,040	59	86	75
14	8.0	14				1,100	211	130	1,770	55	69	59
15	8.0	14				1,320	186	115	1,380	74	53	48
			16	10	8							
16	8.0	14				1,540	162	101	1,090	92	49	40
17	8.0	14				1,340	140	88	918	88	36	32
18	11	14				980	130	88	745	88	33	25
19	14	14				619	140	83	619	83	27	23
20	14	14				488	162	77	510	71	21	23
21	17	14				358	162	71	425	55	21	23
22	17	14				295	174	88	358	48	100	23
23	17	17				265	186	125	1,150	40	165	21
24	17	21				342	151	237	804	30	194	19
25	17	21			30	453	125	326	459	48	194	19
			12	25								
26	14	22				564	120	265	358	59	134	19
27	14	23				425	151	226	408	342	73	19
28	14	23				310	130	186	493	528	65	19
29	13	21			.....	211	146	186	619	357	46	19
30	12	21			.....	186	162	140	528	186	73	16
31	12	.....			.....	162	.....	265	.....	96	86	.....

NOTE.—Discharge interpolated for Sundays and July 4 and 10; estimated, because of ice, for Dec. 11 to Feb. 28, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Sangamon River at Monticello, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 550 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	17	8.0	11.6	0.021	0.02
November	23	11.0	15.1	.027	.03
December	.....	.....	15.7	.029	.03
January	.....	.....	18.6	.034	.04
February	.....	.....	20.4	.037	.04
March	1,540	21	380	.691	.80
April	865	120	320	.582	.65
May	442	71	195	.354	.41
June	2,530	358	1,080	1.96	2.19
July	528	30	150	.273	.31
August	715	21	152	.276	.32
September	242	16	57.0	.103	.11
The year	2,530	.....	201	.365	4.95

SANGAMON RIVER AT RIVERTON, ILL.

LOCATION.—In southeast corner of SW. ¼ sec. 9, T. 16 N., R. 4 W. third principal meridian, at Wabash Railroad bridge about a quarter of a mile west of Riverton, Sangamon County, and 2½ miles below mouth of South Fork.

DRAINAGE AREA.—2,560 square miles.

RECORDS AVAILABLE.—February 13, 1908, to December 31, 1912; August 7, 1914, to September 30, 1917.

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 and shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 27.4 feet at 4.30 p. m. June 7 (discharge, 19,900 second-feet); minimum stage, 7.43 feet at 8 a. m. November 21 (discharge, 37 second-feet).

1908–1912; 1914–1917: Maximum stage recorded, 27.8 feet February 3, 1916 (discharge, 20,800 second-feet); high water of 1883 reached a height of about 32 feet on the present gage, and that of 1875 is said to have been one-half foot lower (discharge not estimated); minimum stage recorded, 6.9 feet October 3–15, 1915 (discharge, 3 second-feet).

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

ACCURACY.—Stage-discharge relation changed slightly during March. Rating curves used before and after the change, well defined below and fairly well defined above 4,350 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for periods for which daily discharge has been ascertained; fair for October; poor for winter.

Discharge measurements of Sangamon River at Riverton, Ill., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 6	G. J. Trinkaus	27.80	21,600
July 28	H. C. Beckman	10.54	657
Sept. 10	.....do	12.16	1,260

Daily discharge, in second-feet, of Sangamon River at Riverton, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		50	74			162	1,730	1,250	3,420	2,230	404	490
2		50	68			152	2,380	1,370	3,860	1,780	404	515
3		50	72			162	2,330	1,410	3,790	1,690	404	676
4		42	71			152	2,280	1,410	3,790	1,210	380	490
5		53	70			162	2,430	1,730	9,800	1,060	278	490
				340	75							
6		48	65			152	2,380	2,180	19,200	1,030	236	592
7		46	67			142	2,380	1,930	19,900	927	416	619
8		50	102			124	2,280	1,830	18,300	706	706	894
9		54	106			102	2,180	1,880	14,600	676	706	1,140
10		58	74			106	2,180	1,780	14,900	592	676	1,140
11		67				109	1,780	1,780	9,800	566	592	894
12		64				111	1,650	1,610	9,440	592	619	647
13		55				5,160	1,410	1,410	9,980	490	465	592
14		59				7,580	1,370	1,210	9,980	465	368	676
15		48				11,100	1,100	1,170	9,100	440	332	404
			45	140								
16	55	47				8,780	995	960	8,300	416	248	380
17		47			75	9,100	995	894	8,010	392	236	344
18		48				7,720	960	862	6,120	392	229	308
19		46				5,420	960	862	5,610	380	192	151
20		47				5,070	894	894	4,420	380	168	131
21		37				4,000	862	676	2,830	380	232	102
22		44				3,420	1,100	894	2,380	368	380	99
23		56				2,680	960	995	2,080	894	515	100
24		83			217	2,530	706	960	1,780	894	676	105
25		116			228	2,480	676	960	1,610	619	490	97
			40	100								
26		116			252	2,380	619	995	1,490	465	416	94
27		104			217	1,930	706	995	1,490	490	465	102
28		99			162	1,780	1,030	1,030	3,120	566	404	113
29		99			.....	1,610	1,030	1,060	2,940	619	392	105
30		93			.....	1,370	1,060	1,370	2,380	619	440	71
31		.....			.....	1,210	.....	2,680	.....	566	465	.....

NOTE.—Discharge, Oct. 1 to Nov. 3, estimated because of no gage-height record, from records of discharge of Sangamon River at Monticello and at Oakford; also Dec. 11 to Feb. 23, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Sangamon River at Riverton, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 2,560 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	.....	.....	55.0	0.021	0.02
November	116	37	62.5	.024	.03
December	106	.....	53.5	.021	.02
January	.....	.....	190	.074	.09
February	252	.....	100	.039	.04
March	11,100	102	2,800	1.09	1.26
April	2,430	619	1,450	.566	.63
May	2,680	676	1,320	.516	.59
June	19,900	1,490	7,150	2.79	3.11
July	2,230	368	739	.289	.33
August	706	168	417	.163	.19
September	1,140	71	419	.164	.18
The year	19,900	.....	1,230	.480	6.49

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 Railway 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; August 25, 1914, to September 30, 1917.

GAGE.—Chain gage attached to bridge; read by R. W. Schnell.

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, 19.9 feet June 8 and 9 (discharge, determined from extension of rating curve, 33,300 second-feet); minimum stage, 0.68 foot October 10–18 (discharge, 135 second-feet).

1909–1912, 1914–1917: Maximum discharge June 8, 9, 1917; minimum discharge, 85 second-feet, August 30, 31, November 27, and December 2, 1914.

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

ACCURACY.—Stage-discharge relation not permanent. Rating curve used to March 31, 1916, fairly well defined between 310 and 17,500 second-feet; curves used after that date fairly well defined between 170 and 17,500 second-feet; extended above 17,500 second-feet. Gage read to tenths once daily till December 31, 1914, and to hundredths once or twice daily afterwards. Gage reading for March to September, 1916, somewhat unreliable. Daily discharge ascertained by applying daily gage height to rating table. Open-water records good for medium stages, and fair for low and very high stages; winter records poor.

Discharge measurements of Sangamon River near Oakford, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 3	0.77	158	Mar. 28	6.34	3,540
Mar. 16	11.98	10,000	June 27	6.40	2,950
21	10.48	8,160	Sept. 8	2.57	755

Daily discharge, in second-feet, of Sangamon River near Oakford, Ill., for the years ending Sept. 30, 1914–1917.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1914.								
1		99	11		427	21		348
2		237	12		407	22		348
3		274	13		387	23		329
4		310	14		387	24		310
5		329	15		387	25	117	310
6		348	16		387	26	117	310
7		348	17		387	27	99	292
8		348	18		374	28	99	273
9		468	19		361	29	99	273
10		468	20		348	30	85	273
						31	85	

Daily discharge, in second-feet, of Sangamon River near Oakford, Ill., for the years ending Sept. 30, 1914–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914–15.												
1	202	99	99	.....	.....	.....	448	696	15,900	1,670	7,000	12,800
2	140	99	85	.....	.....	.....	448	600	14,500	1,880	7,520	10,480
3	140	99	92	.....	.....	.....	427	554	12,800	1,810	9,360	6,880
4	132	99	99	.....	.....	.....	427	696	9,920	1,670	10,800	4,330
5	124	99	99	.....	.....	.....	427	600	8,560	1,530	10,500	3,770
6	117	99	99	.....	.....	.....	407	510	6,280	1,320	9,500	3,060
7	99	99	99	.....	.....	.....	407	554	4,730	1,390	7,520	2,900
8	140	99	99	.....	.....	.....	387	906	4,130	1,810	5,820	2,740
9	128	99	117	.....	.....	.....	368	1,460	3,410	2,500	5,600	2,900
10	117	99	117	.....	.....	.....	427	1,020	2,740	2,900	5,710	2,980
11	117	99	117	.....	.....	.....	647	798	2,740	6,160	5,270	3,770
12	117	99	117	.....	.....	.....	798	647	3,140	8,690	4,940	4,530
13	117	99	117	.....	.....	.....	798	600	5,160	8,820	3,860	5,160
14	117	99	117	.....	.....	.....	746	600	5,600	8,690	2,740	3,950
15	117	99	99	.....	.....	.....	746	554	5,270	8,560	2,340	6,760
16	117	99		.....	.....	.....	696	468	4,730	9,080	2,020	10,900
17	117	99		.....	.....	.....	647	407	3,950	9,220	2,740	9,640
18	117	99		.....	.....	.....	600	368	3,060	7,780	2,900	9,920
19	117	99		.....	.....	696	554	329	2,580	6,280	1,880	9,220
20	117	99		.....	.....	647	798	310	2,740	4,530	1,810	8,300
21	117	99		.....	.....	600	510	407	2,980	3,410	7,260	8,820
22	117	99		.....	.....	600	510	448	3,410	2,660	11,300	8,430
23	117	99		.....	.....	600	647	427	4,330	2,180	12,600	7,780
24	108	99	100	.....	.....	600	696	427	4,730	1,740	14,700	6,640
25	99	99		.....	.....	554	746	468	4,530	1,530	17,500	5,380
26	99	92		.....	.....	510	798	6,160	3,060	1,810	20,600	4,940
27	99	85		.....	.....	489	851	9,220	2,420	2,340	22,200	4,730
28	99	92		.....	.....	489	906	11,200	1,950	2,180	21,400	4,330
29	99	99		.....	.....	468	906	13,700	1,740	2,100	20,200	3,860
30	99	99		.....	.....	468	851	16,300	1,600	2,260	16,900	3,590
31	99	.....		.....	.....	448	.....	16,500	.....	4,830	14,700	.....
1915–16.												
1	2,980	851	600	2,420	.....	.....	5,380	1,810	3,770	1,740	363	211
2	2,980	851	554	4,780	.....	7,260	5,270	1,810	3,590	1,470	363	203
3	2,740	798	532	7,910	.....	6,040	5,160	1,810	3,430	1,350	345	196
4	2,580	798	532	9,920	25,800	5,160	5,160	1,810	3,190	1,230	327	173
5	2,420	798	554	10,200	28,400	.....	4,830	1,810	2,790	1,110	292	167
6	2,180	746	600	10,300	.....	.....	4,530	1,810	2,630	1,000	292	167
7	2,020	746	647	10,200	20,200	.....	4,130	1,740	2,950	896	292	167
8	1,880	696	600	9,780	.....	.....	3,860	1,670	3,110	845	538	162
9	1,740	696	600	9,360	13,400	.....	3,590	1,600	3,270	795	419	167
10	1,670	696	600	8,820	.....	.....	3,430	1,530	3,110	746	345	154
11	1,600	696	647	8,170	.....	.....	3,270	1,470	2,790	698	538	154
12	1,530	696	696	8,820	.....	4,630	3,110	1,470	2,550	698	651	154
13	1,460	696	798	0,900	.....	4,530	2,950	1,530	2,310	698	698	173
14	1,460	696	851	10,500	.....	4,130	2,870	3,110	2,160	698	560	162
15	1,390	696	1,080	11,200	.....	3,950	2,790	3,430	2,020	698	477	154
16	1,320	696	1,390		.....	3,770	2,790	4,040	1,880	605	345	154
17	1,320	647	1,320		.....	3,590	2,630	4,040	1,740	582	327	154
18	1,260	624	1,320		.....	3,500	2,470	3,680	1,740	538	327	154
19	1,260	647	1,320		.....	3,410	2,390	3,350	1,670	517	327	154
20	1,260	696	1,390		.....	3,230	2,390 2,390	3,110	1,600	497	259	154
21	1,200	696	1,390		.....	3,140		3,030	1,670	560	276	154
22	1,200	696	1,460		.....	3,140	2,310	2,950	1,950	605	259	154
23	1,140	696	1,390		.....	3,140	2,310	2,630	3,430	651	259	147
24	1,140	696	1,390	13,100	.....	3,060	2,160	2,630	4,040	605	243	140
25	1,140	624	1,200		.....	2,900	2,160 2,090	2,630	3,770	582	227	140
26	1,140	746	1,200		.....	3,250		2,550	3,430	497	227	135
27	1,020	1,020	1,080		.....	3,610	2,090	3,190	2,950	477	227	128
28	962	906	1,080		.....	3,960	2,020	3,510	3,030	438	227	140
29	906	696	1,020		.....	4,320	1,950	3,590	2,630	438	227	151
30	906	647	1,020		.....	4,670	1,880	3,770	2,310	400	227	167
31	906	.....	1 200		.....	5,030	.....	4,130	.....	363	218	.....

Daily discharge, in second-feet, of Sangamon River near Oakford, Ill., for the years ending Sept. 30, 1914–1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.												
1	190	173	259			477	2,550	2,470	4,730	5,550	1,100	746
2	167	173	227			438	3,110	2,630	5,600	5,550	980	798
3	167	154	243			438	4,040	2,710	5,490	4,080	860	746
4	162	154	227			400	4,530	2,950	5,160	3,320	750	696
5	156	154	221			363	4,630	3,190	12,200	2,790	650	647
6	156	154	212	750		363	4,730	3,430	17,100	2,400	650	574
7	148	145				382	5,160	3,590	30,200	2,190	650	574
8	148	154				382	4,830	3,430	32,600	1,980	750	798
9	140	167				363	4,530	3,270	33,300	1,770	1,280	746
10	135	173			245	327	4,040	3,590	30,200	1,560	1,040	1,950
11	135	167				327	3,680	3,430	28,000	1,490	1,040	1,600
12	135	181				327	3,430	3,110	25,800	1,300	1,040	1,390
13	135	181				497	3,110	2,790	23,600	1,240	939	1,260
14	135	181	205			5,600	2,710	2,630	21,500	1,110	838	1,080
15	135	167				8,300	2,870	2,230	19,300	1,050	736	906
16	135	167		455		10,100	2,310	2,160	17,100	1,220	635	696
17	135	167				11,000	2,090	1,950	15,700	1,220	586	598
18	135	167				11,600	2,020	1,880	14,200	1,160	538	524
19	148	167				10,800	2,790	1,740	13,100	1,100	491	500
20	184	167				9,360	2,710	1,600	11,900	1,100	468	452
21	173	167			327	8,040	2,630	1,530	10,800	980	610	428
22	187	167			400	6,520	2,310	2,310	9,640	920	1,900	382
23	187	212			477	5,380	2,090	2,630	8,560	920	925	359
24	187	243			477	4,940	1,950	2,390	6,700	1,100	980	337
25	193	259			477	4,730	1,810	2,310	5,110	1,400	925	337
26	187	259	215	325	560	4,430	1,670	2,230	3,880	1,220	867	337
27	173	259			560	3,950	1,810	2,160	3,050	1,720	814	337
28	173	259			517	3,590	2,090	2,090	6,100	1,460	711	337
29	173	259			.....	3,270	2,160	2,160	7,300	1,340	635	315
30	173	259			.....	3,030	2,310	2,390	6,460	1,220	660	315
31	181	.....			.....	2,710	.....	3,350	.....	1,160	610	.....

NOTE.—Discharge interpolated for about one-third the days in 1914 and June 11–15, 1917; ascertained from estimated gage heights June 18–26, 1917; estimated, because of ice, from gage heights, observer's notes, and weather records, for Dec. 16–31, 1914, Dec. 16–31, 1915, and Dec. 7, 1916 to Feb. 20, 1917.
Gage-height record March to September, 1916, rather unreliable.

Monthly discharge of Sangamon River near Oakford, Ill., for the years ending Sept. 30, 1914–1917.

[Drainage area, 5,000 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914.					
August 25–31	117	85	100	0.020	0.005
September	468	99	338	.068	.08
1914–15.					
October	202	99	118	.024	.03
November	99	85	98.1	.020	.02
December	.....	.....	102	.020	.02
March 19–31	696	448	551	.110	.05
April	906	368	621	.124	.14
May	16,500	310	2,840	.568	.65
June	15,900	1,600	5,090	1.02	1.14
July	9,080	1,320	3,980	.796	.92
August	22,200	1,810	9,330	1.87	2.16
September	12,800	2,740	6,120	1.22	1.36

Monthly discharge of Sangamon River near Oakford, Ill., for the year ending Sept. 30, 1914–1917—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915–16.					
October	2,980	906	1,570	0.314	0.36
November	1,020	624	730	.146	.16
December	1,460	532	970	.194	.22
January	.....	2,420	11,100	2.22	2.56
February	.....	.....	.....	.....	.....
March	.....	.....	.....	.....	.....
April	5,380	1,880	3,140	.628	70
May	4,130	1,470	2,620	.524	.60
June	4,040	1,600	2,720	.544	.61
July	1,740	363	743	.149	.17
August	698	218	345	.069	.08
September	211	128	160	.032	.04
1916–17.					
October	190	135	160	.032	.04
November	259	145	189	.038	.04
December	.....	.....	214	.043	.05
January	.....	.....	504	.101	.12
February	560	.....	311	.062	.06
March	11,600	327	3,950	.790	.91
April	5,160	1,670	3,020	.604	.67
May	3,590	1,530	2,590	.518	.60
June	33,300	3,050	14,500	2.90	3.24
July	5,550	920	1,830	.366	.42
August	1,900	468	828	.166	.19
September	1,950	315	692	.138	.15
The year	33,300	135	2,390	.478	6.49

SOUTH FORK OF SANGAMON RIVER NEAR TAYLORVILLE, ILL.

LOCATION.—In sec. 8, T. 12 N., R. 2 W., at Wabash Railroad bridge about 3½ miles southwest of Taylorville, Christian County, and about a quarter of a mile upstream from highway bridge known as Half Acre Bridge.

DRAINAGE AREA.—427 square miles.

RECORDS AVAILABLE.—February 11, 1908, to December 31, 1912; August 8, 1914, to May 17, 1917, when station was discontinued.

GAGE.—Chain gage attached to bridge; read by Louis Seelbach. On September 2, 1909, gage datum was lowered 2 feet. The gage heights to August 10, 1909, refer to old datum; those from August 11 to September 1, 1909, are of no value because of backwater from a construction dam built and used during that period. Gage heights from September 2, 1909, to December 31, 1912, refer to new datum. On August 8, 1914, the datum was changed by an unknown amount, all bench marks being destroyed during construction of a new concrete steel-plate girder bridge. Gage heights subsequent to August 8, 1914, refer to the datum used in reestablishing the gage on that date.

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

CHANNEL AND CONTROL.—In August, 1909, a drainage ditch was dug along the river in the vicinity of the station, which straightened the course of the stream but coincided with the original channel at the gaging section. Though the cross section of the channel at the measuring section was not changed, the stage-discharge relation was considerably affected by the change in slope. Subsequent to 1912 a new bridge was built, and since then the stage-discharge relation has again changed. Measuring section is in a pool; control likely to shift.

EXTREMES OF DISCHARGE.—1914–1917: Maximum stage recorded, 16.1 feet at 1 p. m. January 31, 1916 (discharge, 9,660 second-feet); minimum stage, 0.51 foot August 10 and 11 and September 29, 1914 (discharge, 0.6 second-foot).

Maximum discharge during periods of records same as for 1914–1917.

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

ACCURACY.—Stage-discharge relation changed several times from 1914 to 1917; affected by ice and by backwater from brush during spring of 1917. Rating curves used from February 1, 1915, to March 31, 1917, fairly well defined between 264 and 2,520 second-feet; rating curves for other periods poorly defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records fair for medium and high stages during open-water periods of 1915 and 1916; poor for remainder of time.

Discharge measurements of South Fork of Sangamon River near Taylorville, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Mar. 17	9.34	1,530
Mar. 20	6.32	387
May 18	4.60	107

Daily discharge, in second-feet, of South Fork of Sangamon River near Taylorville, Ill., for the period Aug. 8, 1914, to May 17, 1917.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1914.			1914.			1914.		
1		2.7	11	0.6	32	21	2.0	2.1
2		2.8	12	.7	17	22	49	2.1
3		11	13	.7	13	23	29	2.0
4		18	14	2.7	9.2	24	10	1.6
5		14	15	1.6	7.8	25	7.4	1.3
6		14	16	1.3	6.8	26	4.4	1.1
7		45	17	1.1	6.0	27	9.0	1.0
8	0.7	190	18	.9	5.0	28	2.7	.9
9	.7	77	19	.8	3.8	29	3.2	.6
10	.6	43	20	6.0	3.0	30	3.4	1.2
						31	3.0	

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914–15.												
1	1.3	2.7	7.0			98	18	19	1,670	558	167	473
2	1.4	2.7	7.2			85	17	16	1,320	383	190	332
3	1.4	2.8	8.0		1,520	68	17	28	985	264	536	248
4	1.4	3.0	8.0			63	17	42	581	190	558	178
5	1.3	3.2	8.8	75		58	16	38	400	315	605	148
6	1.1	3.4	8.4		1,570	63	17	36	264	400	400	148
7	1.2	3.6	8.2		1,270	68	17	40	190	315	190	126
8	1.3	4.4	9.2		790	63	17	140	167	493	126	126
9	3.6	5.2	10		349	63	18	105	140	851	91	148
10	3.6	6.0	9.8		140	54	20	85	119	790	85	133
11	3.0	5.8			133	48	38	48	1,180	1,470	68	112
12	3.0	5.8			98	46	50	40	1,570	2,060	63	105
13	2.8	6.2			85	44	58	30	1,720	2,530	58	105
14	2.7	7.0			85	42	42	25	1,270	2,380	54	98
15	2.6	7.4			85	40	34	28	761	2,000	54	91
16	5.2	7.4	3	30	73	38	30	28	400	1,620	68	98
17	5.0	7.0			68	34	21	30	217	1,370	105	79
18	5.0	6.2			54	32	19	24	167	851	85	126
19	4.6	6.0			50	31	17	17	140	473	148	349
20	4.0	6.0			42	32	17	20	315	315	167	349
21	4.0	6.0			36	32	17	36	1,270	217	3,210	264
22	3.8	6.0			34	31	19	157	1,370	178	7,150	383
23	3.2	6.4			85	30	190	105	1,470	140	5,990	264
24	2.7	6.4			315	28	264	79	950	119	4,230	167
25	2.2	6.6			473	26	454	73	605	98	2,940	157
26	2.1	7.0	8	5	332	25	366	654	248	98	2,310	112
27	2.1	7.0			178	25	203	3,030	140	167	1,620	105
28	2.1	7.0			119	21	112	3,390	157	157	1,370	105
29	2.1	6.8			.....	20	68	2,770	315	140	950	119
30	2.2	6.8			.....	20	26	2,380	680	119	680	105
31	2.4	.....			.....	19	.....	2,000	.....	140	605	.....

Daily discharge, in second-feet, of South Fork of Sangamon River near Taylorville, Ill., for the period Aug. 8, 1914, to May 17, 1917—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.												
1	91	85	91		7,870	514	232	111	102	111	11	2.1
2	79	85	91		3,690	448	232	111	102	84	7.4	4.2
3	73	85	85		2,530	383	232	111	111	68	11	3.3
4	70	85	91		1,940	332	217	120	120	57	8.8	2.5
5	63	85	85		1,470	298	203	129	102	57	7.0	1.9
				1,330								
6	58	85	85		1,140	332	190	120	102	50	4.8	5.0
7	56	85	85		706	605	178	111	90	47	3.1	43
8	54	85	85		493	883	178	102	315	39	4.5	45
9	52	85	85		400	790	167	94	264	35	8.4	22
10	50	85	85		332	654	167	87	190	33	6.0	8.8
11	48	85	112	761	298	536	167	80	129	29	5.0	4.0
12	48	85	178	1,570	298	473	157	80	111	27	6.8	1.9
13	50	91	298	4,460	315	417	147	80	90	26	7.2	2.1
14	52	91	298	4,980	281	400	138	80	74	43	10	1.3
15	54	91	217	3,900	232	366	138	87	68	54	16	.9
16	56	91	178	3,030	232	332	129	102	65	35	18	1.1
17	58	85	232	2,450	417	298	129	203	62	31	17	1.0
18	60	85	383	2,060	605	248	120	157	60	31	15	1.1
19	73	91	435	1,720	883	264	120	120	57	26	7.6	1.1
20	85	98	366	1,320	851	232	120	94	74	24	5.0	1.1
21	85	98	264	1,180	761	217	157	87	733	90	3.5	1.9
22	79	98	232	1,420	761	217	157	84	1,520	43	2.9	1.5
23	79	98	203	1,670	1,100	217	147	80	1,880	37	2.3	1.3
24	73	98	203	1,670	1,320	203	138	77	1,720	27	2.1	1.1
25	73	98	203	1,420	1,420	203	120	74	1,370	21	1.7	.9
26	73	85		1,100	1,370	203	120	71	680	17	1.7	1.0
27	73	91		916	1,100	217	129	74	400	15	2.1	.9
28	79	91		1,100	820	264	129	80	264	12	1.5	5.2
29	79	91	165	1,370	629	264	120	102	190	11	1.9	3.1
30	85	91		2,850	.....	264	111	111	147	9.6	1.5	1.9
31	85	.....		9,460	.....	248	.....	102	.....	7.8	1.7	.....

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.
1916-17.								
1	1.3	11	11			19	107	224
2	1.1	10	10			15	192	283
3	1.1	9.6	9.6			12	435	340
4	1.3	10	9.6			12	385	301
5	1.3	9.6	9.8			11	266	283
				45	1.5			
6	1.1	9.6	9.6			10	249	301
7	.9	9.8	9.6			10	249	385
8	1.1	9.8	10			11	224	320
9	1.3	10				11	200	283
10	1.1	11				11	192	249
11	1.0	10				11	162	301
12	1.1	10				12	128	283
13	1.1	10				248	128	266
14	1.3	11				1,520	102	249
15	2.3	11	5			3,030	90	200
				12	1.2			
16	4.5	11				2,120	82	162
17	3.5	10				1,570	72	134
18	2.7	10				1,140	65	.....
19	8.0	10				714	78	.....
20	9.0	10				385	59	.....
21	9.4	10				283	53	.....
22	9.0	10				249	50	.....
23	8.8	13				216	40	.....
24	9.2	14			20	266	34	.....
25	10	17				519	32	.....
26	10	19	9	7		549	30	.....
27	10	16				362	33	.....
28	10	14				283	65	.....
29	11	13			.....	200	122	.....
30	10	11			.....	156	154	.....
31	11	.....			.....	112	.....	.....

NOTE.—Discharge interpolated for Nov. 8 and 9, 1914, Mar. 2, 1916, and Mar. 30, 1917; estimated for Dec. 11, 1914, to Feb. 5, 1915, Jan. 1–10, 1916, and Dec. 9, 1916, to Feb. 28, 1917, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of South Fork of Sangamon River near Taylorville, Ill., for the period Aug. 8, 1914 to May 17, 1917.

[Drainage area, 427 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in) inches on drainage (area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914.					
August, 8–31	49	0.6	5.90	0.014	0.01
September	190	.6	17.8	.042	.05
1914–15.					
October	5.2	1.1	2.72	.0064	.007
November	7.4	2.7	5.59	.013	.01
December	.....	.....	6.54	.015	.02
January	.....	.....	35.6	.083	.10
February	.....	34	502	1.18	1.23
March	98	19	43.5	.102	.12
April	454	16	74.0	.173	.19
May	3,390	16	500	1.17	1.35
June	1,720	119	693	1.62	1.81
July	2,530	98	684	1.60	1.84
August	7,150	54	1,130	2.65	3.06
September	473	79	178	.417	.46
The year	7,150	.....	321	.752	10.20
1915–16.					
October	91	48	67.5	.158	.18
November	98	85	89.4	.209	.23
December	435	85	183	.428	.49
January	9,460	.....	2,060	4.82	5.56
February	7,870	232	1,180	2.76	2.98
March	883	203	365	.854	.98
April	232	111	156	.365	.41
May	203	71	101	.237	.27
June	1,880	57	373	.873	.97
July	111	7.8	38.6	.090	.10
August	18	1.5	6.53	.015	.02
September	45	.9	5.74	.013	.01
The year	9,460	.9	383	.897	12.20
1916–17.					
October	11	0.9	4.98	.012	.01
November	19	9.6	11.3	.026	.03
December	.....	.....	7.78	.018	.02
January	.....	.....	20.9	.049	.06
February	.....	.....	6.68	.015	.02
March	3,030	10	454	1.06	1.22
April	435	30	136	.319	.36
May, 1–17	385	134	268	.627	.40

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 about 6 miles northwest of Taylorville, Christian County, about 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 U. S. Geological Survey, scale, 1 to 500,000).

RECORDS AVAILABLE.—May 18 to September 30, 1917.

AGE.—Chain gage attached to bridge; read by R. T. Teaney.

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 period of records, 26.6 feet June 6 (discharge, 10,400 second-feet); minimum stage, 3.68 feet at 9 a. m. August 21 (discharge, 3.8 second-feet).

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 a half second-foot of water is used for boiler-feed and other purposes at the power plant.

ACCURACY.—Stage-discharge relation probably permanent during period of records. Rating curve fairly well defined above 25 second-feet. Gage read to hundredths twice a day. Daily discharge ascertained by applying daily gage height to rating table. Records good except those for extremely low stages, which are fair.

Discharge measurements of South Fork of Sangamon River at power plant near Taylorville, Ill., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 18	H. C. Beckman	5.61	102	June 8	G. J. Trinkaus	21.43	5,040
June 1	G. J. Trinkaus	14.21	1,430	26	H. C. Beckman	5.83	109
7	do	24.62	8,090	Sept. 11	do	9.72	504

Daily discharge, in second-feet, of South Fork of Sangamon River at power plant, near Taylorville, Ill., for the year ending Sept. 30, 1917.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1	.....	1,440	155	23	116	16	.....	680	23	7.6	34
2	.....	1,380	108	14	87	17	.....	535	21	6.4	27
3	.....	1,350	96	11	59	18	96	390	19	5.6	20
4	.....	1,230	76	8.6	30	19	88	300	17	5.0	17
5	.....	5,020	62	11	24	20	82	240	15	4.4	15
6	.....	10,400	52	14	22	21	76	200	13	3.9	16
7	.....	8,310	47	220	32	22	96	191	19	70	15
8	.....	5,020	42	59	806	23	220	164	25	522	14
9	.....	3,310	38	96	743	24	330	146	33	240	12
10	.....	2,390	35	62	680	25	300	128	128	137	11
11	.....	1,750	32	40	412	26	240	112	200	84	10
12	.....	1,410	28	28	146	27	370	96	116	32	14
13	.....	1,150	26	16	92	28	663	112	146	73	17
14	.....	868	23	12	59	29	956	124	99	280	16
15	.....	680	23	9.0	42	30	1,150	200	52	350	13
						31	1,410	.....	34	260	.....

NOTE.—No gage height record for May 20, June 17, July 8, 22, and 29, Aug. 5, 12, 19, and 26, and Sept. 2, 3, 9, 16, 23, and 30; discharge interpolated.

Monthly discharge of South Fork of Sangamon River at power plant near Taylorville, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 510 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
May 18–31	1,410	76	434	0.851	0.44
June	10,400	96	1,640	3.22	3.59
July	200	13	58.2	.114	.13
August	522	3.9	87.1	.171	.20
September	806	10	120	.235	.26

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, about 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, 1917.

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; may shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 23.0 feet at 9 p. m. June 6 (discharge, 16,400 second-feet); minimum stage, 0.52 foot October 14 and November 16 to 19 (discharge, 19 second-feet).

1908–1912 and 1914–1917: Maximum stage recorded, 23.0 feet June 6, 1917 (discharge, 16,400 second-feet); minimum stage, 0.38 foot August 12, 1914 (discharge, 13 second-feet).

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

ACCURACY.—Stage-discharge relation changed during high water in June. Rating curve used till May 31 well defined between 270 and 10,800 second-feet; curve used after that date well defined between 327 and 10,800 second-feet; both curves fairly well defined beyond the limits mentioned. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Open-water records good; winter records poor.

Discharge measurements of Kaskaskia River at Vandalia, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Sept. 12	3.84	528
12	3.91	521

Daily discharge, in second-feet, of Kaskaskia River at Vandalia, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	28	22	43	473		254	1,270	3,690	6,660	1,500	685	552
2	28	22	42	520		222	3,890	2,460	8,600	1,440	603	458
3	28	21	36	568		185	2,340	1,580	7,560	1,300	458	307
4	27	20	36	619		153	1,480	1,480	6,880	1,260	369	231
5	26	20	34	1,380		147	2,100	1,860	9,340	1,190	348	196
6	26	20	34	2,500	110	141	1,940	2,220	11,100	1,130	307	180
7	24	20	37	1,690		136	1,800	2,180	9,820	950	770	165
8	23	20	105	1,100		147	1,580	2,140	8,060	830	1,190	950
9	22	28	120	912		141	1,440	2,100	7,560	685	685	770
10	20	24	130	730		130	1,340	2,020	7,560	630	552	528
11	20	21				125	1,240	1,980	6,990	552	369	458
12	19	22				172	1,100	1,720	6,180	504	327	528
13	19	21				2,300	976	1,580	5,930	481	287	458
14	19	20				4,090	820	1,380	5,280	458	231	391
15	20	19				3,940	760	1,270	4,470	435	213	327
16	20	19	125	115	160	3,690	730	1,100	4,190	413	196	268
17	21	19				3,440	673	1,040	4,040	391	172	222
18	22	19				3,040	619	976	3,390	435	158	196
19	28	19				2,740	568	912	2,720	391	138	172
20	32	19				2,660	544	790	2,480	369	132	158
21	43	19				2,560	520	730	2,160	327	231	132
22	41	20			407	2,460	496	2,500	1,750	287	1,010	108
23	40	40			386	2,140	473	2,660	1,400	327	630	102
24	38	60			344	2,840	473	1,550	1,300	391	504	96
25	36	56			305	3,090	429	1,340	1,190	307	435	96
26	33	36	410	145	287	2,460	407	1,240	1,070	287	327	96
27	30	34			287	1,980	429	1,170	980	369	249	90
28	28	49			270	1,760	2,580	2,500	1,100	577	165	84
29	24	46			.....	1,520	3,690	4,040	1,330	1,160	458	78
30	24	46			.....	1,380	3,940	3,490	1,780	1,010	713	72
31	23	.....			.....	1,140	.....	5,490	.....	830	630	.....

NOTE.—Discharge interpolated for Mar. 21; estimated for Dec. 11 to Feb. 21, 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, 1917.

[Drainage area, 1,980 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	43	19	26.8	0.014	0.02
November	60	19	27.4	.014	.02
December	.....	.....	206	.104	.12
January	2,500	.....	427	.216	.25
February	.....	.....	184	.093	.10
March	4,090	125	1,650	.833	.96
April	3,940	407	1,360	.687	.77
May	5,490	730	1,970	.995	1.15
June	11,100	980	4,760	2.40	2.68
July	1,500	287	684	.345	.40
August	1,190	132	437	.221	.25
September	950	72	282	.142	.16
The year	11,100	19	1,000	.505	6.88

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 about 600 feet north of railroad station at New Athens, St. Clair County, about a 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, 1917. 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, 26.1 feet June 14 (discharge, 25,700 second-feet); maximum discharge, 26,100 second-feet, June 13; flow for both these days affected by backwater from Mississippi River; minimum stage recorded, 2.43 feet at noon October 11 (discharge, 142 second-feet).

Maximum stage recorded during periods of records, 35.7 feet August 26, 1915 (discharge, 63,100 second-feet); minimum stage, 2.08 feet August 10, 1914 (discharge, 102 second-feet).

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation changed slightly during year; affected by backwater from Mississippi River when height on gage of United States Weather Bureau at Chester, Ill., is above about 14.0 feet, and by ice during parts of winter. Rating curves used during periods of no backwater from the Mississippi fairly well defined. Gage read to hundredths once daily. Daily discharge for periods of no backwater ascertained by applying daily gage height to rating tables; for periods of backwater determined from daily gage heights at New Athens and Chester by slope method described in Water Supply Paper 345, page 53. Records fair for period of backwater effect, poor for periods of ice effect, and good for rest of year.

Discharge measurements of Kaskaskia River at New Athens, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 17	8.22	*a* 1,730
July 26	6.52	*a* 1,120
Sept. 15	4.79	616

a Backwater from Mississippi River when measurement was made. (See "Accuracy" in station description.)

Daily discharge, in second-feet, of Kaskaskia River at New Athens, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	210	287	330	3,050		1,020	2,230	9,540	12,100	1,850	1,270	360
2	185	267	308	2,160		990	4,750	10,200	13,800	1,670	1,270	486
3	210	228	267	1,640		890	6,670	10,500	14,600	1,650	1,110	572
4	219	228	247	1,720		740	7,040	11,000	15,200	1,620	1,270	659
5	185	202	228	7,260		710	7,320	11,000	15,100	1,530	992	570
					{1,100							
6	193	185	228	10,600		680	7,550	10,900	14,000	1,430	753	486
7	185	170	228	12,400		590	6,770	10,500	12,700	1,340	629	433
8	185	170	710	13,000		560	5,380	9,480	12,200	1,270	570	3,150
9	177	170	1,940	13,000		531	5,380	7,770	11,700	1,180	513	4,430
10	170	170	2,210	12,400		503	5,560	4,850	11,600	1,060	570	3,850
11	142	170	2,120	11,100		503	5,200	3,020	14,600	980	1,590	2,600
12	148	170	1,800	10,100		680	4,730	2,370	21,000	905	1,350	1,350
13	148	170	1,280	5,580		2,120	3,670	2,150	26,100	810	920	955
14	148	170	920	3,530		4,550	2,680	2,040	25,700	741	690	753
15	155	177		1,480		6,540	2,180	1,990	23,200	680	570	629
					375							
16	155	177				8,510	1,820	1,850	20,100	670	486	629
17	148	170				8,130	1,670	1,610	17,400	607	433	570
18	148	162				7,860	1,480	1,450	15,200	574	408	513
19	155	170				6,780	1,330	1,350	13,300	547	360	459
20	170	162		{1,240		5,860	1,340	1,240	12,000	540	337	384
			355									
21	210	162			620	4,730	1,400	1,190	11,000	532	408	360
22	425	162			2,210	4,020	1,380	3,900	10,200	538	337	292
23	400	308			2,450	3,680	1,340	5,980	9,260	593	292	282
24	353	353		2,080	1,900	3,580	1,260	6,700	8,060	593	513	260
25	308	531		2,030	1,280	3,680	1,230	6,940	5,160	1,270	486	250
26	287	620		1,720	1,130	4,070	1,170	6,780	2,790	1,230	513	230
27	247	620	3,050	1,360	1,060	4,070	1,080	5,540	1,960	1,590	753	230
28	219	560	5,440	1,060	990	3,800	2,860	4,100	1,650	2,720	570	211
29	185	450	6,310	1,130	.....	3,360	6,150	4,750	1,430	3,100	513	193
30	185	376	6,940	1,760	.....	2,660	8,090	6,050	1,380	2,210	459	184
31	308	.....	5,030	2,030	.....	2,260	.....	8,300	.....	1,350	384	.....

NOTE.—Discharge estimated for Dec. 15–26, Jan. 16–23, and Feb. 1–20, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated. Discharge Mar. 30 to July 28 determined by slope method, because of backwater from Mississippi River. (See "Accuracy" in station description).

Monthly discharge of Kaskaskia River at New Athens, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 5,220 square miles.]

Month.	Discharge in second-feet				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	425	142	212	0.041	0.05
November	620	162	264	.051	.06
December	6,940	.....	1,410	.270	.31
January	13,000	.....	4,260	.816	.94
February	2,450	.....	942	.180	.19
March	8,510	503	3,180	.609	.70
April	8,090	1,080	3,660	.701	.78
May	11,000	1,190	5,650	1.08	1.24
June	26,100	1,380	12,500	2.39	2.67
July	3,100	532	1,210	.232	.27
August	1,590	292	688	.132	.15
September	4,430	184	878	.168	.19
The year	26,100	142	2,900	.556	7.55

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, about 6 miles west of West Frankfort, 11½ 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, 1917; June 16, 1908, to September 30, 1912, and November 1, to December 31, 1912, maintained at the 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; low-water 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, 24.7 feet at 5 p. m. January 8 (discharge, 9,770 second-feet); minimum stage, 0.84 foot at 6 p. m. October 14 (discharge, 3.4 second-feet).

1914–1917: Maximum stage recorded, 30.2 feet February 1, 1916 (discharge, 16,300 second-feet); minimum stage, August 18–26, 1914, when there was no flow past the gage.

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

ACCURACY.—Stage-discharge relation probably permanent during period of records except as affected by ice during parts of winters. Rating curve fairly-well defined between 43 and 13,500 second-feet. Gage read to hundredths twice daily to May 10, 1917, and once daily afterwards. Daily discharge ascertained by applying daily gage height to rating table. Records good except those for extremely low and high stages, which are fair; poor for periods of ice effect.

Discharge measurements of Big Muddy River at Plumfield, Ill., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 29	G. J. Trinkaus	13.97	2,050	Mar. 29	H. C. Beckman	3.36	169
Jan. 9	H. C. Beckman	24.28	9,310	Sept. 14	do	1.77	28.8
16[a]	do	11.31	531	14	do	1.77	30.3
22[b]	do	9.06	1,150				

[a] Ice along shores; probably an ice jam below gage.
[b] Measurement made during rapidly rising stage.

Daily discharge, in second feet, of Big Muddy River at Plumfield, Ill., for the years ending Sept. 30, 1914–1917.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1914.			1914.			1914.		
1		412	11		1,160	21	0.0	50
2		218	12		910	22	.0	29
3		113	13		466	23	.0	24
4		58	14		196	24	.0	25
5		36	15		103	25	.0	17
6		37	16		67	26	.0	29
7		153	17		40	27	4.2	58
8		580	18	0.0	33	28	14	43
9		970	19	.0	76	29	9.0	27
10		1,140	20	.0	85	30	43	18
						31	494	

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914–15.												
1	14	9.6	6		2,820	1,730	19	7.0	4,040	2,240	43	3,120
2	12	8.8	6		5,680	955	18	6.2	3,610	2,480	123	2,320
3	10	8.0	6		8,230	425	16	5.2	3,070	2,560	312	1,610
4	8.6	8.0	12		8,830	218	15	4.6	2,280	2,680	264	910
5	7.4	7.4	16		8,530	399	15	4.1	1,640	2,720	133	336
6	6.8	7.0	22	380	7,830	790	14	4.8	895	2,560	85	85
7	5.8	6.2	35		7,110	895	14	9.6	670	2,180	46	50
8	5.0	6.0	123		6,380	730	13	207	336	2,120	28	34
9	108	5.8	108		5,120	466	12	133	207	2,090	20	27
10	580	5.0	76		4,100	312	13	123	123	2,240	19	32
11	1,000	4.8			3,070	229	15	67	85	2,320	36	28
12	1,120	4.5			2,090	174	14	50	80	2,280	252	23
13	1,140	4.5			1,360	133	13	42	207	2,060	399	20
14	1,220	38			925	108	12	32	76	1,480	336	17
15	1,340	27			730	98	11	22	67	955	625	14
			35	560								
16	1,380	19			580	76	11	18	62	790	1,020	14
17	1,300	15			386	67	11	15	41	640	1,080	13
18	1,160	13			240	62	10	13	39	494	820	153
19	910	8.6			174	58	9.0	11	123	360	820	174
20	508	7.8			133	54	11	14	113	218	1,360	113
21	240	8.0			113	50	10	17	550	128	2,180	43
22	133	8.0			133	46	10	43	1,180	94	3,170	33
23	94	7.4			1,200	46	10	820	1,560	80	5,760	21
24	58	7.4			1,670	42	9.0	1,970	1,880	54	7,830	16
25	40	7.0			2,240	39	8.6	2,640	2,060	33	8,430	12
26	28	7.0	230	290	2,640	35	7.2	2,770	2,000	24	8,030	9.3
27	25	7.0			2,600	30	7.0	2,920	1,440	19	7,370	8.4
28	17	6.6			2,280	28	7.4	3,220	1,030	14	6,470	16
29	14	7.0			.....	27	7.0	3,610	1,540	46	5,440	72
30	13	6.8			.....	23	6.6	4,110	1,940	118	4,530	123
31	10	.....			.....	22	.....	4,250	.....	76	3,670	.....

Daily discharge, in second-feet, of Big Muddy River at Plumfield, Ill., for the years ending Sept 30, 1914–1917—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1915–16.												
1	94	4.7	18	2,210	16,000	174	153	31	438	26	7.8	252
2	98	4.4	16	2,820	15,900	174	133	29	438	19	12	103
3	76	4.5	15	3,320	14,700	19	185	30	1,220	17	7.4	80
4	50	4.7	14	3,550	13,600	218	373	30	1,320	13	9.6	90
5	29	4.8	12	3,490	12,400	386	336	31	1,220	10	14	67
6	22	4.6	10	3,170	11,300	565	240	30	1,300	240	12	58
7	17	4.8	10	2,680	10,100	1,140	163	27	1,640	229	9.6	50
8	14	5.0	11	2,150	8,830	1,440	153	25	1,760	118	8.0	58
9	13	4.8	10	1,400	7,370	1,640	196	30	1,880	67	7.0	610
10	10	4.8	10	985	5,930	1,790	240	31	2,000	38	7.0	865
11	8.2	6.2	163	1,280	4,530	1,580	229	26	2,150	26	6.4	565
12	7.2	43	700	1,970	3,320	985	196	22	2,000	21	6.2	196
13	7.0	31	820		2,640	480	153	19	1,560	153	7.6	85
14	7.8	16	745		2,320	264	118	17	1,040	58	196	46
15	7.2	25	480		2,150	218	94	229	386	174	775	31
16	6.6	22	640	2,150	1,940	207	72	1,120	508	118	1,000	23
17	5.8	17	1,910		1,760	196	58	1,000	595	76	1,100	17
18	5.4	23	2,400		1,610	185	46	775	480	58	1,180	14
19	5.0	103	3,120		1,560	163	39	386	565	128	1,240	11
20	4.8	386	3,370		1,420	153	42	163	508	348	1,460	9.3
21	4.6	252	3,120	1,420	1,000	128	240	128	360	174	1,640	7.8
22	4.4	98	2,600	1,320	625	118	480	153	412	163	1,730	7.0
23	4.3	54	1,760	1,400	466	108	300	118	264	123	1,610	6.2
24	4.2	39	970	1,440	730	103	185	98	324	76	1,100	5.0
25	4.2	35	910	1,400	865	113	143	76	276	42	580	5.0
26	4.2	29	1,100	1,240	760	174	108	80	218	25	252	4.8
27	4.2	25	1,220	1,030	522	466	76	54	153	17	123	4.7
28	4.4	22	1,160	1,460	336	565	58	37	94	14	348	43
29	4.3	21	1,020	2,680	229	425	43	32	58	9.6	715	43
30	4.4	20	1,300	7,640	.....	300	37	27	37	7.4	820	67
31	4.6	.....	1,640	13,300	.....	207	.....	276	.....	6.4	640	.....
1916–17.												
1	76	12	33	2,360		128	805	1,760	1,180	30	805	6.0
2	42	10	29	2,060		143	2,120	2,120	1,610	21	522	113
3	28	8.4	25	1,970		163	3,370	2,440	1,910	14	760	94
4	22	7.0	23	2,090		153	4,250	2,480	2,090	12	700	336
5	17	6.2	50	3,270		123	4,880	2,360	2,120	10	324	373
6	14	10	36	6,110	410	94	4,960	2,120	2,180	9.3	196	196
7	11	16	22	8,730		76	4,670	1,700	2,240	12	118	113
8	8.2	14	240	9,770		85	4,250	1,060	2,180	9.9	80	72
9	6.6	16	670	9,330		80	3,850	480	2,120	8.4	76	373
10	5.4	19	1,140	8,330		76	3,490	218	2,210	7.2	39	452
11	4.8	43	1,320	7,100		67	3,370	153	2,520	6.4	39	360
12	4.4	35	1,300	5,840		163	3,170	118	2,560	5.4	25	143
13	4.0	39	1,080	4,460		895	2,720	90	2,400	4.8	18	62
14	3.5	36	610			1,500	2,150	72	2,180	4.8	15	32
15	4.8	28			25	1,760	1,360	58	1,910	5.2	14	21
16	6.2	24				2,000	715	46	1,240	4.8	46	15
17	5.2	22				2,210	300	39	640	4.7	46	12
18	9.6	20		610		2,180	153	33	185	4.7	29	9.3
19	13	18				1,970	123	27	90	4.3	13	8.4
20	18	17				1,460	108	24	54	4.2	9.0	8.2
21	26	17	120		54	790	90	22	39	5.4	7.0	9.0
22	24	16		1,000	50	730	85	252	30	5.0	7.8	300
23	19	16		1,360	54	895	103	595	24	5.2	14	123
24	20	23		1,540	72	910	76	715	21	4.5	16	41
25	27	24		1,700	118	820	54	480	17	4.3	8.0	23
26	25	94		1,460	143	580	39	288	15	100	42	17
27	22	94		835	128	348	33	143	14	196	37	11
28	20	76	1,540	438	123	229	98	360	13	820	20	8.6
29	16	54	2,030	640	.....	163	760	970	31	1,000	14	7.2
30	14	41	2,320	1,180	.....	113	1,360	1,160	20	1,080	10	6.0
31	13	.....	2,480	1,440	.....	85	.....	1,020	.....	1,040	7.2	.....

NOTE.—Discharge estimated for Dec. 11, 1914, to Jan. 31, 1915, Jan. 13–20 and Dec. 15–27, 1916, Jan. 14–21 and Feb. 1–20, 1917, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Big Muddy River at Plumfield, Ill., for the years ending Sept. 30, 1914–1917.

[Drainage area, 753 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914.					
August 18–31	494	0	40.6	0.054	0.028
September	1,160	17	239	.317	.35
1914–15.					
October	1,380	5.0	403	.535	.62
November	38	4.5	9.54	.013	.01
December	.....	6.0	106	.141	.16
January	.....	.....	406	.539	.62
February	8,830	113	3,110	4.13	4.30
March	1,730	22	270	.359	.41
April	19	6.6	11.6	.015	.02
May	4,250	4.1	876	1.16	1.34
June	4,040	39	1,100	1.46	1.63
July	2,720	14	1,170	1.55	1.79
August	8,430	19	2,280	3.03	3.49
September	3,120	8.2	315	.418	.47
The year	8,830	4.1	825	1.10	14.86
1915–16.					
October	98	4.2	17.3	.023	.03
November	386	4.4	43.8	.058	.06
December	3,370	10	1,010	1.34	1.54
January	13,300	985	2,600	3.45	3.98
February	16,000	229	5,000	6.64	7.16
March	1,790	103	479	.636	.73
April	480	37	163	.216	.24
May	1,120	17	165	.219	.25
June	2,150	37	840	1.12	1.25
July	348	6.4	83.7	.111	.13
August	1,730	6.2	536	.712	.82
September	865	4.7	114	.151	.17
The year	16,000	4.2	905	1.20	16.36
1916–17.					
October	76	3.5	17.1	.023	.03
November	94	6.2	28.5	.038	.04
December	2,480	22	533	.708	.82
January	9,770	.....	2,840	3.77	4.35
February	.....	.....	182	.242	.25
March	2,210	67	677	.899	1.04
April	4,960	33	1,780	2.36	2.63
May	2,480	22	755	1.00	1.15
June	2,560	13	1,130	1.50	1.67
July	1,080	4.2	143	.190	.22
August	805	7.0	131	.174	.20
September	452	6.0	111	.147	.16
The year	9,770	3.5	697	.926	12.56

BIG MUDDY RIVER AT MURPHYSBORO, ILL.

LOCATION.—In SW. ¼ sec. 8, T. 9 S., R. 2 W., at lower highway bridge, South Twentieth Street, about a quarter of a mile below mouth of Louis Creek at Mobile & Ohio Railway bridge.

RECORDS AVAILABLE.—December 6, 1916, to September 30, 1917.

DRAINAGE AREA.—2,170 square miles (measured on map issued by U. S. Geological Survey; scale, 1 to 500,000).

GAGE.—Chain gage attached to bridge; read by G. A. Johnson until May 21 and by E. B. Jacobs afterward.

CHANNEL AND CONTROL.—Heavy clay; may shift.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of records, 33.3 feet at noon January 10 (discharge, 15,600 second-feet); minimum stage (interpolated), 2.32 feet September 30 (discharge, 29 second-feet).

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).

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

ACCURACY.—Stage-discharge relation changed slightly during high water in January; affected by ice during a period in February, and by backwater from Mississippi River when height on gage of U. S. Weather Bureau at Chester, Ill., is above about 10.0 feet. Rating curves well defined between 435 and 9,000 second-feet, and fairly well defined between 45 and 435 second-feet and between 9,000 and 18,200 second-feet. Gage read to hundredths once daily. Daily discharge during periods of no backwater ascertained by applying daily gage height to rating table; not determined for periods of backwater. Records good except those for very high and low stages, which are fair; poor for period of ice effect.

Discharge measurements of Big Muddy River at Murphysboro, Ill., during the year ending Sept. 30, 1917.

[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.*
Dec. 6	3.10	146	Jan. 19	14.46	3,480	July 26 [a]	5.32	46
Jan. 10	33.30	15,600	20	10.02	1,670	Sept. 15	3.34	157
15	27.20	10,600	21	6.60	777	15	3.32	148
17	22.30	7,380	Mar. 30 [a]	6.67	495			
18	18.69	5,540	May 17 [a]	8.18	239			

[a] Backwater from Mississippi River when measurement was made.

Daily gage height, in feet, of Big Muddy River at Murphysboro, Ill., for the year ending Sept. 30, 1917.

Day.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	17.2	14.0	3.9	15.6	20.1	19.4	10.6	8.3	5.2
2	.....	15.6	13.3	4.0	20.5	20.6	22.3	11.4	8.2	.....
3	.....	18.4	12.5	4.0	23.7	21.4	23.0	11.6	8.3	4.4
4	.....	19.8	12.4	4.6	.....	21.6	23.5	11.4	8.5	3.25
5	.....	25.1	9.0	5.1	.....	21.6	23.8	11.2	.....	3.15
6	3.1	26.6	7.0	4.7	.....	20.2	23.4	11.0	6.6	4.9
7	2.9	29.1	5.4	4.3	.....	19.4	21.9	10.8	4.9	6.0
8	6.7	31.7	4.0	4.3	.....	18.4	20.7	.....	4.8	5.4
9	10.5	33.2	4.0	4.6	.....	17.1	20.2	10.0	4.1	.....
10	13.8	33.3	7.4	4.3	.....	15.0	20.1	9.8	3.8	6.4
11	14.2	32.6	3.25	3.8	.....	13.6	20.0	9.7	3.55	6.5
12	13.7	31.8	3.15	8.2	.....	12.3	20.2	9.5	.....	5.6
13	12.5	30.2	3.05	14.7	.....	11.1	20.8	9.3	3.1	4.9
14	10.5	28.5	3.0	17.9	.....	10.2	21.5	8.7	2.86	3.6
15	8.5	27.1	2.96	18.7	.....	9.3	22.1	9.2	3.1	3.2
16	6.6	24.4	2.80	19.6	.....	8.7	22.2	8.7	3.4	.....
17	4.7	22.1	2.72	19.5	.....	8.2	21.9	8.1	4.2	2.80
18	4.2	18.6	3.0	19.0	.....	8.3	21.2	7.6	5.3	2.72
19	3.4	14.3	3.05	17.8	.....	7.4	20.1	6.9	3.6	2.70
20	3.5	9.9	3.1	16.3	.....	6.6	19.4	6.3	2.90	2.50
21	3.0	6.6	3.4	14.7	.....	6.2	18.4	6.0	2.84	2.48
22	3.15	8.4	3.55	12.6	.....	7.4	17.5	5.9	2.66	2.36
23	3.2	11.6	3.4	10.1	.....	8.9	16.6	5.8	2.54	3.3
24	3.1	12.3	3.55	11.0	.....	10.3	15.2	5.8	2.52	3.1
25	3.2	12.1	3.55	11.2	.....	9.9	14.4	5.4	2.48	2.90
26	4.4	11.8	3.8	10.4	.....	8.5	13.4	5.3	.....	2.50
27	12.5	11.6	4.0	9.0	.....	7.5	12.4	6.0	2.40	2.42
28	15.7	10.5	4.0	7.4	.....	9.4	11.6	5.6	2.34	2.40
29	18.5	9.6	.....	6.4	14.4	11.5	11.3	7.0	2.36	2.38
30	19.3	11.3	.....	6.4	18.2	12.9	10.5	8.8	2.54	.....
31	17.2	13.7	.....	6.4	.....	15.9	.....	8.9	4.0	.....

NOTE.—Stage-discharge relation affected by ice Feb. 6–17 and by backwater from Mississippi River Mar. 16 to Aug. 7.

Daily discharge, in second-feet, of Big Muddy River at Murphysboro, Ill., for the year ending Sept. 30, 1917.

Day.	Dec.	Jan.	Feb.	Mar.	Aug.	Sept.
1	.....	4,750	3,250	240	.....	475
2	.....	3,970	2,940	255	.....	398
3	.....	5,350	2,600	255	.....	321
4	.....	6,070	2,560	357	.....	142
5	.....	9,060	1,370	455	.....	128
6	144	9,960		376	.....	415
7	118	11,700		304	.....	640
8	798	13,900		304	395	515
9	1,820	15,500		357	271	622
10	3,160	15,600		304	225	729
11	3,340	14,800		225	188	752
12	3,120	14,000	190	1,170	154	556
13	2,600	12,600		3,560	120	415
14	1,820	11,200		5,100	87	195
15	1,240	10,300		5,500	120	135
16	775	8,640		.....	165	107
17	394	7,340		.....	287	79
18	307	5,450	105	.....	495	69
19	186	3,380	112	.....	195	67
20	200	1,640	120	.....	92	45
21	131	775	165	.....	84	43
22	151	1,220	188	.....	63	32
23	158	2,240	165	.....	49	150
24	144	2,520	188	.....	47	120
25	158	2,440	188	.....	43	92
26	341	2,320	225	.....	39	45
27	2,600	2,240	255	.....	35	37
28	4,020	1,820	255	.....	30	35
29	5,400	1,550	.....	.....	32	33
30	5,800	2,120	.....	.....	49	29
31	4,750	3,120	.....	.....	255	.....

NOTE.—Discharge interpolated for Aug. 12 and 26, and Sept. 2, 9, 16, and 30. Discharge Mar. 16 to Aug. 7 not determined owing to backwater from Mississippi River.

Monthly discharge of Big Muddy River at Murphysboro, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 2,170 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum	Minimum.	Mean.	Per square mile.	
Dec. 6–31	5,800	118	1,680	0.774	0.75
January	15,600	775	6,700	3.09	3.56
February	3,250	.....	606	.279	.29
Mar. 1–15	5,500	225	1,240	.572	.32
Aug. 8–31	495	30	147	.068	.06
September	752	29	247	.114	.13

FLOOD ON CEDAR RIVER, IOWA, MARCH 23–29, 1917.

The flood on Cedar River in March, 1917, was the highest since that of March, 1906, which exceeded it by about 1 foot. A flood in the fifties exceeded it by about 3 feet. A reconnaissance of the flood situation on Cedar River in the vicinity of Cedar Falls was made March 28, 1917. Information regarding conditions on the main stream was obtained at Cedar Falls, Waterloo, and Cedar Rapids; that concerning Shellrock River was obtained at Shellrock.

The drainage area of Cedar River at Janesville is 1,660 square miles. A few miles below Janesville the Cedar is joined by Shellrock River, whose drainage area comprises 2,690 square miles. Of this area the West Fork, which unites with the Shellrock a few miles above its junction with Cedar River, drains 965 square miles. Beaver River, draining 380 square miles, enters Cedar River between the mouth of Shellrock River and Cedar Falls. The drainage area of Cedar River above Cedar Falls is therefore about 4,730 square miles, and the run-off from 65 per cent of this area is discharged into Cedar River between Janesville and Cedar Falls.

The flood of March, 1917, was due to a small amount of precipitation accompanied by high temperature that caused rapid melting of the snow on the drainage basin. At Charles City, near the eastern border of the drainage basin above Cedar Falls, the temperature rose above freezing March 21, reached 48° March 22, 58° March 23, and 42° March 24. On March 23 there was a rainfall of 0.42 inch.

As nearly as could be determined, the peaks of the March flood on the tributaries entering Cedar River between Janesville and Cedar Rapids occurred at the same time and each was as high as or higher than any that has occurred within the last ten years. The crest of the flood on Cedar River passed Waverly at 3 a. m., Cedar Falls at 8 a. m., and Waterloo about 4 p. m. March 24, Cedar Rapids about 6 p. m. March 26, and Wapello about 3 a. m. March 30.

A current-meter measurement of the flow at Cedar Rapids March 27 at a stage of 15.4 feet on the gage at that place showed a discharge of 44,900 second-feet. The discharge corresponding to the crest of the flood at that place—17.2 feet—was 54,000 second-feet.

The total damage to property from the headwaters of Cedar River to its mouth is estimated at not over $50,000. All streams above Cedar Falls were covered with ice about 24 inches thick until March 22. Small bridges and dams on tributary streams were damaged when the ice broke up, but aside from knocking out a few timbers in the bulkhead of the Nashua dam, the ice did no serious damage at that place. An ice gorge on Cedar River between Nashua and Waverly held the water back for several hours March 23, and when this gorge was dynamited about 9 p. m. March 23, there was a sudden rise of about 3 feet in the stage at the dam at Waverly. There was no damage to property at Waverly, but considerable inconvenience was caused when the power plant had to shut down for a short time. About two-thirds of the apron of the timber dam on Shellrock River at Shellrock was carried out by ice, the damage being about $300. A steel truss bridge at Greene, and three small pile bridges on West Fork, were taken out by the ice. The cost of replacing the steel bridge is estimated at $3,000, and the pile bridges $6,000.

The flood did most damage in the vicinity of Cedar Falls. The total damage to property was estimated by the city engineer at not more than $30,000, exclusive of small losses of private individuals. Of this sum the damage to property which would have to be replaced by the city is estimated at $15,000. One pile bridge of the Illinois Central Railroad was carried out and roadbed washed away in several places, the damage being estimated at $3,000. Damage to the Rock Island Railroad was estimated at $2,500—the cost of replacing a fill about three-fourths of a mile long, between Cedar Falls and Waterloo.

At Waterloo there was no material damage to property, but considerable inconvenience was caused by flooding of basements of residences and business houses. Residents had to move out from six blocks of well-settled residence districts. Flooding of the business district of East Waterloo was prevented by increasing the height of the levee.

There was no damage of consequence to property in Cedar Rapids or below that place.

MISCELLANEOUS MEASUREMENTS.

Miscellaneous discharge measurements in Hudson Bay drainage basin.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1915.				*Feet.*	*Sec.-ft.*
July 20	Pembina River	Red River	Neche, N. Dak	3.87	24
Sept. 6	do	do	do	2.79	1.9
1916.					
Apr. 24	do	do	do	16.82	[a]2,040

[a] Velocity determined with floats. Coefficient of 0.875 used for reducing measured velocity to mean velocity.

Miscellaneous discharge measurements in Mississippi River drainage basin during the year ending Sept. 30, 1917.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Oct. 25	West Fork of Chippewa River.	Mississippi River	Sec. 34, T. 40 N., R. 6 W., 1 mile above mouth of East Fork of Chippewa River, Wis.	[a] 5.56	522
Jan. 6	do	do	do	[a] 5.38	[b] 190

[a] Gage at old gaging station of U. S. Geological Survey.
[b] Complete ice cover.

INDEX.

STREAM-GAGING STATIONS

AND

PUBLICATIONS RELATING TO WATER RESOURCES

PART V. HUDSON BAY AND UPPER MISSISSIPPI RIVER DRAINAGE BASINS

96719°—19—WSP 455——14

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 basin.
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.
Atlanta, Ga., Post Office Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Helena, Mont., Montana National Bank Building.
Topeka, Kans., 25 Federal Building.
Austin, Tex., Capitol Building.
Denver, Colo., 403 New Post Office Building.
Salt Lake City, Utah, 421 Federal Building.
Boise, Idaho, 615 Idaho Building.
Portland, Oreg., 606 Post Office Building.
Tacoma, Wash., 406 Federal Building.
San Fancisco, Calif., 328 Customhouse.
Los Angeles, Calif., 619 Federal Building.
Tucson, Ariz., University of Arizona.
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 4,240 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.	1987.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
W 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.

Stream-flow data in reports of the United States Geological Survey—Continued.

Report.	Character of data.	Year.
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.

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 1917. 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, and 451 which contain records for the New England streams from 1903 to 1917. 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, 1899–1917.

Year.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
												North Pacific drainage basins.		
	North Atlantic slope basin (St. John River to York River).	South Atlantic slope and eastern Gulf of Mexico basin (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[d]	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	332A	332B	332C
1913	351	352	353	354	355	356	357	358	359	360	361	362A	362B	362C
1914	381	382	383	384	385	386	387	388	389	390	391	392	393	394
1915	401	402	403	404	405	406	407	408	409	410	411	412	413	414
1916	431	432	433	434	435	436	437	438	439	440	441	442	443	444
1917	451	452	453	454	455	456	457	458	459	460	461	462	463	464

[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, 1917. 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–
Swiftcurrent Creek at Many Glacier, Mont., 1912–
Swiftcurrent Creek at Sherburne, Mont., 1912–
Swiftcurrent Creek near Babb (formerly Wetzel) Mont., 1902–1910.
U. S. Reclamation Service, St. Mary canal at Hudson Bay divide near Browning, Mont., 1917–
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.
Red River at Emerson, Manitoba, 1900–1902.
Mustinka River near Wheaton, Minn., 1916; 1917.
Pelican River near Fergus Falls, Minn., 1909–1912.
Sheyenne River at Haggart, N. Dak., 1902–1907.
Wild Rice River at Twin Valley, Minn., 1909–1917.
Devils Lake near Devils Lake, N. Dak., 1901–
Red Lake River at Thief River Falls, Minn., 1909–

Mississippi River tributaries—Continued.
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., 1908–1916.
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–
Turkey River at Garber, Iowa, 1913–1916.
Maquoketa River above mouth of North Fork, near Maquoketa, Iowa, 1913–14.
Maquoketa River at Manchester, Iowa, 1903.
Maquoketa River below mouth of North Fork, near Maquoketa, Iowa, 1913–
Wapsipinicon River at Stone City, Iowa, 1903–1914.
Rock River at Watertown, Wis., 1914.

REPORTS ON WATER RESOURCES OF THE HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS.

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

WATER-SUPPLY PAPERS.

Water-supply papers 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 is 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.
Discusses, by counties, glacial deposits and sources of well waters; many well sections.

*44. Profiles of rivers in the United States, by Henry Gannett. 1901. 100 pp., 11 pls. 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 esatern 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 st.tus 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 Minnesots, 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 quarzite, 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 possibilitiey 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 ground-water 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 importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general methods of work; gives tabulated records of wells in Illinois and Iowa, and detailed records of wells in Boone, Dupage, Henry, and La Salle counties, Ill., and Des Moines and Scott counties, Iowa. These wells were selected because they give definite stratigraphic information.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 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 datailed 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 qaudrangle. 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 damages 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

[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.

185 and higher numbers sells for 50 cents a copy. A discount of 40 per cent is allowed on an order for folios or for folios together with topographic maps amounting to $5 at the retail rate.

All the folios contain descriptions of the drainage of the quadrangles. The folios in the following list contain also a brief discussion of the underground waters in connection with the economic resources of the areas and more or less information concerning the utilization of the water resources.

An asterisk (*) indicates that the stock of the folio is exhausted.

117. Casselton-Fargo, North Dakota-Minnesota. 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.[1] 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.[1] Library edition, 25c., octavo edition, 50c.

188. Tallula-Springfield, Illinois.[1] 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.[1] 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.

[1] Issued in two editions; specify which edition is wanted.

The mineral content of Illinois waters, by Edward Barstow, J. A. Udden, S. W. Parr, and George T. Palmer: Illinois State Geol. Survey Bull. 10, 1909.

Water resources of the East St. Louis district, by Isaiah Bowman: Illinois State Geol. Survey Bull. 5, 1907.

Chemical and biological survey of waters of Illinois, by Edward Bartow: Univ. Illinois Pub. 3, 6, 7, 1906–1909.

Chemical survey of the waters of Illinois, report for the years 1897–1902, by A. W. Palmer, with report on geology of Illinois as related to its water supply, by Charles W. Rolfe: Univ. Illinois Pub.

Report and plans for the reclamation of lands subject to overflow in the Kaskaskia River Valley, Illinois; begun under the direction of the Internal Improvement Commission; completed and published under the direction of the Rivers and Lakes Commission of Illinois, by Jacob A. Harman. 1912.

Diversion of the waters of the Great Lakes by way of the sanitary and ship canal of Chicago: A brief of the facts and issues, by Lyman E. Cooley, Chicago. 1913.

The State of Missouri *vs.* the State of Illinois and the Sanitary district of Chicago, before Frank S. Bright, Commissioner of the Supreme Court of the United States. 1904.

The mineral waters of Indiana, their location, origin, and character, by W. S. Blatchley: Indiana Dept. Geology and Nat. Res. Twenty-sixth Ann. Rept., 1901.

Report of the water-resources investigation of Minnesota by the State drainage commission, 1910.

Report of the commission on conservation [Montana] on bills relating to the public lands, water rights, and the protection and preservation of the forests, 1911.

Governor's message relating to conservation [in Montana] on bills relating to public lands, water rights, and the protection and preservation of the forests.

Water resources of the Devils Lake region, North Dakota, by E. J. Babcock: North Dakota Geol. Survey, Second Bienn. Rept., 1903.

The water powers of Wisconsin, by Leonard S. Smith: Wisconsin Geol. and Nat. Hist. Survey Bull. 20. Madison, Wis., 1908.

Report of the Railroad Commission of Wisconsin to the legislature on water powers. Madison, Wis., 1915.

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 mothods 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 bibliograghy 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.
Electrical 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 plane table, 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 statues 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, geolgist 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 cities State legislative acts affecting them.

140. Field measurements of the rate of movement of underground waters, by C. S. Slitcher. 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. Disscuses 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 bibilography 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.

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. Bibligoraphic 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 course 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. 29 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. 15c.

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.

*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 sterlization 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 steam 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 steam 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. Hoty, 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, Cal., 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 Sierre 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 Sacremento 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=Progessional 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 abstracts.

INDEX OF STREAMS.

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