DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

Water-Supply Paper 454

SURFACE WATER SUPPLY OF THE UNITED STATES

1917

PART IV. ST. LAWRENCE RIVER BASIN

NATHAN C. GROVER, Chief Hydraulic Engineer
W. G. HOYT, A. H. HORTON, C. C. COVERT, and
C. H. PIERCE, District Engineers

Prepared in cooperation with the
STATES OF MINNESOTA, WISCONSIN, NEW YORK, AND VERMONT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1919

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SURFACE WATER SUPPLY OF ST. LAWRENCE RIVER BASIN, 1917.

AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 14 reports presenting results of measurements of flow made on streams in the United States during the year ending September 30, 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, 1895–1917.

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

In the execution of the work many private and State organizations have cooperated either by furnishing data or by assisting in collecting data. Acknowledgements for cooperation of the first kind are made in connection with the description of each station affected; cooperation of the second kind is acknowledged on page 9.

Measurements of stream flow have been made at about 4,240 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

precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country and will be made available in water-supply papers from time to time. Information in regard to publications relating to water resources is presented in the appendix to this report.

DEFINITION OF TERMS.

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

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

"Second-feet per square mile" is the 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.

The following terms not in common use are here defined:

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

"Control," a term used to designate the section or sections of the stream below the gage which determines 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 would fall if there were no flow.

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1916, and ending September 30, 1917. At the first 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 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 a year beginning October 1, is practically all derived from precipitation in that year.

The base data collected at gaging stations (Pl. I, *B*) 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 (Pl. II) that gives a continuous record of the fluctuations. Measurements of discharge are made with a current meter by the general methods 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 daily discharge from which the monthly and yearly mean discharge is determined.

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

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

The description of the station gives, in addition to statements regarding location and equipment, information in regard to any conditions that may affect the constancy of the stage-discharge relation, covering such subjects as the occurrence of ice, the use of the stream for log driving, shifting of channel, 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 dirunal 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 is obtained by averaging the discharge at regular intervals during the day or by use of 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 for each second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 6, are based.

ACCURACY OF FIELD DATA AND COMPUTED RESULTS.

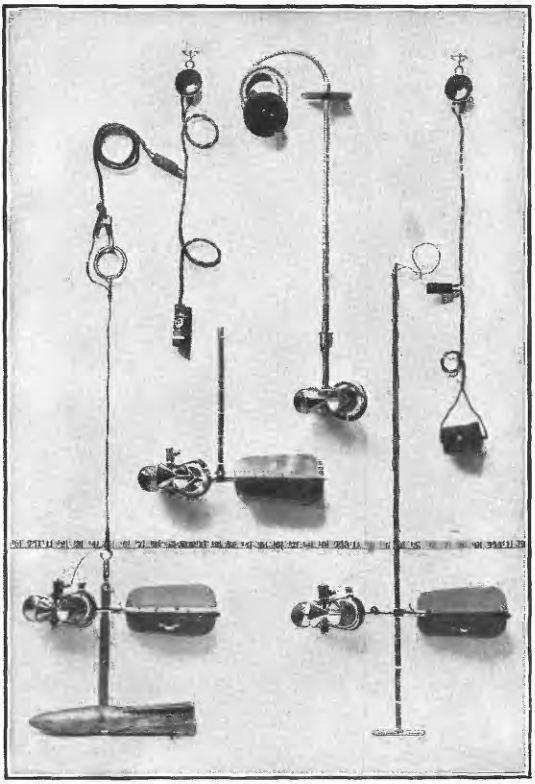
The accuracy of stream-flow data depends primarily (1) on the permanency of the stage-discharge relation and (2) on the accuracy of observation of stage, measurements of flow, and interpretation of records.

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

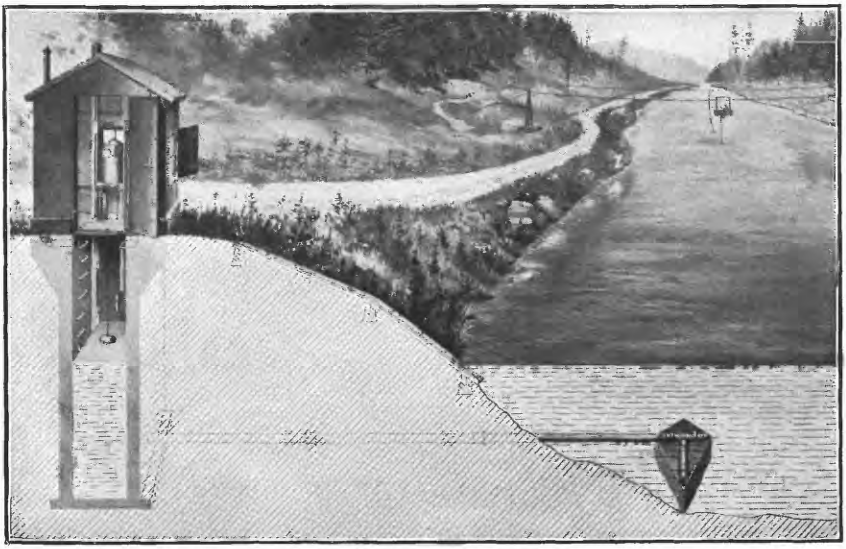
For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference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

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

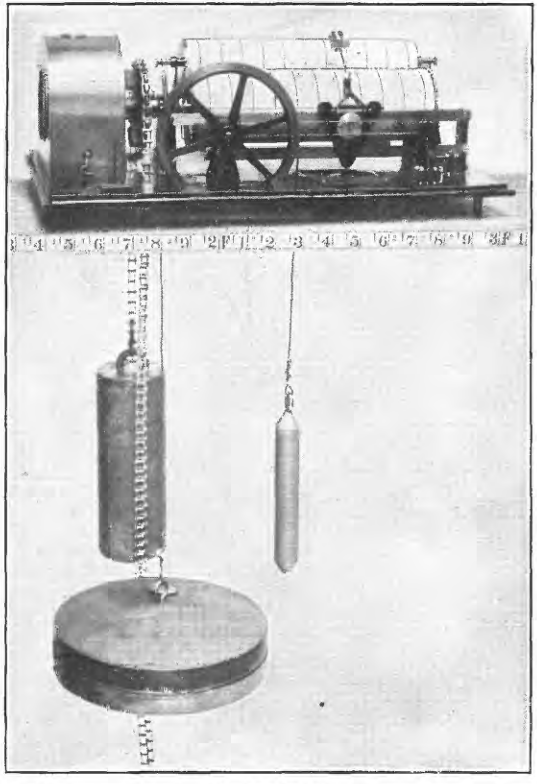
[1] For a more detailed discussion of the accuracy of stream-flow data see Grover, N. C., and Hoyt, J. C., Accuracy of stream-flow data: U. S. Geol. Survey Water-Supply Paper 400, pp. 53-59, 1916.



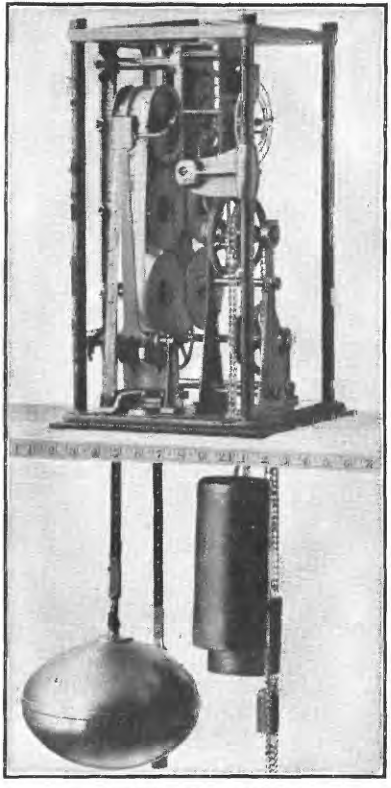
A. PRICE CURRENT METERS.



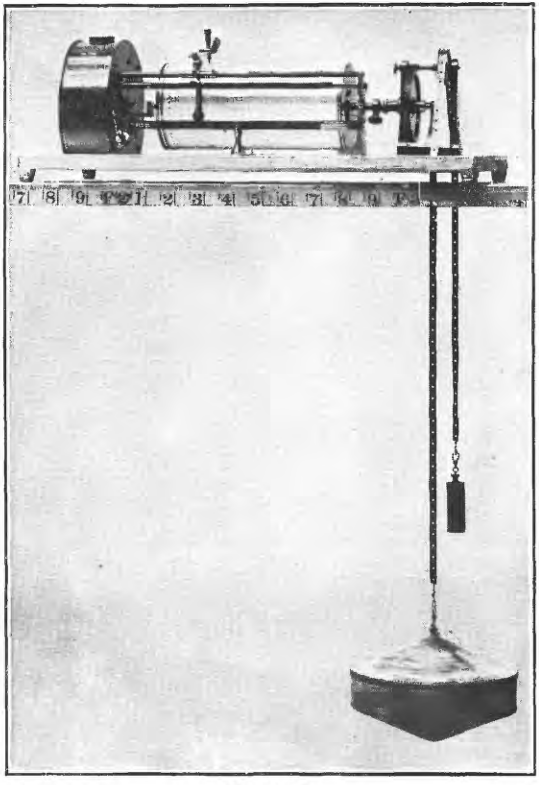
B. TYPICAL GAGING STATION.



A. STEVENS.



B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

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.

The work in Minnesota during the year ending September 30, 1917, was done with State cooperation 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 problem in this State.

The work was carried on in conjunction with the State Drainage Commission, E. V. Willard, acting State drainage engineer.

The work in Wisconsin during the year ending September 30, 1917, was done in cooperation with the Railroad Commission of Wisconsin, C. M. Larson, chief engineer, and at certain stations with the following organizations: Menominee & Marinette Light & Traction Co., Edward Daniell, general manager (Menominee River below Koss, Mich.); United States Army Engineer Corps (Wolf River at New London) and Fox River at Rapide Croche Dam; United States Indian Office (Wolf River at Keshenas).

The station on Little Calumet River at Harvey, Ill., was maintained in cooperation with the State of Illinois through the Rivers and Lakes Commission until June 30, 1917, and the Division of Waterways of the Department of Public Works, after that date, and with the sanitary district of Chicago.

The gage reader for Huron River at Flat Rock, Mich., was paid by the Eastern Michigan Edison Co., Washtenaw division, Ann Arbor, Mich.

Work in the State of New York has been conducted under cooperative agreements with the State engineer and surveyor, and since July 1, 1911, with the division of inland waters of the State Conservation Commission as provided by an act of the State legislature.

The water-stage recorder on Genesee River at Rochester, N. Y., was inspected by an employee of the Rochester Railway & Light Co. Water-stage recorder on Raquette River at Piercefield, N. Y., was inspected by an employee of the International Paper Co.

The work in Vermont has been carried on in cooperation with the the State of Vermont, Horace F. Graham, governor, and Herbert M. McIntosh, State engineer, and at certain stations in cooperation with the following organizations and individuals: Vermont Marble Co. (Otter Creek at Middlebury); the department of civil engineering of Norwich University (Dog River at Northfield); Charles T. Middlebrook, consulting engineer, Albany, N. Y. (Green River at Garfield), Newport Electric Light Co. (Clyde River at West Derby).

DIVISION OF WORK.

Data for stations in the Lake Superior and Lake Michigan drainage basins in Minnesota and Wisconsin were collected and prepared for publication under the direction of W. G. Hoyt, district engineer, assisted by S. B. Soulé, H. C. Beckman, E. L. Williams, R. B. Kilgore, F. W. Huels, and J. P. Schwada.

Data for stations in Lake Michigan drainage basins in Illinois were collected and prepared for publication, under the general direction of W. G. Hoyt, district Engineer, by H. C. Beckman, assisted by A. M. Wahl, H. S. Wahl, and Marcia Towle.

For stations in the Lake Huron, the Lake Michigan, and the Lake Erie drainage basins in Michigan, data were collected and prepared for publication under the direction of A. H. Horton, district engineer; assisted by B. J. Peterson.

Data for stations in the St. Lawrence drainage basin in New York were collected and prepared for publication under the direction of C. C. Covert, district engineer, assisted by O. W. Hartwell, E. D. Burchard, A. H. Davison, J. W. Moulton, W. A. James, and Helen Kimmey.

Data for stations in Vermont were collected and prepared for publication under the direction of C. H. Pierce, district engineer, assisted by H. W. Fear, Hardin Thweatt, H. H. Khachadoorian, M. R. Stackpole, and Hope Hearn.

The manuscript was assembled by B. J. Peterson.

GAGING-STATION RECORDS.

STREAMS TRIBUTARY TO LAKE SUPERIOR.

POPLAR RIVER AT LUTSEN, MINN.

LOCATION.—In sec. 34, T. 60 N., R. 3 W., near post office of Lutsen, Cook County, about 750 feet above mouth of river and same distance below State highway bridge.

DRAINAGE AREA.—144 square miles.

RECORDS AVAILABLE.—August 22, 1912, to September 30, 1917, when station was discontinued. May 6 to November 4, 1911 (gage heights only), at point about 350 feet downstream from present site.

GAGE.—Vertical staff bolted to rock wall of right bank of stream, in pool between two distinct falls; read by C. A. A. Nelson. Gage used prior to August 22, 1912, was a vertical staff gage attached to stump on right bank opposite lower point of easterly of two islands that divide flow into three channels. No determined relation between the two gages.

DISCHARGE MEASUREMENTS.—Made by wading or from a boat about 500 feet below the gage.

CHANNEL AND CONTROL.—Crest of falls below gage constitutes control. Channel at this point is solid rock. Banks not subject to overflow. Point of zero flow, gage-height −0.35 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.72 feet at 6 p. m. June 19 (discharge, 756 second-feet); minimum stage recorded, 0.85 foot March 7–22 (discharge, 19 second-feet).

1912–1917: Maximum state recorded, 4.7 feet at 6 p. m. April 25, 1916 (discharge, 1,390 second-feet); minimum stage recorded, 0.80 foot January 4, February 8 and 13, 1913 (discharge, 18 second-feet).

ICE.—Stage-discharge relation not seriously affected by ice; open-channel rating curve assumed applicable.

REGULATION.—Flow in former years controlled to some extent by two dams above the station, the nearest being that of the National Paper & Pulp Co., 2½ miles above mouth of river, but it is believed that the flow for the last three years was entirely natural.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 18 and 1,040 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

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

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

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	35	79	36	24	20	20	23	190	280	240	75	39
2	34	78	34	24	20	20	23	228	280	228	62	42
3	34	75	34	24	20	20	23	280	240	215	53	42
4	34	71	34	24	20	20	24	295	190	179	58	42
5	33	70	32	24	20	20	28	295	168	159	114	42
6	31	70	32	24	20	20	30	325	190	265	97	48
7	30	70	33	24	20	19	33	360	360	378	92	48
8	29	70	36	24	20	19	37	378	360	325	114	49
9	28	70	36	24	20	19	43	360	295	265	159	49
10	27	67	36	23	20	19	50	360	240	215	146	44
11	27	66	35	23	20	19	71	342	202	168	126	39
12	27	66	34	23	20	19	83	342	202	168	103	42
13	26	65	34	23	20	19	73	325	190	159	89	50
14	25	62	33	23	20	19	61	325	168	150	78	60
15	25	60	32	22	20	19	53	325	146	143	71	55
16	48	58	32	22	20	19	47	325	139	146	65	49
17	86	55	30	22	20	19	61	310	252	129	59	47
18	59	53	30	22	20	19	70	295	470	114	53	44
19	59	49	29	22	20	19	79	295	695	113	47	44
20	86	47	29	22	20	19	108	280	645	114	42	60
21	79	44	28	22	20	19	134	252	600	106	38	62
22	71	43	27	22	20	19	150	215	510	99	36	55
23	65	43	27	21	20	20	159	202	395	89	48	49
24	59	42	27	21	20	20	159	190	325	80	102	43
25	55	40	27	21	20	20	150	168	325	78	100	37
26	58	40	25	21	20	20	136	159	325	71	83	35
27	65	38	25	20	20	20	146	150	295	61	66	34
28	67	38	25	20	.....	21	148	146	265	55	55	35
29	79	38	25	20	.....	21	150	134	240	49	46	37
30	83	36	25	20	.....	21	168	134	215	55	37	38
31	80	.....	24	20	.....	22	.....	215	.....	62	34	.....

Monthly discharge of Poplar River at Lutsen, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 144 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	86	25	49.8	0.346	0.40
November	79	36	56.8	.394	.44
December	36	24	30.5	.212	.24
January	24	20	22.3	.155	.18
February	20	20	20.0	.139	.14
March	22	19	19.6	.136	.16
April	168	23	84.0	.583	.65
May	378	134	265	1.84	2.12
June	695	139	307	2.13	2.38
July	378	49	151	1.05	1.21
August	159	34	75.7	.526	.61
September	62	34	45.3	.315	.35
The year	695	19	94.2	.654	8.88

WHITEFACE RIVER BELOW MEADOWLANDS, MINN.

LOCATION.—In sec. 26, T. 53 N., R. 19 W., in St. Louis County, half a mile below beginning of a decided rapids, 1½ miles below Duluth, Missabe & Northern Railway bridge; 2½ miles below highway bridge on line between secs. 14 and 23, T. 53 N., R. 19 W., at which station on Whiteface River at Meadowlands was located; 4 miles below mouth of Little Whiteface River, which enters from left, and 8 miles above confluence of Whiteface and St. Louis Rivers.

DRAINAGE AREA.—446 square miles.

RECORDS AVAILABLE.—April 28, 1912, to September 30, 1917, when station was discontinued. Records June 7, 1909, to Nov. 9, 1912, collected at the station at Meadowlands, 2½ miles upstream.

GAGE.—Chain gage attached to a horizontal timber fastened to two trees on left bank of river, near residence of A. A. Jochim; used for all readings since November 8, 1914; read by A. A. Jochim. Chain gage attached to a horizontal timber fastened to two trees on the same bank but 300 feet upstream from the present gage was used from April 28, 1912, to November 7, 1914. Present gage was set so as to read the same as the former one at a stage of 2.85 feet.

DISCHARGE MEASUREMENTS.—Made from the Duluth, Missabe & Northern Railway bridge or by wading near gage.

CHANNEL AND CONTROL.—Bed of stream consists of heavy gravel and rock; practically permanent. Right bank is rather low and is overflowed at extremely high stages; left bank high and not subject to overflow. A decided rapids a short distance below the gage constitutes the control. Another rapids, above the gage, is frequently obstructed by logs, but when there is sufficient water to carry them over this rapid they are generally carried also over the lower rapids, so that the control is seldom obstructed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.05 feet July 21 (discharge, 589 second-feet); minimum stage recorded, 1.98 feet at 7 p. m. September 26 (discharge, about 27 second-feet).

1909–1917: Maximum stage recorded, 12.0 feet April 21, 1916 (discharge, 5,880 second-feet); minimum stage recorded, 1.6 feet at 8.20 a. m. August 31, 1916 (discharge 15 second-feet). Open-water periods only; minimum flow probably much lower at times during the winter.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during the winter.

REGULATION.—Flow controlled to a large extent by logging dams above the stations. Operation of gates to these dams causes a fluctuation in stage of several feet at the gaging station.

ACCURACY.—Stage-discharge relation probably permanent except as affected by logs and ice. Two rating curves used, one, applicable October 1 to November 18, 1916, fairly well defined above 92 second-feet; the other, applicable April 15 to September 30, 1917, poorly defined throughout. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Mean daily gage height, as determined from two readings daily subject to some error on account of rather rapid fluctuation in stage occasioned by regulation of flow for log driving. Open-water records at medium and high stage fair to good; low-water records subject to error.

Discharge measurements of Whiteface River below Meadowlands, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 26[a]	S. B. Soulé	3.40	322
Sept. 15	R. B. Kilgore	2.47	68

[a] Made from Duluth, Missabe & Northern Railway bridge.

Daily discharge, in second-feet, of Whiteface River near Meadowlands, Minn., for period Aug. 29, 1916, to Sept. 30, 1917.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1916.			1916—Contd.			1916—Contd.		
1		78	11		239	21		254
2		74	12		254	22		196
3		82	13		254	23		196
4		65	14		254	24		196
5		67	15		320	25		210
6		79	16		338	26		224
7		117	17		338	27		196
8		196	18		286	28		170
9		224	19		270	29	117	146
10		224	20		254	30	136	136
						31	43	

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.								
1	108	170		195	144	93	168	93
2	78	183		122	74	195	254	102
3	117	210		156	93	224	239	102
4	100	210		394	144	84	195	156
5	117	183		394	182	93	182	93
6	117	196		286	112	239	168	93
7	108	183		476	182	133	182	84
8	108	146		320	78	112	210	93
9	108	196		270	82	144	286	70
10	100	183		224	144	182	254	133
11	100	210		168	133	102	224	84
12	100	210		93	144	102	254	78
13	91	108		60	156	156	210	68
14	85	108		93	210	156	210	73
15	82	183	144	122	82	102	168	82
16	86	85	144	82	84	224	168	102
17	91	84	168	112	133	122	133	84
18	92	71	182	71	112	144	133	73
19	73		195	84	122	102	112	59
20	84		286	112	168	270	112	46
21	117		434	102	112	520	82	35
22	158		356	122	270	320	93	35
23	196		356	79	239	356	84	31
24	126		434	112	182	254	79	31
25	108		338	93	133	254	63	30
26	117		356	70	303	210	60	28
27	158		338	68	210	93	63	29
28	170		303	64	168	144	76	34
29	196		286	73	270	195	102	41
30	239		434	82	195	168	84	47
31	183			122		224	84	

NOTE.—Daily-discharge record in the above table, Aug. 29 to Sept. 30, 1916, supersedes that published in Water-Supply Paper 434, p. 16. Gage-height observations, Nov. 19 to Apr. 14, discontinued because of ice.

Monthly discharge of Whiteface River below Meadowlands, Minn., for the period Aug. 1, 1916, to Sept. 30, 1917.

[Drainage area, 446 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
August	136	46	81.4	0.183	0.21
September	338	67	198	.444	.50
October	239	73	120	.269	.31
November 1–18	210	71	162	.363	.24
1917.					
April 15–30	434	144	297	.666	.40
May	476	60	156	.350	.40
June	303	74	155	.348	.39
July	520	84	184	.413	.48
August	286	60	153	.343	.40
September	156	28	70.3	.158	.18

NOTE.—Records of monthly discharge for August and September, 1916, supersede those published in Water-Supply Paper 434, p. 16.

CLOQUET RIVER AT INDEPENDENCE, MINN.

LOCATION.—In sec. 26, T. 52 N., R. 17 W., at highway bridge at Independence, St. Louis County, just below small tributary entering from right.

DRAINAGE AREA.—698 square miles.

RECORDS AVAILABLE.—June 28, 1909, to September 30, 1917, when station was discontinued.

GAGE.—Chain gage attached to upstream handrail of bridge, near left bank of stream; read by Theodore Haakensen. Gage used prior to October 13, 1915, was a vertical staff attached to upstream end of an old log bulkhead, immediately under the bridge and at the left bank.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading about one-fourth mile below gage.

CHANNEL AND CONTROL.—Heavy gravel and rock; practically permanent. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.4 feet October 19 (discharge, 3,650 second-feet); minimum stage recorded, 4.08 feet April 16, 17, 18 (discharge, about 78 second-feet).

1909–1917: Maximum stage recorded, 9.58 feet June 1, 1911 (discharge, 6,010 second-feet); minimum stage recorded, 3.90 feet July 20, 21, 22, 1911 (discharge, 54 second-feet). The Great Northern Power Co. reported there was no discharge from Fish Lake and Island Lake reservoirs April 6–20 and December 1, 1915; discharge at Independence estimated at 10 second-feet.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during the winter. Since January, 1913, the determination of monthly mean discharge during winter periods has been based on discharge at outlet of Fish Lake reservoir on Cloquet River, in sec. 15, T. 52 N., R. 15 W., and from Island Lake reservoir on the Beaver River, in sec. 29, T. 52 N., R. 15 W.

REGULATION.—Cloquet River is used extensively for log driving, and the run-off from the greater part of the drainage area above Independence is controlled by logging dams. The operation of these dams causes rapid fluctuations in stage which may amount to several feet in 24 hours.

ACCURACY.—Stage-discharge relation permanent except as affected by ice and possibly by logs. Two rating curves used during year, both well defined between 128 and 4,690 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Mean daily gage height determined from two readings daily subject to considerable error on account of rapid fluctuation in stage occasioned by regulation of flow for log driving; records are therefore only roughly approximate to fair.

COOPERATION.—Records of flow from logging reservoirs December 9 to April 7 furnished by Great Northern Power Co., of Duluth.

Discharge measurements of Cloquet River at Independence, Minn., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 25[a]	S. B. Soulé	5.36	456
Sept. 14	R. B. Kilgore	5.05	304

[a] A few logs near left bank.

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

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	613	526	613					189	295	93	665	355
2	613	472	613					162	333	109	772	233
3	676	526	613					175	355	93	450	248
4	584	584	676				200	150	295	93	530	248
5	554	554	676					175	248	86	377	218
6	709	584	676					175	295	80	355	233
7	812	584	613					175	263	93	248	248
8	1,040	644	644				139	150	175	93	162	333
9	1,600	613					139	139	109	93	118	295
10	3,050	584					150	139	162	101	109	263
11	2,040	613					128	139	263	109	128	295
12	961	676					109	118	233	109	162	355
13	176	709					109	109	203	109	150	333
14	254	812					109	118	248	109	150	295
15	446	848			500		93	101	150	118	150	295
16	291	1,040		600		480	80	93	128	109	150	263
17	422	1,040					80	93	128	109	2,520	233
18	446	644					80	93	109	109	2,280	189
19	3,650	676	830				86	101	150	109	3,050	139
20	3,490	613					139	93	248	189	3,050	128
21	2,780	613					189	93	314	175	2,400	139
22	1,210	676					203	86	377	189	314	189
23	613	777					175	80	263	175	150	218
24	709	812					203	80	333	150	109	203
25	613	742					218	80	450	109	109	279
26	613	777					175	86	450	86	109	425
27	613	812					128	101	333	80	109	475
28	644	644					139	118	189	93	118	355
29	709	613					175	175	109	109	139	401
30	644	613					175	263	101	162	203	295
31	554	.....					.....	295	.....	203	425	.....

NOTE.—Stage-discharge relation affected by ice Dec. 9 to Apr. 7; gage readings discontinued; discharge estimated from records of discharge from Fish Lake and Island Lake reservoirs.

Monthly discharge of Cloquet River at Independence, Minn., for the year ending Sept. 30, 1917.

[Drainage area, 698 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,650	176	1,040	1.49	1.72
November	1,040	472	681	.976	1.09
December	.....	.....	781	1.12	1.29
January	.....	.....	600	.860	.99
February	.....	.....	500	.716	.75
March	.....	.....	480	.688	.79
April	.....	80	154	.221	.25
May	295	80	134	.192	.22
June	450	101	244	.350	.39
July	203	80	118	.169	.19
August	3,050	109	637	.913	1.05
September	475	128	273	.391	.44
The year	3,650	80	471	.675	9.17

BRULE RIVER NEAR BRULE, WIS.

LOCATION.—About sec. 26, T. 48 N., R. 10 W., at Brule Outing Club, Douglas County, 4½ miles downstream from Brule and 9 miles above mouth of river.

DRAINAGE AREA.—162 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—March 19, 1914, to February 28, 1917, when station was discontinued.

GAGE.—Vertical staff; low-water section, reading from 0 to 7.9 feet, fastened to downstream side of Brule Outing Club boat landing; high-water section, reading from 8.0 to 9.9 feet, fastened to tree on shore end of landing; read by Charles Leppanen.

DISCHARGE MEASUREMENTS.—Made from a boat held in place by a wire across the river below the gage, or by wading. All measurements are made about 200 feet below gage section.

CHANNEL AND CONTROL.—Bed composed of gravel. One channel at all stages. Control formed by head of rapids below gage. Banks wooded; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.18 feet October 21 (discharge, 220 second-feet); minimum discharge, February 28, 134 second-feet (determined by current-meter measurement).

1914–1917: Maximum stage recorded, 6.2 feet April 21, 1916 (discharge, 1,490 second-feet); minimum stage recorded, 2.75 feet at 7 a. m. March 20, 1914 (discharge, 115 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 145 and 1,370 second-feet. Gage read once daily, to quarter-tenths. Daily discharge ascertained by applying daily gage height to rating table, except for periods when stage-discharge relation was affected by ice, for which periods it was obtained by applying to rating curve 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.

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

[Made by R. B. Kilgore.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 27[a]	4.62	207
Jan. 26[a]	4.08	136
Feb. 28[a]	4.23	134

[a] Complete ice cover.

Daily discharge, in second-feet, of Brule River near Brule, Wis., for the period Oct. 1, 1915, to Feb. 28, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Day.	Oct.	Nov.	Dec.	Jan.	Feb.
1	170	195	170			16	170	180	145		
2	170	195	170			17	170	180	145		
3	170	195	170			18	170	175	145		
4	170	195	170			19	195	175	145		
5	170	195	170			20	220	170	145		
6	170	195	170			21	220	170	145		
7	170	195	170			22	208	170	160		
8	170	195	170	175	135	23	195	170	170	140	135
9	170	195	170			24	195	170	170		
10	170	195	170			25	195	170	180		
11	170	195	170			26	195	170	195		
12	170	195	170			27	195	170	205		
13	170	190	160			28	195	170	205		
14	170	185	160			29	195	170	195		
15	170	185	145			30	195	170	195		
						31	195		195		

NOTE.—Stage-discharge relation affected by ice Nov. 12 to Feb. 28, when station was discontinued.

Monthly discharge of Brule River near Brule, Wis., for the period Oct. 1, 1916, to Feb. 28, 1917.

[Drainage area 162 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	220	170	183	1.13	1.30
November	195	170	183	1.13	1.26
December	205	145	169	1.04	1.20
January			157	.969	1.12
February			135	.833	.87

BAD RIVER NEAR ODANAH, WIS.

LOCATION.—In sec. 25, T. 47 N., R. 3 W., 8 miles upstream from Odanah, Ashland County, 12 miles above mouth. Potato River enters from right about 8 miles above station.

DRAINAGE AREA.—607 square miles (measured on map issued by Wisconsin Geological & Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 31, 1914, to September 30, 1917.

GAGE.—Stevens continuous water-stage recorder, installed March 31, 1915, over a wooden well, just above first falls above the mouth of river. A Gurley water-stage recorder at the same site was used July 31, 1914, to March 31, 1915.

DISCHARGE MEASUREMENTS.—Made from a cable about 700 feet upstream from the gage.

CHANNEL AND CONTROL.—Bed of channel is sand and gravel. Rock outcrops at the beginning of rapids about 200 feet below the gage form a permanent control. During log-driving periods logs may collect on the outcrop and cause backwater at the gage. Right bank high and not subject to overflow; left bank of medium height and may be overflowed by extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.05 feet at 9 a. m. April 21 (discharge, 4,060 second-feet); minimum discharge somewhat less than 90 second-feet, in February.

1914–1917: Maximum stage recorded, 6.66 feet at 1 a. m. April 22, 1916 (discharge, 12,200 second-feet); minimum discharge occurred in February, 1917.

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

REGULATION.—A number of small reservoirs are operated during the early spring and summer as an aid to log driving. During such periods the stage may fluctuate rapidly.

ACCURACY.—Stage-discharge relation fairly permanent except when affected by ice. Rating curve well defined between 80 and 7,270 second-feet; extended above 7,270 second-feet and may be subject to considerable error. Operation of water-stage recorder only fairly satisfactory from October 1 until ice formed; record continuous from April 16 to September 30. Daily discharge October 1 to April 15 ascertained by applying to rating table mean daily gage height obtained by planimeter from recorder graph except for the following periods: October 6–12 and October 2 to November 15, discharge was estimated from records of flow in adjoining drainage basins; December 14 to April 15 (stage-discharge relation affected by ice), discharge determined from current-meter measurements and comparison with records of flow of streams in adjacent drainage basins; discharge April 16 to September 30 obtained by discharge integrator. Open-water records good except those based on estimates, which are fair; winter records roughly approximate.

Discharge measurements of Bad River near Odanah, 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. 10 [a]	1.58	72	Mar. 2 [a]	1.78	92
Jan. 27 [a]	1.76	90	May 11	2.28	1,270

[a] Complete ice cover.

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

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	354		236					2,160	1,820	680	300	250
2	311		230					2,120	1,760	540	280	230
3	258		230					2,290	1,390	460	250	210
4	241		230					2,400	1,450	460	245	195
5	264		236					1,930	1,690	410	245	195
6			219					1,840	1,490	670	230	190
7			253					1,620	1,920	1,140	200	190
8		270	258			95	400	1,570	2,420	1,050	220	190
9	250		219					1,460	1,980	890	250	190
10			183					1,340	1,590	680	275	190
11			180					1,240	1,210	580	265	190
12			175					1,120	1,030	530	245	185
13	305		160					1,050	790	540	240	190
14	400		150					980	660	410	230	190
15	435		140					890	610	390	220	250
16	435	275	135	95	90		700	860	510	380	215	300
17	435	305	130				1,040	830	470	290	205	305
18	456	275	130				1,430	840	450	280	200	305
19	470	275	125				2,010	750	620	280	200	300
20		269	120				2,900	720	1,120	255	200	270
21		247	120				3,340	680	1,100	250	200	250
22		253	115				2,800	605	880	250	200	240
23		253	110			130	2,170	580	770	280	195	220
24		241	105				1,830	490	640	650	195	210
25	260	219	100				1,710	470	650	840	240	195
26		198	100				1,500	420	910	650	285	195
27		264	95				1,420	420	930	450	295	210
28		264	95				1,690	390	840	350	305	260
29		253	95		.....		1,880	380	840	290	305	280
30		241	95		.....		2,010	390	730	240	290	295
31		.....	95		.....		.....	810	.....	250	270	.....

NOTE—Gage not in operation Oct. 6–12, Oct. 20 to Nov. 15. Stage-discharge relation affected by ice Dec. 12 to Apr. 15.

Monthly discharge of Bad River near Odanah, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 607 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October			298	0.491	0.57
November			263	.433	.48
December	258		157	.259	.30
January			95	.157	.18
February			90	.148	.15
March			109	.180	.21
April	3,340		1,150	1.89	2.11
May	2,400	380	1,090	1.80	2.08
June	2,420	450	1,110	1.83	2.04
July	1,140	240	497	.819	.94
August	305	195	242	.399	.46
September	305	185	229	.377	.42
The year	3,340		444	.731	9.94

STREAMS TRIBUTARY TO LAKE MICHIGAN.

MENOMINEE RIVER BELOW KOSS, MICH.

LOCATION.—In sec. 5, T. 33 N., R. 23 E., at "Grand Rapids," about 4 miles below Koss, Marinette County, Mich., and 3 miles west of Ingalls, Mich. Little Cedar River, draining an area entirely in Michigan, enters from the left about half a mile below the station.

DRAINAGE AREA.—3,790 square miles.

RECORDS AVAILABLE.—July 1, 1913, to September 30, 1917.

DISCHARGE.—The flow is computed by the Menominee & Marinette Light & Traction Co., of Menominee, Mich., as follows: Each hour the load on the generators is noted and gage heights are read of the head and tail water to determine the head on the spillway of the dam and the acting head on the turbines. The flow through the turbines for each hour is taken from a table giving the discharge corresponding to load and head. The flow over the spillway is taken from a table computed from a weir formula. When water is wasted through the gates the magnitude and duration of the gate openings are noted and the quantity wasted is determined from computed tables. The sum of the hourly flow through the turbines and over the spillway, plus the quantity wasted through the gates, divided by the number of seconds in 24 hours, gives the average discharge in second-feet for the day. No account is taken of the water passing through the exciter turbine, nor waste over the "trash gate" at the power house. This quanity is, however, relatively small.

EXTREMES OF DISCHARGE.—Maximum daily discharge recorded during year, 13,800 second-feet April 24; minimum daily discharge recorded, 1,550 second-feet February 21.

1913–1917: Maximum daily discharge recorded, 23,200 second-feet, April 23 and 25, 1916; minimum daily discharge recorded, 1,000 second-feet, June 14, 1914.

REGULATION.—Above the station are the following power plants: Sturgeon Falls, owned by Penn. Iron Mining Co., 50 miles; Little Quinnesec, owned by Kimberly Clark Co., 57 miles; Upper Quinnesec, owned by Oliver Iron Mining Co., 62 miles; Twin Falls, owned by Peninsular Power Co. With the exception of the Kimberly Clark dam at Little Quinnesec, the dams furnish power for utility and mining uses, so that the flow past the dams is comparatively uniform. The Kimberly Clark dam is used for paper mills and regulates the flow on Sundays and holidays. The effect of this dam is felt at the stations generally on Tuesdays. The monthly flow should represent the natural flow.

ACCURACY.—No current-meter measurements have been made by the Survey engineers at this plant, but records of measurements made at Koss, Mich., during the year ending September 30, 1914, show a close comparison with the discharge as determined at the power house.

COOPERATION.—Daily discharge records furnished monthly by Edward Daniell, general manager of the Menominee & Marinette Light & Traction Co.

Daily discharge, in second-feet, of Menominee River below Koss, Mich., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	7,670	7,640	4,830	2,070	1,910	1,880	3,970	11,000	4,900	5,870	2,160	3,140
2	6,520	8,130	4,500	2,080	1,860	1,570	4,090	11,300	5,460	5,310	2,030	3,320
3	6,370	7,890	4,200	2,370	1,850	1,710	4,820	11,600	5,290	4,580	2,180	3,000
4	4,740	7,770	4,600	2,450	1,840	1,603	5,140	11,600	5,530	5,000	2,280	2,150
5	4,260	7,330	5,150	2,440	1,780	1,730	5,640	11,100	6,900	4,350	2,330	2,520
6	3,910	6,690	4,480	2,510	1,670	1,930	5,560	10,600	7,130	4,050	2,400	2,980
7	3,830	6,420	4,220	2,400	1,820	1,860	5,890	9,790	9,200	4,510	2,320	2,980
8	3,560	5,660	4,190	2,290	2,050	1,970	6,280	10,500	10,300	2,960	2,880	2,790
9	2,820	5,750	3,910	2,400	1,850	1,880	6,810	8,890	11,600	3,750	3,680	2,850
10	3,390	6,820	3,180	2,320	1,940	1,790	7,220	9,770	13,000	3,340	3,770	2,370
11	3,010	7,590	2,380	2,260	1,810	2,110	7,660	9,680	12,100	2,780	3,560	2,110
12	3,100	7,820	2,200	2,210	1,760	1,940	7,340	7,850	10,900	3,070	3,600	2,100
13	3,180	7,520	2,380	1,930	1,720	1,760	7,490	7,590	9,210	3,250	3,400	2,300
14	3,340	6,860	2,470	2,250	1,720	1,920	7,651	7,250	8,150	3,370	3,960	2,550
15	3,840	5,220	2,480	1,840	1,840	1,910	7,160	7,340	6,900	3,030	3,840	3,040
16	4,560	3,610	2,430	1,770	1,900	1,840	6,230	7,180	6,480	3,040	3,360	3,440
17	4,660	3,460	2,590	1,900	1,880	1,770	6,190	7,150	6,020	3,260	3,140	3,720
18	4,850	4,130	2,270	1,940	1,970	1,980	5,460	7,210	5,600	2,860	3,000	4,040
19	5,150	4,720	2,030	1,880	1,770	1,820	6,560	7,220	4,650	2,720	2,890	3,760
20	5,420	5,290	2,440	1,650	1,710	1,750	8,900	7,760	4,920	2,600	2,870	3,590
21	5,350	5,310	2,460	1,980	1,550	1,820	10,800	7,420	5,410	3,310	2,650	3,540
22	5,130	5,010	2,480	1,610	1,570	2,030	11,000	7,430	6,280	2,620	2,920	3,430
23	5,150	5,220	2,460	1,560	1,720	2,230	12,300	6,770	6,450	2,540	3,410	2,960
24	4,990	5,620	2,570	1,660	1,740	2,190	13,800	6,900	6,220	2,890	2,960	2,685
25	4,860	2,380	2,120	1,880	2,080	2,550	13,700	6,530	5,570	2,730	2,820	2,660
26	5,310	2,260	2,360	1,910	1,780	2,680	11,900	5,460	4,650	2,710	2,500	2,440
27	6,380	3,070	2,400	1,990	1,780	2,880	10,900	5,280	5,810	2,430	2,980	2,430
28	6,140	3,470	2,420	2,010	1,860	3,180	10,200	4,730	7,320	2,110	2,590	2,570
29	6,830	4,240	2,410	1,960	.....	3,320	10,200	4,840	7,140	2,580	2,860	2,460
30	6,910	5,020	2,380	1,970	.....	3,680	10,200	4,530	6,500	1,970	2,743	2,710
31	7,430	.....	2,230	1,920	.....	3,730	.....	4,350	.....	1,990	3,090	.....

Monthly discharge of Menominee River below Koss, Mich., for the year ending Sept. 30, 1917.

[Drainage area, 3,790 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	7,670	2,820	4,920	1.30	1.50
November	8,130	2,260	5,600	1.48	1.65
December	5,150	2,030	3,010	.794	.92
January	2,510	1,560	2,050	.541	.62
February	2,080	1,550	1,810	.478	.50
March	3,730	1,570	2,160	.570	.66
April	13,800	3,970	8,040	2.12	2.36
May	11,600	4,350	7,950	2.10	2.42
June	13,000	4,650	7,190	1.90	2.12
July	5,870	1,970	3,290	.868	1.00
August	3,960	2,030	2,940	.776	.89
September	4,040	2,100	2,890	.763	.85
The year	13,800	1,550	4,320	1.14	15.49

NOTE.—Monthly and yearly discharge computed by engineers of the United States Geological Survey from records of daily discharge furnished by Menominee & Marinette Light & Traction Co.

PINE RIVER NEAR FLORENCE, WIS.

LOCATION.—In secs. 23 and 26, T. 39 N., R. 17 E., at highway bridge 8 miles southwest of Florence, Florence County, and 12 miles above mouth of river. Popple River enters from right about 200 feet above station.

DRAINAGE AREA.—488[a] square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 22, 1914, to September 30, 1917.

GAGE.—Chain gage fastened to guard rail on upstream side of bridge; read by William Taft.

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

CHANNEL AND CONTROL.—Coarse gravel and stones. Left bank high; not subject to overflow; extremely high water may overflow right bank around approach to bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.90 feet at noon, June 8 (discharge, 2,460 second-feet); minimum estimated discharge 135 second-feet in January and February.

1914–1917: Maximum recorded stage, 9.25 feet at noon, April 23, 1916 (discharge, about 4,520 second-feet); minimum recorded stage, 1.6 feet, September 6 and 7, 1915 (discharge, about 118 second-feet).

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

REGULATION.—River not used for log driving during year. Gates of a dam below remained open throughout the year.

ACCURACY.—Stage-discharge relation practically permanent; rating curve fairly well defined between 200 and 418 second-feet and well defined between 418 and 1,540 second feet; extension of curve below 200 and above 1,540 second-feet may be subject to considerable error. Gage read once daily to half-tenths. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained from results of current-meter measurements, observer's notes, and weather records. Open-water records good except for extreme high and low stages; winter records fair.

Discharge measurements of Pine River near Florence, 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. 1[b]	2.90	177	Mar. 5[a]	3.22	173
30[b]	3.00	179	June 25	4.30	1,060

[a] Supersedes figure published in previous reports. Revision based on the fact that Kentuck Lake discharges into Brule River, rather than into Pine River.

[b] Complete ice cover.

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

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	690	797	518	175	175	170	745	1,380	905	905	169	287
2	655	761	518	175	160	170	795	1,330	869	869	196	287
3	620	725	484	175	150	155	850	1,290	905	833	256	287
4	552	690	451	190	145	140	905	1,290	941	833	352	303
5	518	690	418	200	155	170	940	1,330	1,010	797	385	319
6	451	690	418	200	165	175	975	1,380	1,430	761	402	319
7	385	725	385	200	180	180	995	1,430	1,780	690	418	303
8	385	761	385	200	190	185	1,010	1,430	2,460	655	451	287
9	385	761	385	200	195	190	1,010	1,480	2,380	620	451	319
10	418	797	370	200	200	195	975	1,540	2,240	620	418	319
11	418	797	370	200	180	200	940	1,540	2,100	552	385	352
12	451	761	350	195	180	210	725	1,600	1,840	518	352	368
13	451	725	335	195	165	215	638	1,330	1,720	451	352	385
14	468	690	320	195	150	220	552	1,290	1,540	418	336	434
15	484	690	305	210	150	225	484	1,250	1,430	385	319	484
16	518	690	305	220	150	235	468	1,210	1,210	352	319	451
17	518	725	285	220	160	250	451	1,210	1,130	319	287	418
18	552	760	270	220	145	255	588	1,170	1,090	303	240	418
19	552	760	255	210	140	265	725	1,130	1,010	287	225	385
20	586	725	225	200	140	275	1,090	1,050	941	287	256	368
21	620	690	210	160	140	285	1,330	977	905	256	256	352
22	690	655	210	160	135	305	1,380	905	869	256	272	319
23	690	620	195	160	150	335	1,290	869	761	256	272	319
24	725	552	195	150	160	350	1,250	833	725	240	287	319
25	761	518	195	135	155	385	1,210	797	690	240	287	319
26	797	552	180	140	170	420	1,130	725	655	225	287	336
27	869	586	180	145	180	470	1,130	1,050	655	225	256	352
28	905	586	180	155	175	520	1,090	1,010	690	196	256	352
29	905	552	180	165	.....	585	1,290	977	690	169	256	368
30	869	552	180	180	.....	640	1,330	941	725	169	272	368
31	833	.....	180	180	.....	690	.....	905	.....	169	287	.....

NOTE.—Stage-discharge relation affected by ice Nov. 13-21, and Dec. 10 to April 11; gage not read Apr. 13, 16, and 18; discharge interpolated.

Monthly discharge of Pine River near Florence, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 488 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	905	385	604	1.24	1.43
November	797	518	686	1.41	1.57
December	518	180	304	.623	.72
January	220	135	184	.377	.43
February	200	135	162	.332	.35
March	690	140	292	.598	.69
April	1,380	451	943	1.93	2.15
May	1,600	725	1,180	2.42	2.79
June	2,460	655	1,210	2.48	2.77
July	905	169	447	.916	1.06
August	451	169	308	.631	.73
September	484	287	350	.717	.80
The year	2,460	135	557	1.14	15.49

PIKE RIVER AT AMBERG, WIS.

LOCATION.—In sec. 15, T. 35 N., R. 21 E., at Chicago, Milwaukee & St. Paul Railway bridge half a mile south of Amberg, Marinette County, immediately below junction of two branches of Pike River, and about 11 miles above mouth.

DRAINAGE AREA.—240 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale 1 inch= 6 miles).

RECORDS AVAILABLE.—February 26, 1914, to September 30, 1917.

GAGE.—Chain gage fastened to guard rail on upstream side of bridge; read by Frank Bunce.

DISCHARGE MEASUREMENTS.—Made by wading or from a highway bridge a quarter of a mile downstream from the bridge to which the gage is attached.

CHANNEL AND CONTROL.—Solid rock and some loose granite boulders. Bed permanent but very rough at gage. Banks medium high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.5 feet, 8.30 a. m. June 9 (discharge 1,120 second-feet); estimated minimum discharge, 120 second-feet, during January and February.

1914–1917: Maximum stage recorded, 4.65 feet at 8.10 p. m. July 14, 1914 (discharge 1,200 second-feet); minimum stage recorded, 1.55 feet September 7, 1915 (discharge, 109 second-feet).

REGULATION.—No dams are at present in operation above this station, flow natural.

ACCURACY.—Stage-discharge relation permanent except when affected by ice. Rating curve well defined between 180 and 1,120 second-feet. Gage read to quarter-tenths, once daily. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was ascertained from current meter measurements, observer's notes, and weather records. Open-water records excellent except for extremely high stages, for which they are good. Records for winter period fair.

Discharge measurements of Pike River at Amberg, 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. 2[a]	2.39	180	Mar. 6[a]	2.10	168
Jan. 31[a]	2.36	173	June 26	2.56	371

[a] Incomplete ice cover at control.

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

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	620	582	273	180	150	150	476	658	364	333	192	185
2	546	546	244	180	120	145	444	698	396	318	204	169
3	476	510	273	180	120	165	546	658	428	303	192	176
4	396	460	288	170	125	185	698	620	476	288	169	169
5	364	428	273	170	125	175	658	546	582	273	180	162
6	333	396	273	160	120	165	658	493	620	258	185	177
7	333	364	288	160	125	180	658	428	862	273	176	192
8	318	364	288	160	130	195	658	396	1,080	258	288	180
9	303	396	288	170	120	210	658	380	1,120	244	318	180
10	303	428	199	170	125	230	620	364	904	230	333	176
11	288	412	244	160	135	220	582	348	778	217	288	169
12	273	380	273	160	140	210	582	333	698	217	244	158
13	318	333	230	150	140	215	582	318	546	217	364	180
14	273	244	217	140	140	220	510	318	493	217	380	244
15	303	273	215	130	145	235	460	303	428	204	380	258
16	303	303	230	130	150	250	428	303	380	204	333	258
17	318	333	215	120	165	240	380	303	333	204	318	244
18	364	333	215	120	180	230	412	318	333	204	258	230
19	348	348	215	130	160	240	476	333	333	192	244	204
20	348	318	230	130	145	245	582	348	318	217	244	192
21	364	303	215	120	145	290	582	348	318	217	258	176
22	380	303	215	120	150	340	582	318	303	204	244	158
23	364	288	230	120	150	285	582	303	303	192	237	169
24	348	303	245	130	150	230	510	303	318	180	230	162
25	396	244	260	140	155	440	476	288	303	180	204	158
26	510	303	260	140	155	645	412	288	364	180	204	162
27	546	348	260	150	150	725	460	273	380	192	204	158
28	546	318	245	150	150	610	546	258	348	180	348	158
29	510	318	230	160	.....	675	582	258	318	169	348	162
30	546	273	205	170	.....	698	620	244	318	158	199	158
31	582	.....	180	175	.....	510	.....	303	.....	148	180	.....

NOTE.—Stage-discharge relation affected by ice Dec. 15, to Mar. 29; gage not read Aug. 23 and Sept. 6; discharge interpolated.

Monthly discharge of Pike River at Amberg, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 240 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	620	273	394	1.64	1.89
November	582	244	358	1.49	1.66
December	288	180	242	1.01	1.16
January	180	120	150	.625	.72
February	180	120	142	.592	.62
March	725	145	308	1.28	1.48
April	698	412	547	2.28	2.54
May	698	244	376	1.57	1.81
June	1,120	303	492	2.05	2.29
July	333	148	222	.925	1.07
August	380	169	256	1.07	1.23
September	258	158	184	.767	.86
The year	1,120	120	306	1.28	17.33

PESHTIGO RIVER AT HIGH FALLS, NEAR CRIVITZ, WIS.

LOCATION.—In sec. 1, T. 32 N., R. 18 E., at High Falls, near Crivitz, Marinette County, about a quarter of a mile downstream from power house of Wisconsin Public Service Co., 1 mile upstream from Thunder River (coming in from the right), and 15 miles by road northwest of Crivitz.

DRAINAGE AREA.—520[1] square miles (measured on Wisconsin Geological & Natural History Survey map, edition of 1911; scale: 1 inch=6 miles).

RECORDS AVAILABLE.—October 1, 1912, to September 30, 1917.

GAGE.—Barrett and Lawrence water-stage recorder set over a wooden well about 15 feet from the left bank and quarter of a mile downstream from power house; well is protected from floating logs by a large boulder.

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

CHANNEL AND CONTROL.—Banks at control and measuring section are high and not subject to overflow. Control for gage at low stages is a small gravel riffle about 50 feet downstream from the gage; apparently drowned out at medium and high stages, when control is probably formed by some point farther downstream.

EXTREMES OF DISCHARGE.—Maximum mean daily discharge during the year, 2,590 second-feet; minimum mean discharge, 104 second-feet January 7.

1912–1917: Maximum stage, from water-stage recorder, 7.2 feet, May 13, 1916 (discharge, 3,480 second-feet); minimum stage, 1.1 feet at 5 p. m. March 21, 1915 (discharge, 54 second-feet). Owing to artificial regulation extremes given do not represent the natural flow.

ICE.—Because of the relatively warm water in the large service reservoir ice does not form on the river in the vicinity of the gage; open-water rating curve used throughout year.

REGULATION.—Flow controlled by operation of the power plant. During log-driving seasons large and sudden fluctuations are caused by the operation of logging and sluice gates. The fluctuation due to changes in load are relatively small. The mean monthly flow does not represent the natural flow because of storage in the service reservoir.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curve well defined between 145 and 3,980 second-feet. During periods when recording gage was in operation discharge ascertained by averaging the results obtained by applying gage heights for hourly or other regular intervals to the rating table; for period when gage was not in operation (see footnote to table of daily discharge) discharge determined from power-plant records. From the data available the power-plant records are believed to be accurate within 5 per cent.

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

June 23, 1917: Gage height, 3.37 feet; discharge, 1,150 second-feet.

[1] Supersedes figure published in previous reports.

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

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,020	1,050	632	274	318	579	349	1,220	956	641	614	555
2	1,050	1,040	632	377	273	596	505	1,230	782	784	590	357
3	983	1,030	433	343	287	484	575	1,180	542	721	577	296
4	835	1,040	641	303	120	279	607	1,200	881	531	580	517
5	699	850	638	256	303	413	615	1,210	994	600	339	562
6	690	962	606	256	397	485	574	961	1,280	587	551	621
7	567	893	600	104	384	499	593	1,240	1,860	587	642	605
8	410	805	614	238	390	501	326	1,250	2,180	391	649	667
9	538	653	606	268	382	551	499	1,170	2,590	547	622	361
10	643	681	378	276	358	500	561	1,050	2,540	627	655	548
11	544	983	471	247	204	306	543	1,390	2,370	619	635	579
12	577	820	513	267	321	435	750	1,200	1,940	618	360	580
13	581	962	534	279	360	524	1,130	703	1,600	592	563	620
14	578	910	493	111	360	541	803	549	1,310	554	633	604
15	409	632	470	238	360	558	577	652	1,200	334	615	575
16	527	647	475	265	359	489	725	779	1,230	506	609	304
17	579	630	278	274	368	432	808	563	900	591	586	498
18	640	660	423	275	186	254	712	563	992	569	544	481
19	674	537	492	275	285	469	764	616	740	545	290	509
20	759	881	485	269	368	549	775	674	764	556	523	462
21	729	628	460	138	405	564	747	944	947	523	623	484
22	633	679	468	246	463	587	841	905	946	322	585	467
23	728	653	458	270	496	542	1,430	760	957	493	557	226
24	644	632	276	275	476	563	1,400	611	756	537	554	393
25	734	636	226	276	303	304	1,260	576	768	543	561	395
26	818	425	429	258	430	486	1,210	558	763	578	300	355
27	860	569	465	260	480	563	1,040	376	723	573	529	360
28	920	630	451	112	542	564	1,140	768	728	570	587	388
29	1,050	630	457	224	.....	539	1,140	691	785	351	563	431
30	1,220	465	462	256	.....	533	1,430	406	822	366	567	174
31	1,010	.....	274	296	.....	540	.....	877	.....	609	545	.....

NOTE.—Discharge based on power-plant records as follows: Oct. 18, 20, 25, 26, 31; Nov. 1, 5–9, 12–30; Dec. 1–31; Jan. 1–9, 11–18, 25–28; Feb. 2–7; Apr. 8–12, 25–26; May 3, 6–9, 13–17, 24, 29–31; June 5–12, 14–30; July 1–31; Aug. 1–31; Sept. 1–6, 9–10, 16–20, 23–27, 30. About 2 second-feet of seepage water enters the river below the gage but above the cable and is included in the published record.

Monthly discharge of Peshtigo River near Crivitz, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 520 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,220	409	731	1.41	1.63
November	1,050	425	754	1.45	1.62
December	641	226	479	.921	1.06
January	377	104	252	.485	.56
February	542	120	356	.685	.71
March	596	254	491	.944	1.09
April	1,430	326	814	1.57	1.75
May	1,390	376	867	1.67	1.92
June	2,590	542	1,190	2.29	2.56
July	784	322	547	1.05	1.21
August	655	290	553	1.06	1.22
September	667	174	466	.896	1.00
The year	2,590	104	626	1.20	16.33

OCONTO RIVER NEAR GILLETT, WIS.

LOCATION.—In sec. 34, T. 28 N., R. 18 E., at highway bridge 2½ miles southeast of Gillett, Oconto County, and about 27 miles above mouth of river.

DRAINAGE AREA.—678 square miles (measured on Wisconsin Geological and Natural History Survey Map, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—June 7, 1906, to March 30, 1909; January 6, 1914, to September 30, 1917.

GAGE.—Chain gage attached to iron railing on upstream side of bridge; read by Miss Nettie Gilbertson. Zero of gage used January 6, 1914, to September 30, 1917, is 4 feet above that of gage used June 7, 1906, to March 31, 1909.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Gravel; fairly permanent; left bank medium high and not subject to overflow; right bank may overflow during extreme flood stages and water flow around the end of the bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.7 feet, at 3.30 p. m. April 2 (discharge estimated, because of ice, 2,870 second-feet); estimated minimum discharge, 305 second-feet, January 24 to February 1.

1906–1917: Maximum stage recorded, 5.3 feet at 3.30 p. m. April 25, 1916 (discharge 3,220 second-feet); minimum open-water discharge, 95 second-feet January 3 and 6, 1907.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—A dam above the station stores water to float logs during the spring; except when this dam is in operation flow at the gage is natural.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 239 and 1,790 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating curve 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 flood stages, for which they are only fair; winter records fair.

Discharge measurements of Oconto River near Gillett, 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. 6 [a]	H. C. Beckman	2.78	421	Mar. 8 [a]	E. L. Williams	2.93	373
Feb. 6 [a]	E. L. Williams	2.79	358	June 21	R. B. Kilgore	2.02	770

[a] Complete ice cover.

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

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	930	1,290	870	470	305	335	2,790	1,570	670	1,430	362	515
2	930	1,290	780	470	325	330	2,870	1,570	780	2,630	362	492
3	900	1,290	725	445	325	330	2,090	1,570	840	1,290	424	492
4	900	1,290	725	445	340	325	2,320	1,570	1,020	960	424	468
5	752	1,220	725	425	340	320	2,090	1,500	1,020	960	424	540
6	752	1,220	780	425	360	325	1,790	1,430	1,220	698	424	515
7	725	1,160	840	405	360	330	1,790	1,160	1,430	565	424	515
8	725	1,160	780	405	360	365	1,570	1,290	1,860	670	468	515
9	615	1,160	725	380	360	405	1,500	1,160	2,160	670	1,160	515
10	615	1,160	698	380	360	405	1,430	1,090	2,160	615	615	515
11	615	1,160	492	380	360	405	1,430	1,020	2,320	590	565	515
12	698	1,020	468	360	360	405	1,430	960	2,160	565	615	468
13	670	1,160	468	360	360	405	1,430	930	1,790	565	615	515
14	642	1,160	425	360	350	415	1,430	870	1,790	565	670	540
15	642	960	425	360	340	425	1,430	870	1,360	515	670	615
16	725	780	380	340	340	435	1,290	840	1,290	515	780	615
17	615	725	380	340	340	445	1,290	780	1,640	515	780	615
18	590	900	380	340	340	455	1,220	725	1,290	540	725	615
19	590	1,020	380	340	340	460	1,290	752	992	515	670	565
20	725	960	405	340	340	465	1,290	780	840	492	698	565
21	752	900	425	325	340	470	1,360	810	780	468	670	515
22	752	752	470	325	340	505	1,360	840	780	424	515	515
23	725	840	515	325	340	540	1,220	810	780	446	515	492
24	725	840	565	305	340	735	1,220	810	810	424	515	492
25	780	900	565	305	340	930	1,220	752	615	424	468	468
26	960	900	565	305	360	1,160	1,290	752	752	424	468	468
27	960	565	540	305	380	1,430	1,430	670	698	403	468	468
28	1,020	670	515	305	365	1,790	1,500	670	725	382	424	446
29	1,360	810	515	305	.....	2,090	1,570	670	780	382	382	468
30	1,090	840	490	305	.....	2,390	1,570	670	1,500	382	565	424
31	1,160	.....	470	305	.....	2,630	.....	670	.....	362	515	.....

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Apr. 3.

Monthly discharge of Oconto River near Gillett, Wis., for the year ending Sept. 30, 1917.

[Drainage area 678 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,360	590	795	1.17	1.35
November	1,290	565	1,010	1.49	1.66
December	870	380	564	.832	.96
January	470	305	361	.532	.61
February	380	305	347	.512	.53
March	2,630	320	724	1.07	1.23
April	2,870	1,220	1,580	2.33	2.60
May	1,570	670	986	1.45	1.67
June	2,320	615	1,230	1.81	2.02
July	2,630	362	658	.971	1.12
August	1,160	362	561	.827	.95
September	615	424	516	.761	.85
The year	2,870	305	778	1.15	15.55

FOX RIVER AT RAPIDE CROCHE DAM, NEAR WRIGHTSTOWN, WIS.

LOCATION.—At Rapide Croche dam, in sec. 4, T. 21 N., R. 19 E., 2 miles upstream from Wrightstown, Brown County, 19 miles downstream from Lake Winnebago, and 20 miles upstream from mouth of river at Green Bay.

RECORDS AVAILABLE.—March 3, 1896, to September 30, 1917. Daily-discharge records for this station, 1896–1914, were published by the Wisconsin Railroad Commission in a report entitled "Water-power report to the Legislature, 1915." The records published in this report have since been found to be considerably in error and should not be used. See "Determination of flow."

DRAINAGE AREA.—6,150 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

DETERMINATION OF DISCHARGE.—The dam is owned and operated by the United States Army Engineers to aid navigation, and the flow is computed by the United States Army Engineers as follows: The dam is made of timber and is equipped with 4 needle sluice gates which are used only in times of high water. A vertical staff gage at the lower end of the canal leading to the lock and about a quarter of a mile below the dam is read five times daily at 7 a. m., 9 a. m., 12 noon, 3 p. m., and 6 p. m. The mean flow for the day is computed from a formula using the 5 gage heights for the day, assuming gradual changes in gage height between the readings, and weighting the different gage heights by elapsed time. Prior to 1917 determinations of daily discharge were based on tables derived from theoretical formulas for flow over a sharp-crested weir and through the sluice gates. During 1917 discharge measurements were made by engineers of the United States Geological Survey from a cable a short distance downstream from the dam. Seven measurements were made with the four sluices closed and eight with all sluices open. The measured discharge varied from 1,000 to 13,000 second-feet. Curves based on the discharge measurements show that the theoretical formulas gave results ranging from about 850 second-feet too small at low stages, with the sluices closed, to 250 second-feet too large at high stages, with all sluices open. The deficiency of amounts in the old records as published is due to the fact no allowance was made for leakage through the dam, which is now determined to be about 1,000 second-feet with water at the crest of the dam and all gates closed. Discharge measurements made by the United States Geological Survey in 1902 and 1903 at Wrightstown, about 2 miles below the dam, indicate that the leakage at the dam was apparently the same during 1902 and 1903 as at the present time. As Rapide Croche dam was built in 1878 and existed in 1902 as in 1917, it is considered necessary and proper to correct the old records for 1896–1917 to agree with the results of the current-meter measurements of 1917. The records published herewith are the old records corrected by means of the curves for 1917, each recomputation taking into consideration the relation between the old and new curves according to the number of sluice gates open. Corrections were applied to the semimonthly and monthly mean discharge. The yearly discharge is derived from the mean monthly discharge. The semimonthly and mean monthly discharge was computed by engineers of the office of the Army Engineer Corps at Milwaukee; the flow in second-feet per square mile, run-off depth in inches, and yearly means and totals were computed by engineers of the United States Geological Survey.

EXTREMES OF DISCHARGE.—Not determined. Information regarding the daily maximum and minimum may be obtained from the office of the Corps of Engineers, United States Army, Milwaukee, Wis.

REGULATION.—Flow regulated by Lake Winnebago, which has an area of 215 square miles, and also by dams between the outlet of Lake Winnebago and the station, the dams being operated for power development and to some extent in the interests of navigation. Under existing conditions, which, as regards storage, have been the same throughout the period covered by the records, the flow past the station is natural.

ACCURACY.—Though the accuracy of the records prior to 1902–1903 is somewhat doubtful it is believed that the records for entire period are good. See "Determination of discharge."

COOPERATION.—Records collected and monthly and semimonthly discharge computed by the United States Army Engineers from curves based on current-meter measurements made by engineers of the United States Geological Survey.

Discharge of Fox River at Rapide Croche dam, Wis., for years ending Sept. 30, 1896–1917.

[Drainage area, 6,150 square miles.]

Month.	Mean discharge, in second-feet.				Run-off (depth in inches on drainage area).
	Semimonthly.		Monthly.		
	First half.[a]	Second half.[b]	Mean.	Per square mile.	
1896.					
March	1,980	2,010	1,990	0.324	0.37
April	1,520	1,700	1,610	.262	.29
May	3,440	4,130	3,800	.618	.71
June	4,530	4,170	4,350	.707	.79
July	3,710	3,280	3,490	.567	.65
August	2,680	1,720	2,180	.354	.41
September	1,020	970	990	.161	.18
The period	.....	.....	.....	.....	.....
1896–97.					
October	1,600	2,020	1,820	.296	.34
November	2,510	2,950	2,730	.444	.50
December	3,390	2,790	3,080	.501	.58
January	3,400	3,500	3,450	.561	.65
February	3,360	3,590	3,470	.564	.59
March	3,050	3,740	3,410	.554	.64
April	5,910	7,300	6,600	1.07	1.19
May	4,900	4,350	4,620	.751	.87
June	3,830	3,990	3,910	.636	.71
July	3,920	3,800	3,860	.628	.72
August	3,210	1,980	2,570	.418	.48
September	1,330	1,830	1,580	.257	.29
The year	.....	.....	3,420	.556	7.56
1897–98.					
October	1,840	2,440	2,150	.350	.40
November	2,300	2,540	2,420	.393	.44
December	2,870	3,110	2,990	.486	.56
January	3,380	3,280	3,330	.541	.62
February	3,220	2,940	3,090	.502	.52
March	3,460	3,830	3,650	.593	.68
April	3,990	4,950	4,470	.727	.81
May	5,640	4,730	5,170	.841	.97
June	4,500	3,270	3,880	.631	.70
July	2,380	2,210	2,290	.372	.43
August	2,190	2,880	2,550	.415	.48
September	2,110	1,560	1,830	.298	.33
The year	.....	.....	3,150	.512	6.94
1898–99.					
October	1,590	2,270	1,940	.315	.36
November	2,870	3,010	2,940	.478	.53
December	3,060	2,760	2,910	.473	.55
January	2,770	2,490	2,630	.428	.49
February	2,950	2,630	2,800	.455	.47
March	2,640	3,280	2,970	.483	.56
April	4,150	4,420	4,280	.696	.78
May	6,310	6,690	6,510	1.06	1.22
June	5,570	7,350	6,460	1.05	1.17
July	4,710	3,930	4,310	.701	.81
August	2,990	2,170	2,570	.418	.48
September	1,740	1,720	1,730	.281	.31
The year	.....	.....	3,500	.569	7.73

[a] 15 days.

[b] Sixteenth to end of month.

Discharge of Fox River at Rapide Croche dam, Wis., for years ending Sept. 30, 1896–1917—Continued.

Month.	Mean discharge, in second-feet.				Run-off (depth in inches on drainage area).
	Semimonthly.		Monthly.		
	First half.	Second half.	Mean.	Per square mile.	
1899–1900.					
October	1,740	2,010	1,880	0.306	0.35
November	2,950	2,750	2,850	.463	.52
December	2,870	2,660	2,760	.449	.52
January	2,860	2,950	2,910	.473	.55
February	2,920	3,040	2,980	.485	.50
March	2,990	3,530	3,270	.532	.61
April	3,950	4,170	4,060	.660	.74
May	3,560	3,750	3,660	.595	.69
June	2,070	1,220	1,640	.267	.30
July	1,200	2,210	1,730	.281	.32
August	2,580	2,520	2,550	.415	.48
September	2,600	2,880	2,740	.446	.50
The year			2,750	.447	6.08
1900–1.					
October	4,830	6,610	5,750	.935	1.08
November	8,250	6,980	7,610	1.24	1.38
December	4,920	3,790	4,340	.706	.81
January	4,010	3,720	3,860	.628	.72
February	3,970	4,130	4,040	.657	.68
March	3,910	4,340	4,130	.672	.77
April	7,830	9,140	8,480	1.38	1.54
May	5,170	4,650	4,900	.797	.92
June	4,410	3,940	4,170	.678	.76
July	4,100	4,190	4,150	.675	.78
August	3,310	2,510	2,900	.472	.54
September	2,020	1,890	1,950	.317	.35
The year			4,690	.763	10.33
1901–2.					
October	2,620	3,840	3,250	.528	.61
November	3,940	3,880	3,910	.636	.71
December	3,670	3,280	3,470	.564	.65
January	3,140	2,850	2,990	.486	.56
February	2,880	2,870	2,870	.467	.49
March	3,260	3,630	3,450	.561	.65
April	3,200	2,650	2,920	.475	.53
May	3,730	6,880	5,350	.870	1.00
June	8,030	4,880	6,450	1.05	1.17
July	4,320	3,680	3,990	.649	.75
August	3,670	2,860	3,250	.528	.61
September	2,150	1,850	2,000	.325	.36
The year			3,660	.595	8.09
1902–3.					
October	2,150	2,980	2,580	.420	.48
November	3,170	3,070	3,120	.507	.57
December	3,110	2,910	3,010	.489	.56
January	3,180	3,720	3,460	.563	.65
February	3,560	3,720	3,630	.590	.61
March	3,810	4,960	4,410	.717	.83
April	7,820	5,750	6,780	1.10	1.23
May	5,540	5,730	5,640	.917	1.06
June	5,510	5,040	5,270	.857	.96
July	4,230	4,550	4,400	.715	.82
August	4,040	3,800	3,920	.637	.73
September	4,490	5,150	4,820	.784	.87
The year			4,250	.691	9.37

Discharge of Fox River at Rapide Croche dam, Wis., for years ending Sept. 30, 1896–1917—Continued.

Month.	Mean discharge, in second-feet.				Run-off (depth in inches on drainage area).
	Semimonthly.		Monthly.		
	First half.	Second half.	Mean.	Per square mile.	
1903–4.					
October	5,170	5,140	5,150	0.837	0.96
November	4,490	3,970	4,230	.688	.77
December	3,450	3,420	3,430	.558	.64
January	3,710	3,540	3,620	.589	.68
February	3,560	3,790	3,670	.597	.64
March	3,570	4,200	3,890	.633	.73
April	4,940	8,720	6,830	1.11	1.24
May	7,700	9,630	8,700	1.41	1.63
June	8,590	5,060	6,820	1.11	1.24
July	3,510	3,440	3,470	.564	.65
August	3,480	2,880	3,170	.515	.59
September	2,560	2,400	2,480	.403	.45
The year			4,620	.751	10.22
1904–5.					
October	3,670	4,400	4,050	.659	.76
November	4,180	3,780	3,980	.647	.72
December	3,750	3,600	3,670	.597	.69
January	3,810	4,120	3,970	.646	.74
February	4,480	4,150	4,330	.704	.73
March	3,820	4,250	4,040	.657	.76
April	7,770	8,810	8,290	1.35	1.51
May	5,380	5,630	5,510	.896	1.03
June	11,670	12,820	12,250	1.99	2.22
July	9,290	5,690	7,430	1.21	1.40
August	4,450	4,400	4,420	.719	.83
September	4,150	3,910	4,030	.655	.73
The year			5,500	.894	12.12
1905–6.					
October	3,380	3,550	3,470	.564	.65
November	3,690	3,610	3,650	.593	.66
December	3,580	3,450	3,510	.571	.66
January	3,650	3,940	3,800	.618	.71
February	3,890	4,050	3,960	.644	.67
March	3,980	5,200	4,610	.750	.86
April	11,690	13,910	12,800	2.08	2.32
May	10,950	5,080	7,920	1.29	1.49
June	4,430	4,680	4,550	.740	.83
July	4,500	4,310	4,400	.715	.82
August	3,200	2,990	3,090	.502	.58
September	2,850	2,780	2,810	.457	.51
The year			4,880	.793	10.76
1906–7.					
October	3,100	2,910	3,010	.489	.56
November	3,790	4,470	4,130	.672	.75
December	5,450	5,670	5,560	.904	1.04
January	5,780	5,620	5,700	.927	1.07
February	7,030	4,530	5,870	.954	.99
March	3,790	4,360	4,080	.663	.76
April	9,000	10,780	9,890	1.61	1.80
May	8,360	6,460	7,380	1.20	1.38
June	6,420	4,830	5,620	.914	1.02
July	4,310	5,390	4,870	.792	.91
August	4,200	3,770	3,980	.647	.75
September	2,900	3,460	3,180	.517	.58
The year			5,270	.857	11.61

Discharge of Fox River at Rapide Croche dam, Wis., for years ending Sept. 30, 1896–1917—Continued.

Month.	Mean discharge, in second-feet.				Run-off (depth in inches on drainage area).
	Semimonthly.		Monthly.		
	First half.	Second half.	Mean.	Per square mile.	
1907–8.					
October	3,640	3,510	3,570	0.580	0.67
November	2,570	2,780	2,670	.434	.48
December	2,940	3,090	3,020	.491	.57
January	3,180	3,360	3,270	.532	.61
February	3,440	3,440	3,440	.559	.60
March	3,760	6,470	5,160	.839	.97
April	9,220	7,020	8,120	1.32	1.47
May	8,910	10,630	9,800	1.59	1.83
June	6,140	4,020	5,080	.826	.92
July	3,380	3,590	3,500	.569	.66
August	2,840	1,890	2,350	.382	.44
September	1,590	1,380	1,480	.241	.27
The year			4,290	.698	9.49
1908–9.					
October	1,280	1,290	1,280	.208	.24
November	1,720	2,190	1,950	.317	.35
December	3,220	2,770	2,990	.486	.56
January	3,210	3,490	3,350	.545	.63
February	3,390	3,460	3,420	.556	.58
March	3,520	3,720	3,620	.589	.68
April	4,040	5,380	4,710	.766	.85
May	10,630	8,240	9,400	1.53	1.76
June	6,010	5,700	5,860	.953	1.06
July	3,960	3,080	3,510	.571	.66
August	1,580	1,660	1,620	.263	.30
September	2,280	2,180	2,230	.363	.40
The year			3,660	.595	8.07
1909–10.					
October	2,250	1,670	1,950	.317	.37
November	1,690	2,780	2,230	.363	.40
December	3,710	3,520	3,610	.587	.68
January	3,840	3,750	3,790	.616	.71
February	3,820	3,730	3,780	.615	.64
March	3,900	3,740	3,820	.621	.72
April	3,770	4,100	3,930	.639	.71
May	4,810	4,650	4,730	.769	.89
June	3,930	3,210	3,570	.580	.65
July	1,660	1,190	1,420	.231	.27
August	1,170	1,090	1,130	.184	.21
September	1,830	2,510	2,170	.353	.39
The year			3,010	.489	6.63
1910–11.					
October	2,520	2,560	2,540	.413	.48
November	2,140	2,630	2,380	.387	.43
December	3,390	3,400	3,390	.551	.64
January	3,570	3,460	3,510	.571	.66
February	3,420	4,000	3,690	.600	.62
March	3,890	3,810	3,850	.626	.72
April	4,280	3,860	4,070	.662	.74
May	3,460	3,870	3,670	.597	.69
June	7,010	4,630	5,820	.946	1.06
July	2,820	1,340	2,060	.335	.39
August	960	1,500	1,240	.202	.23
September	1,420	2,300	1,860	.302	.34
The year			3,170	.515	7.00

Discharge of Fox River at Rapide Croche dam, Wis., for years ending Sept. 30, 1896–1917—Continued.

Month.	Mean discharge, in second-feet.				Run-off (depth in inches on drainage area).
	Semimonthly.		Monthly.		
	First half.	Second half.	Mean.	Per square mile.	
1911–12.					
October	6,420	9,630	8,080	1.31	1.51
November	5,480	4,950	5,210	.847	.94
December	6,410	8,960	7,730	1.26	1.45
January	4,650	5,000	4,830	.785	.90
February	4,810	4,770	4,790	.779	.84
March	4,630	3,900	4,250	.691	.80
April	3,770	5,920	4,840	.787	.88
May	5,720	8,170	6,980	1.13	1.30
June	8,500	3,790	6,140	.998	1.11
July	2,570	3,680	3,140	.511	.59
August	8,380	6,960	7,650	1.24	1.43
September	9,550	9,050	9,300	1.51	1.68
The year			6,080	.989	13.43
1912–13.					
October	5,980	4,070	4,990	.811	.94
November	3,960	4,340	4,150	.675	.75
December	4,620	3,710	4,150	.675	.78
January	3,870	3,640	3,750	.610	.70
February	3,410	3,280	3,350	.545	.57
March	3,720	8,350	6,110	.993	1.14
April	13,650	12,150	12,900	2.10	2.34
May	7,840	9,160	8,520	1.39	1.60
June	8,860	4,240	6,550	1.07	1 19
July	3,670	4,100	3,890	.633	.73
August	3,770	3,260	3,510	.571	.66
September	2,430	2,350	2,390	.389	.43
The year			5,360	.872	11.83
1913–14.					
October	3,480	3,730	3,610	.587	.68
November	3,770	3,870	3,820	.621	.69
December	4,220	4,050	4,130	.672	.77
January	3,720	4,010	3,870	.629	.73
February	4,100	4,190	4,140	.673	.70
March	3,590	3,530	3,560	.579	.67
April	2,390	3,460	2,920	.475	.53
May	4,020	5,000	4,530	.737	.85
June	10,900	11,180	11,040	1.80	2.01
July	5,620	3,430	4,490	.730	.84
August	2,350	1,650	1,990	.324	.37
September	1,770	2,850	2,310	.376	.42
The year			4,200	.683	9.26
1914–15.					
October	2,960	2,830	2,890	.470	.54
November	2,580	2,590	2,580	.420	.47
December	2,760	2,810	2,790	.454	.52
January	2,790	3,470	3,140	.511	.59
February	4,100	4,290	4,190	.681	.71
March	7,570	7,250	7,400	1.20	1.38
April	7,130	3,610	5,370	.873	.97
May	3,330	3,560	3,450	.561	.66
June	3,660	3,620	3,640	.592	.66
July	3,330	2,930	3,120	.507	.58
August	2,790	2,310	2,540	.413	.48
September	2,200	4,700	3,450	.561	.63
The year			3,710	.603	8.19

Discharge of Fox River at Rapide Croche dam, Wis., for years ending Sept. 30, 1896–1917—Continued.

Month.	Mean discharge, in second-feet.				Run-off (depth in inches on drainage area).
	Semimonthly.		Monthly.		
	First half.	Second half.	Mean.	Per square mile.	
1915–16.					
October	5,180	4,930	5,050	0.821	0.95
November	4,560	5,180	4,870	.792	.88
December	5,610	5,050	5,320	.865	1.00
January	4,740	4,750	4,740	.771	.89
February	5,300	5,020	5,170	.841	.91
March	4,800	6,020	5,430	.883	1.02
April	12,960	11,330	13,140	2.14	2.39
May	12,720	11,320	12,000	1.95	2.25
June	9,180	11,880	10,530	1.71	1.91
July	6,120	3,890	4,970	.808	.93
August	3,100	3,370	3,240	.527	.61
September	2,840	2,970	2,900	.472	.53
The year			6,450	1.05	14.27
1916–17.					
October	3,340	4,300	3,830	.623	.72
November	5,310	6,550	5,930	.964	1.08
December	6,570	5,600	6,070	.987	1.14
January	5,920	6,480	6,210	1.01	1.16
February	4,980	4,540	4,780	.777	.81
March	4,670	5,770	5,240	.852	.98
April	12,050	12,290	12,170	1.98	2.21
May	9,920	5,300	7,540	1.23	1.42
June	5,940	8,400	7,170	1.17	1.30
July	4,900	4,300	4,590	.746	.86
August	3,740	3,910	3,830	.623	.72
September	2,810	2,650	2,730	.444	.50
The year			5,840	.950	12.90

NOTE.—Records in the above table supersede those contained in the "Water-power report to the Legislature, 1915," published by the Wisconsin Railroad Commission.

WOLF RIVER AT KESHENA, WIS.

LOCATION.—In sec. 26, T. 28 N., R. 15 E., at the highway bridge at Keshena, Shawano County, 3 miles below the junction with West Branch of Wolf River, which enters from the right.

DRAINAGE AREA.—797 square miles.

RECORDS AVAILABLE.—May 9, 1907, to March 31, 1909; February 10, 1911, to September 30, 1917.

GAGE.—Chain gage fastened to downstream side of new bridge on December 9, 1914; May 9, 1907, to November 29, 1914, vertical staff gage fastened to downstream abutment, both gages at same datum; read by Jerome M. Beauprey.

DISCHARGE MEASUREMENTS.—Made from the bridge.

CHANNEL AND CONTROL.—Gravel; smooth and practically permanent. Banks of mediun height; overflow improbable. During the last part of November and the first part of December, 1914, a new bridge was erected at the site of the old gage. The plotting of the discharge measurements made since the bridge was built indicates that the construction of the new piers changed condition of channel.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.50 feet at 5 p. m. June 8 and 8 a. m. June 9 (discharge, 2,260 second-feet); minimum discharge about 470 second-feet February 18.

1907–1909 and 1911–1917: Maximum discharge recorded 3,910 second-feet September 2, 1912; minimum open-water discharge, 275 second-feet September 26, 1908.

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

REGULATION.—The river and its main tributaries above Keshena are controlled to some extent by logging dams.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 510 and 2,260 second-feet; above and below these limits curve is extended and is subject to error. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean of daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating curve mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records excellent except for extremely high and low stages, for which they are fair; winter records fair.

Discharge measurements of Wolf River at Keshena, Wis., during the year ending September 30, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 15[a]	E. L. Williams	3.49	518	Mar. 8[a]	E. L. Williams	3.28	497
Feb. 6[a]	do	3.36	539	June 22	R. B. Kilgore	2.61	1,070

a Ice at control.

Daily discharge, in second-feet, of Wolf River at Keshena, Wis., for the year ending September 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,130	1,190	1,020	565	540	510	1,220	1,700	810	960	670	586
2	1,020	1,250	1,130	560	545	510	1,280	1,640	909	1,020	715	586
3	960	1,130	1,130	555	535	485	1,250	1,640	909	1,020	715	547
4	909	1,130	1,020	550	560	495	1,190	1,640	1,020	960	670	586
5	859	1,190	810	545	530	490	1,190	1,640	1,250	859	627	627
6	810	1,070	715	545	540	480	1,190	1,500	1,310	715	586	715
7	810	1,020	810	540	555	495	1,190	1,190	2,120	715	762	762
8	810	1,020	715	540	540	495	1,220	1,250	2,200	670	859	715
9	762	1,020	715	535	545	485	1,220	1,190	2,190	762	960	715
10	762	1,070	670	535	520	500	1,250	1,190	1,980	909	960	670
11	762	1,070	625	530	510	495	1,310	1,250	1,910	859	909	627
12	670	1,070	620	530	515	490	1,380	1,190	1,770	859	715	547
13	715	1,020	620	525	485	490	1,310	1,250	1,500	810	909	547
14	810	810	615	525	475	490	1,250	1,190	1,440	810	1,310	547
15	810	715	615	520	375	490	1,130	1,070	1,380	627	1,070	547
16	859	670	610	520	485	520	960	1,070	1,380	547	859	627
17	715	670	605	490	510	545	859	1,020	1,130	547	762	715
18	670	760	600	495	470	515	1,130	859	1,020	627	715	715
19	762	810	600	480	475	525	1,440	810	960	586	715	715
20	909	860	595	485	490	565	1,570	960	960	547	715	670
21	909	860	595	510	485	625	1,640	960	909	547	715	475
22	960	860	590	490	490	715	1,640	909	1,020	586	670	510
23	909	810	585	495	505	785	1,570	909	1,070	586	627	510
24	859	760	580	505	500	875	1,440	909	1,070	586	627	510
25	960	715	580	505	490	960	1,440	859	1,310	547	627	547
26	1,020	715	575	490	510	960	1,380	859	1,380	586	627	475
27	1,250	810	575	480	510	990	1,440	762	1,190	627	627	475
28	1,190	1,070	570	485	510	990	1,440	715	1,020	586	627	475
29	1,130	1,190	570	505	.....	1,070	1,500	715	960	586	627	510
30	1,190	1,130	565	535	.....	1,100	1,700	762	909	586	627	475
31	1,190	.....	565	535	.....	1,160	.....	810	.....	586	586	.....

NOTE.—Stage-discharge relation affected by ice Nov. 15 to Apr. 9.

Monthly discharge of Wolf River at Keshena, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 797 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,250	670	906	1.14	1.31
November	1,250	670	949	1.19	1.33
December	1,130	565	684	.858	.99
January	565	480	520	.652	.75
February	560	470	511	.641	.67
March	1,160	480	655	.822	.95
April	1,700	859	1,320	1.66	1.85
May	1,700	715	1,110	1.39	1.60
June	2,260	810	1,300	1.63	1.82
July	1,020	547	704	.883	1.02
August	1,310	586	748	.939	1.08
September	762	475	591	.742	.83
The year	2,260	470	834	1.05	14.20

WOLF RIVER AT NEW LONDON, WIS.

LOCATION.—In sec. 12, T. 22 N., R. 14 E., at Pearl Street highway bridge, New London Waupaca County. Embarrass River enters from the right three-fourths of a mile above the station, and Little Wolf River, also from the right, 5 miles below.

DRAINAGE AREA.—2,240 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch = 6 miles).

RECORDS AVAILABLE.—Gage heights March 1, 1899, to September 30, 1917; daily discharge record, October 1, 1913, to September 30, 1917.

GAGE.—Enameled steel gage, reading from 1.0 to 13.0 feet, fastened to right-hand downstream pier of Pearl Street bridge. Datum of the gage raised 0.641 foot March 1, 1911, according to the United States Army Engineers. Zero of gage 748.874 feet above mean sea level, New York City datum.

DISCHARGE MEASUREMENTS.—Made from the Shawano Street bridge, two blocks below the gage.

CHANNEL AND CONTROL.—Bed composed of sand, hardpan, and mud; not permanent. No well-defined control. Banks at gage fairly high and not subject to overflow. It is reported that during extremely high stages water from Embarrass River flows across New London into the channel of Wolf River below the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 9.45 feet April 1 (discharge, 8,060 second-feet); minimum discharge about 840 second-feet February 8–12.

1914–1917: Maximum discharge recorded, 8,960 second-feet April 4, 1916; minimum discharge, 755 second-feet January 1–10, 1915. The United States Army Engineer Office reports a stage of 11.6 feet April 16, 1888.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Little if any diurnal fluctuation due to operation of the power plants on river above station observable at gage; monthly flow natural.

ACCURACY.—Stage-discharge relation not permanent. Two rating curves used during 1917; one applicable October 1 to March 31 fairly well defined between 910 and 9,280 second-feet; the other, applicable April 1 to September 30, fairly well defined between 1,080 and 9,280 second-feet. Gage read to 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. Records fair.

Discharge measurements of Wolf River at New London, 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. 16[a]	E. L. Williams	3.18	1,020	Apr. 16	E. L. Williams	7.31	4,350
Feb. 7[a]	do	3.33	874	June 18	R. B. Kilgore	6.48	3,280
Mar. 7[a]	do	3.59	927	Aug. 25	do	2.00	1,160

[a] Complete ice cover.

Daily discharge, in second-feet, of Wolf River at New London, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,280	3,100	2,560	1,140	910	910	8,060	4,050	1,810	2,500	1,050	1,100
2	2,340	3,160	2,500	1,140	910	910	7,780	4,160	1,910	2,440	1,050	1,080
3	2,280	3,220	2,500	1,140	910	910	7,510	4,270	1,960	2,280	1,050	1,050
4	2,280	3,220	2,560	1,140	875	910	7,000	4,270	2,060	2,170	1,075	1,000
5	2,170	3,220	2,560	1,140	875	910	6,530	4,270	2,170	2,060	1,100	1,080
6	2,060	3,220	2,500	1,140	875	910	6,530	4,270	2,220	1,960	1,160	1,130
7	2,010	3,220	2,440	1,140	875	910	6,310	4,270	2,560	1,860	1,080	1,220
8	1,910	3,160	2,390	1,140	840	930	5,900	4,160	2,860	1,810	1,160	1,370
9	1,710	3,160	2,280	1,100	840	945	5,710	3,950	2,980	1,660	1,190	1,460
10	1,560	3,220	2,220	1,100	840	960	5,360	3,760	3,100	1,420	1,260	1,420
11	1,420	3,220	2,010	1,100	840	980	5,200	3,500	3,220	1,420	1,330	1,330
12	1,460	3,160	1,710	1,060	840	1,000	4,920	3,350	3,350	1,510	1,460	1,260
13	1,560	3,100	1,660	1,060	875	1,020	4,780	3,220	3,580	1,560	1,460	1,260
14	1,510	3,040	1,610	1,020	875	1,040	4,510	3,040	3,760	1,560	1,330	1,260
15	1,560	2,980	1,560	1,020	875	1,060	4,390	2,920	3,850	1,560	1,420	1,290
16	1,510	2,740	1,460	1,020	875	1,060	4,160	2,800	3,670	1,510	1,560	1,330
17	1,560	2,740	1,370	1,020	875	1,060	4,050	2,680	3,580	1,330	1,760	1,370
18	1,560	2,680	1,320	980	875	1,060	3,950	2,500	3,500	1,330	1,860	1,330
19	1,560	2,680	1,280	980	875	1,100	3,850	2,340	3,280	1,290	1,860	1,330
20	1,560	2,620	1,240	980	875	1,120	3,850	2,280	3,160	1,260	1,660	1,290
21	1,660	2,500	1,240	980	875	1,190	3,850	2,220	3,040	1,330	1,370	1,190
22	1,810	2,500	1,240	980	875	1,320	3,850	2,280	2,860	1,290	1,260	1,160
23	1,960	2,620	1,190	945	875	1,610	3,850	2,170	2,680	1,220	1,220	1,050
24	2,060	2,860	1,190	945	875	2,340	3,760	2,220	2,560	1,100	1,160	1,020
25	2,280	3,040	1,190	945	875	3,500	3,850	2,170	2,560	1,130	1,100	1,020
26	2,500	2,980	1,190	945	875	4,780	3,850	2,170	2,680	1,190	1,080	1,000
27	2,620	2,860	1,190	945	910	5,360	3,950	2,010	2,620	1,190	1,080	1,009
28	2,740	2,860	1,140	945	910	5,900	3,950	1,960	2,620	1,160	1,050	985
29	2,800	2,800	1,140	910	.....	5,900	3,950	1,760	2,620	1,130	1,080	965
30	2,920	2,620	1,140	910	.....	5,710	3,950	1,780	2,560	1,100	1,100	1,000
31	3,100	.....	1,140	910	.....	5,530	.....	1,760	.....	1,020	1,100	

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Mar. 31.

Monthly discharge of Wolf River at New London, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 2,240 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,100	1,420	2,010	0.897	1.03
November	3,220	2,500	2,950	1.32	1.47
December	2,560	1,140	1,700	.759	.88
January	1,140	910	1,030	.460	.53
February	910	840	875	.391	.41
March	5,900	910	2,030	.906	1.04
April	8,060	3,760	4,970	2.22	2.48
May	4,270	1,760	2,990	1.33	1.53
June	3,850	1,810	2,850	1.27	1.42
July	2,500	1,020	1,530	.683	.79
August	1,860	1,050	1,270	.567	.65
September	1,460	965	1,180	.527	.59
The year	8,060	840	2,120	.946	12.82

WEST BRANCH OF WOLF RIVER AT NEOPIT, WIS.

LOCATION.—In sec. 20, T. 29 N., R. 14 E., at dam and power plant at Neopit, Shawano County, a station on Wisconsin Northern Railroad, 20 miles north of Shawano; about 11 miles above confluence of Wolf River and West Branch.

DRAINAGE AREA.—108 square miles.

RECORDS AVAILABLE.—January 25, 1911, to February 7, 1917, when station was discontinued.

GAGE.—Vertical staff, head and tail race gages.

DETERMINATION OF FLOW.—Observations of the head of water flowing over the spillway, the head on the wheels, and the kilowatt output as measured at the switchboard are taken at 6, 7, and 10 a. m. and at 3, 6, and 10 p. m. The flow at these times is determined by means of a curve developed by current-meter measurements, and the computed discharge is then weighted in accordance with the elapsed interval.

EXTREMES OF DISCHARGE.—Maximum daily discharge recorded during year, 169 second-feet, January 7; minimum daily discharge, 62 second-feet December 10.

1911–1917: Maximum daily discharge, 999 second-feet, July 24, 1912; minimum daily discharge, 17 second-feet, August 30, 1914. Extremes are caused by regulation, and are not natural.

ACCURACY.—Rating tables used in determination of daily discharge based on numerous measurements made throughout the year. Conditions relative to leakage and plant equipment are becoming more unsatisfactory; records published for year only fair.

Daily discharge, in second-feet, of West Branch of Wolf River at Neopit, Wis., for the period Oct. 1, 1916, to Feb. 7, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Day.	Oct.	Nov.	Dec.	Jan.	Feb.
1	122	132	112	100	123	16	106	121	82	89	.....
2	122	122	110	102	117	17	103	123	66	94	.....
3	115	132	105	108	125	18	130	110	87	93	.....
4	110	122	113	100	106	19	103	105	90	105	.....
5	84	113	106	101	137	20	95	113	92	114	.....
6	76	124	110	98	131	21	103	114	96	103	.....
7	84	127	116	169	125	22	90	109	86	119	.....
8	79	124	116	112	.....	23	89	116	87	124	.....
9	149	91	109	104	.....	24	68	113	96	106	.....
10	128	106	62	95	.....	25	71	80	89	95	.....
11	103	100	107	94	.....	26	149	99	104	115	.....
12	116	112	110	101	.....	27	153	121	91	140	.....
13	86	114	104	102	.....	28	132	117	92	98	.....
14	74	106	95	83	.....	29	131	116	105	140	.....
15	74	82	82	96	.....	30	139	100	98	118	.....
						31	152	.....	98	119	.....

Monthly discharge of West Branch of Wolf River at Neopit, Wis., for the period Oct. 1, 1915, to Feb. 7, 1917.

[Drainage area, 108 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	153	68	108	1.00	1.15
November	132	80	112	1.04	1.16
December	116	62	97.0	.898	1.04
January	169	83	108	1.00	1.15
February 1–7	137	106	123	1.14	.30

LITTLE WOLF RIVER AT ROYALTON, WIS.

LOCATION.—In sec. 1, T. 22 N., R. 13 E., at highway bridge at Royalton, Waupaca County, about 4 miles above mouth of river.

DRAINAGE AREA.—485 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 13, 1914, to September 30, 1917.

GAGE.—Sloping gage on left bank 150 feet upstream from highway bridge; read by J. C. Jenson. Prior to August 21, 1915, a chain gage fastened to upstream side of highway bridge was used. Datum of sloping gage is 0.75 foot higher than that of the chain gage; owing to change in slope, however, difference between readings on the slope gage and the chain gage is not constant.

DISCHARGE MEASUREMENTS.—Made by wading or from cable about 500 feet upstream from chain gage.

CHANNEL AND CONTROL.—Stream bed at gage consists of heavy gravel and rock; fairly permanent; at measuring section bed is fine, smooth gravel. Neither bank is overflowed to any extent at flood stages.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year, about 4,800 second-feet March 26; minimum discharge recorded, about 130 second-feet January 23.

1914–1917: Maximum stage recorded, 7.5 feet at 7.15 p. m., June 7, 1914 (discharge, 5,350 second-feet); a higher stage was recorded in March, 1917, but discharge was less owing to backwater from ice; minimum discharge recorded, about 130 second-feet March 5 and 6, 1916, and January 23, 1917.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—The few power plants above the station have little storage and produce no observable diurnal fluctuation at the gage.

ACCURACY.—Stage-discharge relation not permanent. Two rating curves used during the year; one applicable for periods when slope gage was read—October 1 to November 15, November 21–24, December 1–6, and June 19 to September 30—well defined between 209 and 1,570 second-feet; the other, applicable to chain-gage readings, poorly defined throughout. 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 for high stages, for which they are fair; winter records fair.

Discharge measurements of Little Wolf River at Royalton, 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. 16[a]	E. L. Williams	[b]1.98	166	Apr. 16	E. L. Williams	2.47	719
Feb. 7[a]	do	[b]2.40	176	June 19	R. B. Kilgore	1.86	392
Mar. 7[a]	do	[b]2.72	243	Aug. 25	do	1.35	214

[a] Almost complete ice cover. [b] Gage height referred to chain gage.

Daily discharge, in second-feet, of Little Wolf River at Royalton, Wis., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	680	800	496	160	250	175	1,680	1,150	384	501	193	221
2	560	740	474	185	235	190	1,450	1,010	428	417	193	221
3	444	740	433	170	210	205	1,300	978	424	397	207	219
4	371	710	442	170	195	185	1,300	749	438	381	227	225
5	376	680	406	200	180	185	1,220	640	469	371	301	267
6	337	650	402	215	145	240	1,150	615	615	318	284	352
7	314	650	385	195	175	240	1,150	542	911	323	245	439
8	276	680	380	175	175	230	1,080	478	1,220	284	337	530
9	297	740	370	160	170	240	1,050	496	1,080	301	293	386
10	314	710	360	160	160	240	978	478	944	289	305	356
11	284	680	355	170	170	635	911	496	846	310	347	318
12	280	615	345	165	170	450	846	469	720	332	305	301
13	314	566	340	165	180	385	846	442	615	366	305	356
14	314	474	335	160	195	615	749	428	566	332	276	337
15	376	442	325	145	195	405	666	397	519	323	301	328
16	361	450	320	155	180	280	666	388	456	318	366	386
17	371	450	310	160	190	260	615	328	442	289	402	301
18	397	450	305	150	175	260	666	388	446	305	501	318
19	386	475	295	165	180	320	776	420	347	310	227	310
20	392	475	290	175	170	385	1,010	442	371	323	241	276
21	461	492	280	160	185	450	1,050	496	407	318	241	280
22	590	542	275	150	185	665	978	478	439	267	234	257
23	590	542	270	130	165	1,560	944	496	461	280	241	267
24	560	542	260	135	195	2,080	846	469	530	270	215	276
25	740	540	255	145	150	3,490	720	446	830	276	205	280
26	865	520	260	150	195	4,560	776	460	680	245	207	276
27	935	520	240	170	205	4,340	776	380	560	236	227	270
28	1,010	495	250	135	190	3,390	776	371	560	227	211	241
29	935	495	230	255	.....	2,430	776	362	530	186	215	243
30	935	495	235	270	.....	1,760	911	384	501	193	225	227
31	900	.....	175	240	.....	1,760	.....	433	.....	186	219	.....

NOTE.—Stage-discharge relation affected by ice Nov. 16–20, 25–30, and Dec. 7 to Mar. 31.

Monthly discharge of Little Wolf River at Royalton, Wis., for the year ending Sept. 30, 1917.

[Drainage area, 485 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area.)
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,010	280	515	1.06	1.22
November	800	442	579	1.19	1.33
December	496	175	326	.672	.77
January	270	130	172	.355	.41
February	250	145	185	.381	.40
March	4,560	175	1,050	2.16	2.49
April	1,680	615	955	1.97	2.20
May	1,150	328	520	1.07	1.23
June	1,220	347	591	1.22	1.36
July	501	186	306	.631	.73
August	402	193	268	.553	.64
September	530	219	302	.623	.70
The year	4,560	130	482	.994	13.48

WAUPACA RIVER NEAR WEYAUWEGA, WIS.

LOCATION.—On line between sec. 1, T. 21 N., R. 12 E., and sec. 6, T. 21 N., R. 13 E., at highway bridge 2½ miles west of Weyauwega, Waupaca County.

DRAINAGE AREA.—308 square miles (measured on Wisconsin Geological and Natural History Survey map, edition of 1911; scale 1 inch=6 miles).

RECORDS AVAILABLE.—June 28, 1916, to October 18, 1917, when station was moved one mile upstream.

GAGE.—Chain gage bolted to top chord, downstream truss, across left channel; read by Otto Reek and Harry Radtke.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading about 300 feet above bridge.

CHANNEL AND CONTROL.—Bed composed of coarse gravel; clean and free from aquatic grass. Control is a fairly well defined riffle about 30 feet downstream from gage. Right bank high, wooded, and will be overflowed only occasionally; left bank low and subject to overflow; road is high, so that during ordinary flood stages all the water passes under the bridge.

ICE.—Stage-discharge relation affected by ice.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of records 6.1 feet March 23, 1917; owing to ice effect maximum discharge occurred about March 25, and has been estimated at 920 second-feet. Minimum discharge about 130 second-feet, February 13, 1917.

REGULATION.—Several power plants at Waupaca and above on the main stream and also several on the Crystal River cause slight fluctuations during low stages. The pondage at the various plants is small; mean monthly discharge is believed to represent nearly the natural flow.

ACCURACY.—Stage-discharge relation assumed practically permanent. Rating curve based on 7 current-meter measurements made in 1916 and 1917 and 4 measurements made in 1918 at the new site 1 mile upstream; curve fairly well defined between 158 and 448 second-feet; above 448 second-feet rating curve is an extension and subject to possible error. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to the rating table; except for periods when the stage-discharge relation was affected by ice, for which it was obtained by applying to rating table gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Records probably not better than fair for entire period.

Discharge measurements of Waupaca River near Weyauwega, Wis., during the period Oct. 1, 1916, to Oct. 26, 1917.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 12[a]	E. L. Williams	2.32	170	June 9	W. G. Hoyt	1.99	404
Feb. 3[a]	do	2.87	170	July 7	R. B. Kilgore	1.50	250
Mar. 6[a]	do	3.02	176	Sept. 7	do	1.58	[b]265
Apr. 17	do	1.68	327	Oct. 26	do	1.63	[b]289

[a] Complete ice cover at control. [b] Discharge measured at the site of new station one mile upstream.

Daily discharge, in second-feet, of Waupaca River near Weyauwega, Wis., for the period June 28, 1916 to Nov. 18, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1916.					1916.				
1		303	168	178	16		238	200	318
2		350	168	178	17		275	200	250
3		289	178	200	18		289	178	303
4		262	238	158	19		238	200	262
5		225	275	238	20		262	189	250
6		238	238	200	21		250	275	262
7		225	262	189	22		212	158	250
8		212	225	200	23		212	158	238
9		212	250	275	24		178	158	225
10		189	238	200	25		200	158	200
11		212	262	250	26		200	168	262
12		212	262	540	27		200	158	470
13		200	200	540	28	225	178	158	565
14		178	225	388	29	250	212	158	333
15		189	200	303	30	318	158	178	289
					31		178	178	

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1916–17.													
1	262	350	225	160	145	160	710	590	262	262	178	178	178
2	250	303	210	170	160	150	590	493	303	250	225	178	189
3	238	275	205	180	170	145	590	428	303	238	200	178	200
4	225	333	205	190	170	180	590	388	275	238	178	168	189
5	303	318	210	185	160	160	590	333	303	225	189	262	189
6	200	289	210	180	150	180	590	303	368	238	200	303	168
7	238	303	210	170	150	180	516	275	650	250	212	275	189
8	200	318	205	170	160	180	448	289	448	238	303	225	189
9	238	303	205	170	180	180	408	262	388	262	225	200	200
10	225	333	200	180	180	190	408	225	333	250	238	238	238
11	225	318	200	180	150	190	368	250	303	250	200	225	250
12	225	303	200	170	150	180	368	262	275	250	200	189	275
13	275	289	200	190	130	180	350	238	318	250	250	238	212
14	238	285	200	180	160	190	368	238	289	238	250	303	200
15	275	275	200	150	160	200	318	275	275	225	250	250	250
16	250	275	200	150	170	225	318	250	275	200	238	238	178
17	238	275	195	160	170	240	289	250	250	262	200	225	238
18	225	275	195	160	170	250	303	238	238	238	212	250	225
19	212	275	190	155	150	275	470	250	262	212	189	200	.....
20	250	275	190	150	150	335	540	250	250	225	189	212	.....
21	333	275	185	180	160	450	470	262	262	200	189	189	.....
22	303	255	185	145	160	600	388	318	262	212	189	178	.....
23	275	250	185	145	160	770	368	289	275	212	189	178	.....
24	275	250	185	160	170	890	350	275	303	225	178	178	.....
25	428	250	185	180	145	950	350	250	333	200	189	189	.....
26	448	250	180	180	200	920	428	262	388	225	178	178	.....
27	368	245	190	160	180	890	388	225	318	250	200	178	.....
28	318	240	195	180	180	830	408	225	303	178	200	168	.....
29	470	235	195	170	.....	770	428	238	303	200	178	168	.....
30	408	230	180	180	.....	830	493	225	275	178	178	168	.....
31	368	.....	160	150	.....	830	.....	250	.....	189	168	.....	.....

NOTE.—Stage-discharge relation affected by ice Nov. 14, 1916, to Mar. 28, 1917.

Monthly discharge of Waupaca River near Weyauwega, Wis., for the period July 1, 1916, to Sept. 30, 1917.

[Drainage area, 308 square miles.]

Month.	Disharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
July	350	158	225	0.731	0.84
August	275	158	202	.656	.76
September	565	158	284	.922	1.03
1916–17.					
October	470	200	283	.919	1.06
November	350	230	282	.916	1.02
December	225	160	196	.636	.73
January	190	145	169	.549	.63
February	200	130	162	.526	.55
March	950	145	410	1.33	1.53
April	710	289	440	1.43	1.60
May	590	225	287	.932	1.07
June	650	238	313	1.02	1.14
July	262	178	228	.740	.85
August	303	168	205	.666	.77
September	303	168	210	.682	.76
The year	950	130	266	.864	11.71

SHEBOYGAN RIVER NEAR SHEBOYGAN, WIS.

LOCATION.—In sec. 28, T. 15 N., R. 23 E., 2 miles west of Sheboygan, Sheboygan County, and 2½ miles above mouth.

DRAINAGE AREA.—403 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles.

RECORDS AVAILABLE.—June 30, 1916, to September 30, 1917.

GAGE.—Chain gage fastened to upstream side of bridge; read by Hattie Opgenorth.

DISCHARGE MEASUREMENTS.—Made from highway bridge, or by wading; at extreme flood stages, measurements are made from Chicago & North Western Railway bridge, one-third mile downstream.

CHANNEL AND CONTROL.—Control, well defined riffle about 200 feet below bridge. Stream bed composed of heavy gravel; clear and free from aquatic grass. Both banks are of medium height and are rarely overflowed.

EXTREMES OF DISCHARGE.—1916–17: Maximum discharge 1,490 second-feet March 22 to 24; minimum stage recorded, 1.84 feet at 6.30 p. m., September 2, 1916 (discharge, 16 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—At low stages there is a small amount of diurnal fluctuation due to operation of small power plants above.

ACCURACY.—Stage-discharge relation permanent, except when affected by ice. Rating curve well defined between 58 and 1,040 second-feet, poorly defined outside these limits. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for periods when stage-discharge relation was affected by ice, for which it was obtained by applying to rating curve mean daily gage height corrected for effect of ice by means of discharge measurements, observers' notes, and weather records. Open-water records excellent; winter records fair.

Discharge measurements of Sheboygan River near Sheboygan, Wis., during 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]	H. C. Beckman	3.16	100	Apr. 13	E. L. Williams	2.98	354
Feb. 8[a]	E. L. Williams	3.42	64	18	do	2.71	252
Mar. 9[a]	do	3.57	74	June 8	W. G. Hoyt	4.19	892

[a] Complete ice cover.

Daily discharge, in second-feet, of Sheboygan River near Sheboygan, Wis., for the period June 30, 1916, to Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1916.					1916.				
1		149	62	53	16		115	58	62
2		96	54	23	17		112	58	53
3		107	53	44	18		58	62	54
4		91	56	26	19		83	62	66
5		83	181	37	20		54	56	70
6		78	132	64	21		66	51	47
7		83	83	66	22		70	54	45
8		83	83	81	23		62	56	60
9		53	70	62	24		53	51	74
10		54	58	66	25		62	54	34
11		66	99	54	26		66	58	62
12		62	83	62	27		62	70	62
13		58	99	54	28		49	47	78
14		64	76	58	29		47	49	135
15		51	62	51	30	159	32	44	115
					31		49	51	

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.												
1	78	305	347	120	60	60	1,090	1,340	326	244	99	110
2	66	216	368	115	40	40	992	1,090	805	284	99	49
3	68	212	347	110	50	40	944	624	1,440	264	66	62
4	60	264	347	105	40	40	897	536	1,090	305	107	72
5	40	244	368	100	40	70	897	515	713	264	104	216
6	64	228	494	125	40	90	897	515	851	204	81	91
7	94	264	473	85	40	60	805	431	992	212	166	96
8	70	326	326	90	65	40	624	536	805	139	126	101
9	66	347	325	95	50	80	431	326	558	185	115	94
10	76	389	325	105	80	70	410	284	897	126	94	66
11	54	284	305	120	60	80	624	264	897	104	121	40
12	58	244	305	105	50	205	431	174	713	166	104	83
13	94	244	285	70	50	390	368	139	668	115	149	66
14	54	232	285	55	40	580	264	146	668	139	81	91
15	66	236	270	70	40	715	244	135	494	121	101	107
16	74	160	255	50	65	850	264	129	431	189	42	88
17	88	135	245	50	50	715	264	146	410	228	78	99
18	88	146	225	50	40	850	305	152	264	99	76	91
19	62	452	205	70	40	945	452	132	347	126	78	86
20	99	494	185	85	40	1,040	624	264	224	166	99	94
21	126	410	165	50	70	1,290	580	91	159	135	146	94
22	208	452	130	55	80	1,490	473	389	115	264	110	99
23	212	944	130	50	80	1,490	389	410	368	146	110	86
24	149	536	145	40	80	1,490	494	389	624	166	101	76
25	181	450	165	40	60	1,390	410	284	494	216	76	70
26	389	430	150	65	80	1,340	452	284	494	170	156	99
27	244	430	140	105	50	1,340	494	264	410	146	81	81
28	200	450	135	40	60	1,290	410	264	536	181	83	72
29	212	450	130	40		1,240	431	193	668	86	70	81
30	212	452	115	40		1,190	536	244	580	170	58	91
31	264		100	40		1,140		284		132	94	

NOTE.—Stage-discharge relation affected by ice Nov. 16, Nov. 25–29; Dec. 9 to Mar. 31.

Monthly discharge of Sheboygan River near Sheboygan, Wis., for the period July 1, 1916, to Sept. 30, 1917.

[Drainage area, 403 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
July	149	32	71.5	0.177	0.20
August	181	44	68.8	.171	.20
September	135	23	60.6	.150	.17
1916–17.					
October	389	40	123	.305	.35
November	944	135	348	.864	.96
December	494	100	251	.623	.72
January	125	40	75.5	.187	.22
February	80	40	55.0	.136	.14
March	1,490	40	698	1.73	1.99
April	1,090	244	550	1.36	1.52
May	1,340	91	354	.878	1.01
June	1,440	115	601	1.49	1.66
July	305	86	177	.439	.51
August	166	42	99.1	.246	.28
September	216	40	88.4	.219	.24
The year	1,490	40	286	.710	9.60

MILWAUKEE RIVER NEAR MILWAUKEE, WIS.

LOCATION.—In NW. ¼ sec. 5, T. 7 N., R. 22 E., immediately above an old quarry near north limits of Milwaukee, Milwaukee County, about half mile below concrete highway bridge and 1 mile above Mineral Spring road; 5½ miles above confluence of Milwaukee and Menominee rivers.

DRAINAGE AREA.—661 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

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

GAGE.—Chain gage fastened to cantilever arm supported by posts set in concrete foundations on the left bank of the river; read by Mrs. Joe Wangard.

CHANNEL AND CONTROL.—Bed of channel at gage heavy gravel. About 200 feet below the gage is a rock outcrop with a 4-foot fall which forms the control, and is probably permanent. Below the control the river flows in an artificial channel which at one time was a quarry. Left bank above and below the control high and not subject to overflow; right bank above control of medium height; below the control the right bank is artificial and of such height that overflow will rarely occur.

DISCHARGE MEASUREMENTS.—Made by wading immediately above the gage section; at medium and high stages from the lower members of a wooden railroad bridge about 700 feet below the gage; bridge crosses an abandoned quarry and the channel beneath, being artificial, affords an excellent measuring section. During the summer of 1917 the bridge burned down and at present there is no suitable point for high-water measurements.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 5.5 feet at 5 p.m. March 25 (discharge, about 5,160 second-feet); minimum stage recorded 0.62 foot at 5.30 a. m. September 2 (discharge 48 second-feet).

1914–1917: Maximum stage recorded 5.58 feet February 24, 1915 (discharge 5,280 second-feet); minimum stage recorded 0.50 foot at 8.30 p. m. August 2, 1916 (discharge, about 26 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—No diurnal fluctuation at the gage resulting from operation of small plants above.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 88 and 3,710 second-feet; poorly defined 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 when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean of daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records excellent, except for extreme high and low stages, for which they are only fair; winter records fair.

Discharge measurements of Milwaukee River near Milwaukee, 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. 6	E. L. Williams	1.00	137	Mar. 1[a]	E. L. Williams	2.06	111
Dec. 27[a]	do	1.65	152	Apr. 12	do	1.66	576
Jan. 29[a]	do	1.93	119	Sept. 8	R. B. Kilgore	1.21	239

[a] Incomplete ice cover at control.

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

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	282	692	569	110	100	115	1,040	2,140	360	1,680	109	109
2	282	692	532	140	100	120	952	1,900	610	1,460	104	56
3	225	610	494	175	100	145	908	1,570	1,790	1,040	83	66
4	195	532	427	165	95	150	864	1,220	1,680	777	106	62
5	166	494	420	135	110	115	927	908	1,570	610	106	114
6	154	494	427	125	145	140	1,090	650	1,570	460	83	140
7	154	460	347	100	115	690	1,090	569	1,680	460	109	230
8	140	400	295	130	130	1,420	952	494	1,570	427	88	235
9	140	820	265	165	105	1,680	864	427	1,460	360	114	225
10	150	997	235	175	100	1,790	734	373	1,220	276	120	169
11	120	908	210	120	115	2,020	650	367	908	235	120	140
12	177	777	185	130	130	2,140	569	307	692	276	86	143
13	177	908	165	100	165	2,020	427	292	532	215	106	177
14	177	820	145	100	75	2,260	414	276	532	215	127	181
15	166	532	130	115	115	2,760	400	253	864	190	109	185
16	177	650	130	80	130	2,380	394	220	864	177	88	169
17	177	650	130	100	115	2,260	367	185	610	169	58	146
18	177	610	130	100	115	2,260	414	173	494	215	86	154
19	235	494	145	110	130	2,380	864	195	460	205	80	133
20	494	569	145	95	145	2,380	1,360	185	394	162	74	146
21	650	569	120	115	120	2,760	1,360	294	307	162	83	143
22	734	650	140	120	115	2,500	1,180	569	288	133	78	140
23	734	1,090	165	100	145	3,990	952	1,040	1,900	136	62	114
24	692	1,460	170	90	140	4,270	734	1,180	1,360	150	74	146
25	1,180	777	115	80	145	5,160	692	997	1,220	276	74	154
26	1,460	692	130	55	115	4,410	820	692	1,270	241	78	150
27	1,360	864	155	100	100	3,290	820	569	1,040	210	96	181
28	1,220	908	185	110	130	2,500	734	494	1,220	169	109	177
29	908	734	210	120	.....	1,790	650	427	2,020	166	96	185
30	734	610	175	100	.....	1,360	734	334	1,680	140	74	166
31	650	.....	185	115	.....	1,130	.....	334	.....	109	60	.....

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

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

[Drainage area, 661 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,460	120	461	0.697	0.80
November	1,460	400	715	1.08	1.20
December	569	120	235	.356	.41
January	175	55	115	.174	.20
February	165	75	119	.180	.19
March	5,160	115	2,010	3.04	3.50
April	1,360	367	799	1.21	1.35
May	2,140	173	633	.958	1.10
June	2,020	288	1,070	1.62	1.81
July	1,680	109	371	.561	.65
August	127	60	916	.139	.16
September	235	56	151	.228	.25
The year	5,160	55	567	.858	11.62

LITTLE CALUMET RIVER AT HARVEY, ILL.

LOCATION.—In NW. ¼ sec. 9, T. 36 N., R. 14 E., at Illinois Central Railroad bridge 800 feet north of railroad station at 147th Street, Harvey, Cook County, about 11 miles above mouth of river.

DRAINAGE AREA.—570 square miles (measured on map issued by U. S. Geological Survey, scale 1:500,000).

RECORDS AVAILABLE.—Daily discharge, October 1, 1916, to September 30, 1917; also daily gage-height record collected by Sanitary District of Chicago, June 10, 1907, to September 30, 1916.

GAGE.—Vertical staff gage attached to bridge pier; read by Mrs. H. Wurtman.

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

CHANNEL AND CONTROL.—Bed of river composed of clay and gravel. Low-water control is at "The Rocks," about a mile below gage; bed of river heavy gravel; probably permanent. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.1 feet March 14 (discharge, 1,120 second-feet); minimum stage, 2.96 feet at 5 p. m. August 27 (discharge, 48 second-feet).

1910-1917: Maximum stage recorded, 13.4 feet March 6, 1908 (discharge not determined); minimum stage, 2.9 feet August 10, 1916 (discharge, 39 second-feet).

ACCURACY.—Stage-discharge relation probably permanent throughout the year; seriously affected by ice during the winter. Rating curve well defined above and fairly well defined below 70 second-feet. Gage read to tenths three times daily October 1 to June 1, and to hundredths twice daily June 2 to September 30. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records good; winter records poor.

COOPERATION.—Gage-height records from October 1 to June 1 furnished by the Sanitary District of Chicago.

Discharge measurements of Little Calumet River at Harvey, Ill., during the year ending Sept. 30, 1917.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.
	Feet.	*Sec-ft.*
Apr. 13	5.00	681
June 2	4.48	437
Aug. 25	3.06	62.5

Daily discharge, in second-feet, of Little Calumet River at Harvey, Ill., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	70	170	194				481	309	600	107	86	60
2	70	148	170				519	309	444	115	77	64
3	70	148	170				519	278	374	103	75	59
4	70	148	170				481	248	358	94	74	54
5	70	148	170				642	220	358	83	70	54
6	70	148	170	290	150	180	726	194	726	81	68	60
7	70	127	170				684	194	684	99	67	70
8	70	127	220				684	170	481	103	65	84
9	70	148	309				684	148	408	99	70	81
10	70	148	309				684	148	408	98	65	81
11	70	148				358	684	127	374	96	64	77
12	83	148				444	642	127	341	99	60	74
13	107	127				462	642	127	358	107	59	74
14	107	127				1,120	600	127	391	119	57	70
15	107	127				769	559	107	358	115	56	70
16	107	127		250	120	642	519	107	325	127	57	68
17	107	107				600	519	107	294	263	59	67
18	107	107				600	481	88	263	278	57	62
19	127	107				600	481	88	248	278	56	57
20	159	107				600	444	88	220	278	54	54
21	194	107	200			600	444	107	207	248	54	62
22	194	107				600	408	170	170	234	52	75
23	194	142				769	408	220	148	444	57	84
24	220	170				855	408	194	131	408	67	81
25	248	170			150	726	408	194	127	309	64	74
26	220	170		190		684	374	194	127	263	59	67
27	220	170				642	341	855	115	207	50	74
28	220	170				559	341	600	123	170	52	74
29	194	194			.....	519	341	444	119	144	51	70
30	194	194			.....	519	341	408	111	119	56	70
31	170	.....			.....	519	.....	559	.....	105	60	.....

NOTE.—Discharge Dec. 11 to Mar. 10 estimated, because of ice, from gage heights and weather records. Braced figures show mean discharge for periods indicated.

Monthly discharge of Little Calumet River at Harvey, Ill., for the year ending Sept. 30, 1917.

[Drainage area, 570 square miles]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	248	70	130	0.228	0.26
November	194	107	143	.251	.28
December	309	.....	202	.354	.41
January	.....	.....	242	.425	.49
February	.....	.....	139	.244	.25
March	1120	.....	483	.847	.98
April	726	341	516	.905	1.01
May	855	88	234	.411	.47
June	726	111	313	.549	.61
July	444	81	174	.305	.35
August	86	50	61.9	.109	.13
September	84	54	69.0	.121	.13
The year	1120	50	226	.396	5.37

GRAND RIVER AT GRAND RAPIDS, MICH.

LOCATION.—At Fulton Street Bridge, Grand Rapids.

DRAINAGE AREA.—4,900 square miles.

RECORDS AVAILABLE.—March 12, 1901, to September 30, 1917.

GAGE.—Staff, attached to bridge; read to half tenths October 1, 1916 to February 10, 1917, and to tenths after February 10, 1917; twice daily October 1 to January 5 and March 12 to May 26; once daily during remainder of year.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

EXTREMES OF STAGE.—Maximum stage recorded during year 8.8 feet at 5 p. m. April 10; minimum stage recorded, −1.5 feet, about 2 weeks in August.

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

REGULATION.—Operation of power plants above station may modify low-water flow.

ACCURACY.—The two or three measurements made since 1905 indicate that the rating curve used in 1905 was not applicable after that year.

COOPERATION.—Records furnished by city engineer of Grand Rapids.

No discharge measurements made during the year.

Daily gage height, in feet, of Grand River at Grand Rapids, Mich., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	−0.88	−0.6	.....	0.35	0.8	.....	3.95	3.2	.....	0.6	.....
2	−1.02	− .9	− .7	0.45	.55	.8	4.55	4.15	2.8	0.8	.0	.....
3	−1.0	− .88	.....	.7	.85	.7	5.1	4.35	.....	1.2	.....	−1.0
4	−1.02	− .85	− .85	.45	.....	.....	5.15	4.1	2.65	1.5	− .6	.....
5	−1.12	.....	− .75	.35	.9	.7	5.28	4.2	2.2	1.9	.....	.....
6	−1.18	− .88	.7	.35	.9	.5	5.9	.....	1.8	2.0	− .6	.....
7	−1.18	− .9	− .7	.....	.9	.5	6.58	2.25	1.65	2.2	.....	.....
8	.....	− .88	− .7	.35	.9	.4	.....	2.0	4.0	.....	−1.0	− .3
9	−1.15	− .82	− .6	.15	.85	.5	8.4	1.6	4.2	2.3	.....	.....
10	−1.2	− .8	.....	.30	.5	.3	8.7	1.45	.....	2.4	−1.0	.....
11	−1.18	− .8	− .5	.35	.....	.....	8.25	1.25	3.1	2.4	.....	.....
12	−1.15	.....	− .1	.35	.5	3.05	7.45	1.05	2.2	2.3	.....	.....
13	−1.05	− .82	− .4	.4	.5	3.9	6.2	.....	2.0	2.2	−1.5	−1.0
14	−1.1	− .82	− .5	.....	.9	4.4	4.85	.55	1.9	2.3	.....	.....
15	.....	− .68	− .6	.7	1.0	4.4	.....	.25	1.6	.....	−1.5	−1.0
16	−1.15	− .7	− .35	.7	1.0	4.45	3.02	.3	1.2	2.5	.....	.....
17	−1.1	− .7	.....	.8	.6	4.6	2.85	.25	.....	2.6	−1.5	−1.0
18	−1.12	− .65	− .5	.8	.....	.....	2.9	.35	.7	2.7	.....	.....
19	−1.1	.....	− .4	.7	.5	3.5	2.85	.4	.6	2.7	.....	.....
20	− .9	− .8	− .5	.7	.5	3.25	4.3	.....	.5	2.6	.....	.....
21	− .7	− .8	− .5	.....	.5	3.05	5.15	1.45	.5	2.6	−1.5	.....
22	.....	− .75	− .5	.7	.5	2.85	.....	2.6	.4	.....	.....	−1.0
23	− .72	− .5	− .5	.7	.5	3.15	5.9	3.1	.4	2.3	.....	.....
24	− .75	.2	.....	.4	.5	4.0	5.9	2.65	.....	.....	.....	.....
25	− .75	.3	.....	.4	.....	4.4	6.4	2.7	.0	2.0	−1.5	−1.0
26	− .75	.....	− .5	.4	.6	4.45	5.55	2.9	.0	.....	.....	.....
27	− .85	.3	.5	.35	.7	4.45	5.3	.....	.1	1.5	.....	.....
28	− .88	.35	.5	.....	.7	4.32	5.0	3.9	− .1	1.3	.....	.....
29	.....	.3	.35	.3	.....	4.45	.....	4.1	.0	.....	.....	−1.0
30	− .9	.....	.35	.35	.....	4.45	3.9	3.9	.2	.....	.....	.....
31	− .85	.....	.....	.35	.....	4.0	.....	3.6	.....	.8	.....	.....

NOTE.—Gage read to top of ice, Jan. 15, 16, 22, Feb. 5, 15 and 16. Gage heights, Dec. 17-31, Jan. 8-13, 23, 24 and 29, estimated by observer owing to ice.

STREAMS TRIBUTARY TO LAKE HURON.

TITTABAWASSEE RIVER AT FREELAND, MICH.

LOCATION.—At Highway bridge at Freeland.

DRAINAGE AREA.—2,530 square miles.

RECORDS AVAILABLE.—August 22, 1903, to August 3, 1906; October 28, 1906, to December 31, 1909; January 1, 1912, to September 30, 1917.

COOPERATION.—Estimates of daily discharge were made and furnished by G. S. Williams, consulting engineer, Ann Arbor, Mich.

Daily discharge, in second-feet, of Tittabawassee River at Freeland, Mich., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,140	1,300	1,745	1,119	1,201	1,256	3,760	4,770	1,905	3,760	730	930
2	1,110	1,300	1,670	1,130	1,201	1,300	3,285	7,050	1,785	3,285	700	960
3	1,098	1,340	1,600	1,112	1,215	1,300	3,055	7,500	1,600	2,610	646	1,038
4	1,080	1,360	1,560	1,112	1,300	1,300	2,790	8,124	1,705	2,270	630	1,080
5	1,080	1,377	1,572	1,119	1,300	1,244	3,285	6,930	2,190	1,600	592	1,050
6	1,068	1,377	1,520	1,115	1,215	1,244	5,805	4,370	1,785	1,170	550	1,110
7	1,050	1,410	1,560	1,112	1,215	1,285	7,886	4,100	3,484	1,020	513	1,140
8	1,050	1,480	1,600	1,112	1,300	1,300	6,700	3,475	5,275	3,620	513	1,182
9	1,080	1,584	1,863	1,119	1,300	1,410	5,585	2,875	4,600	3,430	540	1,235
10	1,110	1,635	1,985	1,130	1,300	1,455	4,750	2,400	3,484	3,285	561	1,249
11	1,140	1,745	2,015	1,138	1,282	1,522	3,150	1,841	2,835	2,835	582	1,235
12	1,182	1,705	2,000	1,130	1,264	1,545	2,835	1,450	2,065	2,400	620	1,221
13	1,200	1,670	1,880	1,130	1,256	1,760	2,400	1,080	1,600	1,985	646	1,200
14	1,207	1,700	1,760	1,130	1,244	2,010	2,190	1,068	1,480	1,600	760	1,200
15	1,235	1,800	1,675	1,123	1,244	2,500	1,825	1,050	1,390	1,480	786	1,182
16	1,270	1,900	1,522	1,115	1,236	2,950	1,705	1,050	1,270	1,050	760	1,050
17	1,270	1,900	1,527	1,112	1,232	3,400	1,600	1,080	1,122	930	730	930
18	1,270	1,900	1,531	1,112	1,232	3,860	1,480	1,098	1,050	1,080	730	786
19	1,462	1,900	1,640	1,112	1,220	3,910	1,450	1,110	1,020	3,475	760	760
20	1,480	1,900	1,522	1,112	1,232	4,100	1,560	1,110	990	3,683	770	712
21	1,600	1,900	1,441	1,112	1,244	4,500	1,985	1,110	960	3,110	675	700
22	1,753	1,900	1,365	1,134	1,244	5,125	2,270	1,785	930	2,745	592	675
23	1,705	1,900	1,320	1,134	1,264	5,530	2,400	3,760	930	2,400	675	658
24	1,635	1,900	1,300	1,142	1,282	6,250	2,610	6,035	900	2,965	770	646
25	1,600	1,990	1,300	1,150	1,264	6,200	2,355	5,375	870	3,285	760	625
26	1,536	1,985	1,282	1,165	1,244	6,145	2,270	3,955	930	3,055	786	592
27	1,480	1,990	1,264	1,177	1,224	6,090	2,230	3,285	3,520	1,985	930	571
28	1,410	1,945	1,232	1,190	1,244	6,035	2,215	2,745	5,805	1,340	1,056	582
29	1,377	1,900	1,201	1,201	.....	5,275	2,190	2,520	2,735	930	1,080	582
30	1,377	1,785	1,156	1,201	.....	4,750	2,578	2,400	2,250	870	1,050	592
31	1,340	.....	1,112	1,215	.....	4,070	.....	2,081	.....	786	1,020	.....

Monthly discharge of Tittabawassee River at Freeland, Mich., for the year ending Sept. 30, 1917.

[Drainage area, 2530 square miles]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,753	1,050	1,300	0.514	0.59
November	1,990	1,300	1,710	.676	.75
December	2,095	1,112	1,540	.609	.70
January	1,215	1,112	1,140	.451	.52
February	1,300	1,201	1,250	.494	.51
March	6,250	1,244	3,250	1.28	1.48
April	7,886	1,450	3,010	1.19	1.33
May	8,124	1,050	3,180	1.26	1.45
June	5,805	870	2,080	.822	.92
July	3,760	786	2,260	.893	1.03
August	1,080	513	726	.287	.33
September	1,249	571	916	.362	.40
The year	8,124	513	1,870	.739	10.01

NOTE.—Monthly and yearly discharge computed by engineers of the United States Geological Survey.

STREAMS TRIBUTARY TO LAKE ERIE.

HURON RIVER AT BARTON, MICH.

LOCATION.—At dam and power plant of the Eastern Michigan Edison Co. at Barton, near Ann Arbor, 4 miles above the station at Geddes.

DRAINAGE AREA.—723 square miles.

RECORD AVAILABLE.—January 1, 1914, to September 30, 1917.

DETERMINATION OF DISCHARGE.—Flow computed from records of operation of power plant, the flow through under-sluices during floods, and the depth of flow over dam. The flow through the power house is determined from a calibration of the turbines by means of a specially constructed weir, the crest of which was formed by a ¼-inch by 5-inch milled plate, the discharge over the weir being computed by Bazin's formula for free overflow. The greater part of the flood water passes through under-sluices in the power-house foundations, and this flow is determined from a weir calibration of the sluices. Water flows over crest of dam only a few days during the year.

COOPERATION.—Daily-discharge record furnished by G. S. Williams, consulting engineer, Ann Arbor, Mich.

Daily discharge, in second-feet, of Huron River at Barton, Mich., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	160	237	285	322	300	428	886	822	770	780	202	125
2	165	230	309	279	291	429	958	818	800	655	162	129
3	187	227	247	349	304	428	959	786	770	593	167	135
4	172	279	306	304	259	357	952	759	729	532	166	147
5	158	209	376	369	288	358	1,112	717	670	530	225	193
6	213	210	354	361	268	343	1,669	671	734	537	145	247
7	160	236	327	387	235	358	1,581	674	969	489	107	387
8	131	203	330	378	314	441	1,392	625	842	514	114	369
9	179	242	409	408	235	387	1,215	625	874	470	130	348
10	151	287	356	407	249	454	1,132	546	969	434	140	331
11	147	246	371	304	215	786	1,132	523	804	386	138	244
12	162	191	382	315	196	810	1,059	524	850	406	125	220
13	188	256	358	320	213	799	987	509	693	449	130	244
14	235	238	330	244	211	814	935	511	810	392	127	207
15	108	232	235	349	234	778	933	408	745	335	131	246
16	193	262	253	280	238	809	861	430	679	392	132	204
17	175	186	215	273	313	794	808	410	575	436	133	200
18	177	319	313	313	164	753	791	397	561	302	126	202
19	250	139	252	238	266	690	1,021	405	500	340	118	188
20	189	226	266	289	245	755	1,032	369	457	332	135	197
21	293	217	274	223	255	741	1,014	407	475	328	134	181
22	222	282	262	283	246	741	988	618	438	286	121	231
23	243	232	270	250	398	772	953	736	462	337	130	85
24	173	261	178	264	366	814	939	707	501	283	125	177
25	255	341	305	237	319	838	938	636	538	287	121	177
26	258	230	276	278	301	853	929	590	472	282	120	158
27	250	283	279	266	416	950	951	666	498	248	129	158
28	334	337	316	137	438	970	941	685	441	256	166	157
29	236	261	333	359	.....	969	847	639	766	173	131	193
30	275	263	338	343	.....	890	834	679	792	225	133	100
31	336	.....	326	215	.....	865	.....	704	.....	173	165	.....

Monthly discharge of Huron River at Barton, Mich., for the year ending Sept. 30, 1917.

[Drainage area, 723 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	336	108	206	0.285	0.33
November	341	139	245	.339	.38
December	409	178	304	.420	.48
January	408	137	301	.416	.48
February	438	164	278	.385	.40
March	970	343	683	.945	1.09
April	1,669	791	1,020	1.41	1.57
May	822	369	600	.830	.96
June	969	438	673	.931	1.04
July	780	173	393	.544	.63
August	225	107	140	.194	.22
September	387	85	206	.285	.32
The year	1,669	85	421	.582	7.90

NOTE.—Monthly and yearly discharge computed by engineers of the United States Geological Survey.

HURON RIVER AT FLAT ROCK, MICH.

LOCATION.—At the highway bridge at Flat Rock, 2,000 feet below the crossing of Detroit, Toledo & Ironton Railway.

DRAINAGE AREA.—1,000 square miles.

RECORDS AVAILABLE.—August 6, 1904, to September 30, 1917.

GAGE.—Staff; read daily, morning and evening, to tenths, by C. L. Metler.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Probably permanent.

EXTREMES OF STAGE.—Maximum stage recorded during year, 7.6 feet, at 5.30 p. m., April 7; minimum stage recorded, 1.0 foot, September 25 and 29.

ICE.—Ice jams form below the station and cause backwater at the gage; in general the section above the station is kept open by the power plant.

REGULATION.—At ordinary stages flow of the river is controlled by a dam and power plant immediately above station, but operation of this plant is assumed to have little effect on diurnal fluctuations of stage.

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

Daily gage height, in feet, of Huron River at Flat Rock, Mich., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.1	1.85	1.7	1.9	3.0	3.9	4.5	4.35	3.5	4.1	1.6	1.4
2	1.05	1.8	1.95	2.9	3.1	4.0	5.2	4.1	3.7	3.9	1.55	1.4
3	1.4	1.8	1.6	2.45	2.6	3.7	5.4	4.0	3.8	3.35	1.65	1.3
4	1.5	1.8	1.5	2.9	.....	3.3	5.0	3.8	3.5	3.0	1.55	1.45
5	1.35	1.5	1.9	2.65	2.25	3.15	5.2	3.75	3.45	2.75	.....	1.55
6	1.25	1.65	2.15	3.3	3.0	3.55	6.45	3.5	3.75	2.95	1.4	1.6
7	1.4	1.65	1.9	3.6	2.65	3.3	7.45	3.3	4.45	3.1	2.3	2.05
8	1.6	1.7	1.9	3.0	2.8	3.9	7.1	3.6	4.8	2.8	1.6	1.8
9	1.45	1.5	1.85	2.95	2.85	4.95	6.25	3.25	4.6	2.7	1.6	1.8
10	1.4	1.4	1.9	3.0	3.0	3.9	5.7	3.15	4.5	2.75	1.4	1.8
11	1.25	1.7	1.75	3.0	2.6	4.6	5.2	2.95	4.1	2.75	1.4	2.0
12	1.3	1.8	2.0	2.7	2.6	5.5	5.25	2.9	4.0	1.75	1.2	1.8
13	1.45	1.65	1.9	2.55	2.85	6.0	5.0	2.5	4.05	2.45	1.2	1.55
14	1.4	1.7	1.75	2.6	2.4	5.9	4.85	2.7	3.9	2.65	1.65	1.8
15	1.5	1.7	1.9	2.45	2.5	5.85	4.6	2.75	3.3	2.5	1.15	1.65
16	1.4	1.6	1.85	2.95	2.85	5.4	4.4	2.3	3.6	2.3	1.55	1.4
17	1.3	1.65	1.8	2.8	2.45	5.15	4.2	2.2	3.6	3.0	1.4	1.45
18	1.3	1.55	2.05	2.75	3.0	5.1	4.0	2.3	3.2	3.15	1.4	1.8
19	1.4	1.4	1.7	2.55	3.0	4.75	4.85	2.15	2.8	2.7	1.4	1.5
20	1.8	1.55	2.7	2.65	3.0	4.3	6.45	.....	2.8	2.7	1.25	1.6
21	1.95	1.5	2.4	2.7	3.15	3.7	6.05	1.9	2.6	2.15	1.35	1.6
22	1.8	1.5	2.2	2.15	3.0	3.75	5.35	2.75	2.4	2.0	1.45	1.35
23	1.55	1.65	2.45	2.95	2.7	3.7	5.0	3.9	2.55	1.9	1.4	1.4
24	1.75	1.8	2.0	2.75	3.3	4.35	4.85	4.0	3.8	2.1	1.4	1.4
25	1.8	1.8	2.0	2.65	3.5	4.1	4.8	3.75	3.8	2.0	1.65	1.3
26	1.85	1.6	1.95	2.65	3.35	4.4	4.8	2.35	3.25	2.0	1.5	1.45
27	1.75	1.55	2.65	2.7	4.25	4.3	4.8	2.8	2.8	1.75	1.4	1.4
28	1.7	1.7	3.1	2.5	4.2	4.8	4.7	3.4	2.75	1.7	1.45	1.55
29	1.8	1.85	3.0	2.35	.....	4.75	4.3	3.55	3.2	1.6	1.5	1.3
30	1.65	1.8	2.75	3.0	.....	3.65	4.0	3.5	4.45	1.5	1.65	1.4
31	1.85	.....	2.6	3.9	.....	4.25	.....	3.35	.....	1.65	1.35	.....

CATTARAUGUS CREEK AT VERSAILLES, N. Y.

LOCATION.—At the three-span highway bridge in Versailles, Cattaraugus County, 2¼ miles above mouth of Clear Creek, about 6 miles below Gowanda, and about 8 miles above mouth of stream.

DRAINAGE AREA.—467 square miles (measured on post-route map).

RECORDS AVAILABLE.—September 23, 1910, to September 30, 1917.

GAGE.—Chain on upstream side of right span of bridge; read by James Palmer.

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

CHANNEL AND CONTROL.—Bed composed of rock and gravel; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.2 feet at 9 a. m. March 17 (discharge, about 8,460 second-feet); minimum stage recorded, 4.45 feet October 7, 8, and 11 (discharge, 64 second-feet).

1910–1917: Maximum stage recorded, 11.6 feet at 5.40 p. m. March 25, 1913 (discharge, roughly 30,000 second-feet); minimum stage recorded, 4.65 feet August 21 and September 6, 7, 1913 (discharge, 55 second-feet).

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

ACCURACY.—Stage-discharge relation not permanent; affected by ice during much of the period December to March, inclusive. Gage read to half-tenths twice daily. Daily discharge throughout year ascertained by indirect method, applying mean daily effective gage height to rating table; corrections for obtaining effective gage heights determined from discharge measurements. Records fair.

Discharge measurements of Cattaraugus Creek at Versailles, N. Y., 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. 18[a]	C. S. DeGolyer	5.00	247	May 29	E. D. Burchard	6.22	2,190
Feb. 8[b]	E. D. Burchard	8.00	450	June 27	do	6.06	1,870
Mar. 14	do	6.52	2,750	July 13	C. S. DeGolyer	5.24	555
14	do	6.61	3,080	Aug. 31	J. W. Moulton	4.83	239
May 29	do	6.26	2,240	31	do	4.82	231

[a] Incomplete ice cover at gage and control. [b] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Cattaraugus Creek at Versailles, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	98	134	570	340	1,100	1,190	4,030	404	1,440	592	310	200
2	82	178	386	400	900	920	3,130	493	1,190	738	551	180
3	98	154	310	400	750	795	2,120	474	1,810	522	325	625
4	90	154	294	460	650	703	1,350	456	1,050	430	234	297
5	75	154	261	1,800	550	703	1,190	772	920	386	200	200
6	82	143	261	2,800	500	3,000	1,350	1,190	1,710	371	189	200
7	70	143	231	1,400	480	1,520	1,810	920	5,380	310	180	278
8	75	98	178	600	440	1,050	1,520	920	2,120	493	166	920
9	98	114	178	700	440	858	1,050	680	1,440	551	166	551
10	98	143	178	550	440	920	920	551	2,350	456	166	386
11	64	154	189	320	420	4,680	920	592	1,910	1,350	180	245
12	90	189	200	260	380	6,900	1,350	493	1,120	920	166	200
13	124	178	190	340	320	1,910	1,050	493	795	570	180	166
14	348	203	180	400	260	2,350	795	456	680	3,570	200	166
15	203	231	160	380	200	1,810	703	386	592	2,020	189	166
16	154	203	140	300	150	1,120	703	371	570	1,270	189	143
17	134	203	130	300	110	1,910	658	386	551	658	189	143
18	105	203	120	240	130	1,620	570	371	474	551	166	143
19	124	203	110	240	260	858	592	386	493	493	166	143
20	189	245	100	240	240	985	570	920	456	430	143	325
21	217	278	95	240	190	1,620	592	703	404	456	143	258
22	203	217	90	420	150	1,620	493	772	371	430	143	258
23	154	231	90	900	140	2,020	493	920	371	430	200	200
24	134	1,520	95	900	300	5,750	493	1,050	2,020	371	217	166
25	114	709	160	800	1,200	2,020	474	1,620	920	348	217	152
26	203	386	280	650	5,000	1,910	404	920	570	278	180	143
27	154	386	700	550	4,600	2,020	404	920	658	348	166	124
28	154	430	1,270	480	2,000	2,120	404	1,520	592	297	166	152
29	143	920	703	600	.....	2,240	386	2,350	570	1,190	551	166
30	154	1,050	522	1,500	.....	1,520	386	1,520	625	795	474	180
31	134	.....	371	1,400	.....	1,520	.....	1,050	.....	456	217	.....

NOTE.—Discharge, Dec. 13–27 and Jan. 15 to Feb. 26, estimated because of ice from discharge measurements, weather records, study of gage-height graph and comparison with records for stations on streams in adjacent drainage basins.

Monthly discharge of Cattaraugus Creek at Versailles, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 467 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	348	64	134	0.287	0.33
November	1,520	98	319	.683	.76
December	1,270	90	282	.604	.70
January	2,800	240	675	1.45	1.67
February	5,000	110	796	1.70	1.77
March	6,900	703	1,940	4.15	4.78
April	4,030	386	1,030	2.21	2.47
May	2,350	371	808	1.73	1.99
June	5,380	371	1,140	2.44	2.72
July	3,570	278	712	1.52	1.75
August	551	143	223	.478	.55
September	920	124	249	.532	.59
The year	6,900	64	692	1.48	20.08

STREAMS TRIBUTARY TO LAKE ONTARIO.

LITTLE TONAWANDA CREEK AT LINDEN, N. Y.

LOCATION.—At stone-arch highway bridge in Linden, Genesee County, 3 miles above junction with Towanda Creek.

DRAINAGE AREA.—22.0 square miles (measured on topographic maps).

RECORDS AVAILABLE.—July 8, 1912, to September 30, 1917.

GAGE.—Vertical staff on upstream side of right abutment; lower 2 feet of enameled iron, graduated to hundredths of a foot; upper 4 feet of bronze, graduated to half-tenths; read by C. L. Schenck.

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

CHANNEL AND CONTROL.—A standard Francis weir, 2.01 feet long and 8 inches high, has been constructed under the upstream side of the bridge. When the water overtops this weir it flows over a 2-inch plank about 13 feet long, including the 2 feet of weir. During the winter of 1916–17 crest of weir was worn down by ice passing over it and it was necessary to develop a new rating curve. A tree that lodged against the weir June 26 was partly removed June 28 and entirely removed July 14. Crest of weir was repaired August 20.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water marks on gage, 9.5 feet in early morning of June 27 (discharge not computed); minimum stage recorded, 0.20 foot October 8 and 9 (discharge, 0.51 second-foot).

1912–1917: Maximum stage, determined by leveling from flood marks, 14.6 feet during flood of April 22, 1916 (discharge, about 2,400 second-feet); minimum stage recorded, 0.18 foot August 20 and 21, September 14–16, and October 8, 1913 (discharge, 0.43 second-foot).

ACCURACY.—Stage-discharge relation permanent except for changes caused by wearing of crest of weir by ice. Rating curve used October 1 to March 11 and August 21 to September 30, when weir was in good condition, well defined below 250 second-feet and fairly well defined between 250 and 750 second-feet; curves for period during which weir was obstructed by tree or when crest was in damaged condition are fairly well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for period when weir was in good condition; fair for rest of year.

Discharge measurements of Little Tonawanda Creek at Linden, N. Y., 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 28	E. D. Burchard	[a]1.06	27.3	July 14	C. S. DeGolyer	[c]1.10	24.9
28	do	[a]1.07	28.4	14	do	[c]1.06	23.4
28	do	[a]1.55	66.3	Aug. 21	do	[d].44	1.54
28	do	[a]1.62	73.0	21	do	.44	1.58
June 28	do	[b]1.64	56.8	Sept. 1	J. W. Moulton	.64	2.9
28	do	[b]1.63	57.5	1	do	.62	2.9
28	do	[c]1.52	54.6	1	do	.62	2.8
28	do	[c]1.49	53.1				

[a] Crest of weir worn by ice.
[b] Tree lodged against weir.
[c] Portion of tree removed.
[d] Tree entirely removed and weir repaired.

Daily discharge, in second-feet, of Little Tonawanda Creek at Linden, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.68	0.91	3.07	7.2	16	59	314	17	62	84	3.9	3.21
2	.68	.87	2.72	6.1	10.4	47	166	25	33	74	3.5	3.36
3	.63	.87	2.38	6.1	6.6	22	95	19	28	33	3.22	4.6
4	.59	.82	2.51	9.7	6.9	17	57	17	23	23	3.22	2.93
5	.59	.91	6.1	55.0	6.4	13	49	40	47	19	2.90	2.38
6	.59	.87	3.21	91.0	4.9	12	90	55	60	15	2.78	2.18
7	.55	.82	3.00	37	4.6	12	80	36	365	13	2.66	2.79
8	.51	.82	2.79	22	4.6	13	90	26	214	32	2.54	4.6
9	.51	.96	2.79	13	4.2	11.1	62	23	80	22	2.54	4.2
10	.59	1.39	2.72	9.7	3.9	10.7	45	20	142	74	2.42	3.07
11	.59	1.81	2.45	8.7	4.1	302	62	17	189	29	2.20	2.65
12	.59	1.51	2.38	8.1	3.6	335	66	23	71	36	2.20	2.65
13	.77	1.45	2.79	6.1	3.36	136	76	18	44	25	2.10	2.12
14	.87	1.93	2.25	4.9	3.36	100	47	16	33	24	2.90	2.05
15	.72	2.12	2.51	6.1	3.36	45	39	14	26	24	2.30	1.87
16	.68	2.12	2.38	5.3	3.28	56	36	11.5	28	18	2.20	1.74
17	.68	1.99	2.51	3.07	3.21	116	32	11.0	23	16	2.20	1.74
18	.63	2.12	2.25	3.6	5.6	71	30	11.0	26	20	2.20	1.62
19	.77	2.45	2.25	4.6	7.2	47	30	10.0	80	16	2.00	1.62
20	1.07	2.72	2.12	5.1	12	76	29	34	33	12	1.80	2.05
21	1.07	2.79	2.18	4.6	20	116	26	21	23	10	1.74	1.74
22	.91	2.25	1.99	5.1	10	126	23	31	19	8.2	1.74	1.51
23	.87	2.18	1.99	6.1	8.4	183	23	29	16	7.4	1.74	1.51
24	.77	5.1	2.18	6.4	32	305	22	100	42	6.8	1.74	1.45
25	.77	3.5	2.58	5.6	20	148	18	80	28	6.1	1.74	1.45
26	.87	2.86	2.65	4.6	99	166	20	38	121	5.6	1.68	1.45
27	.77	2.45	3.36	4.2	235	189	17	31	290	5.2	1.51	1.39
28	.87	2.51	34.0	3.9	87	100	16	55	53	4.6	1.74	1.99
29	.77	3.07	20.0	4.1	.....	160	14	95	61	10	3.6	1.51
30	.82	3.6	12.0	17	.....	71	17	62	34	5.6	3.21	1.51
31	.77	.....	8.4	29	.....	90	.....	35	.....	4.6	2.65	.....

Monthly discharge of Little Tonawanda Creek at Linden, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 22.0 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1.07	0.51	0.73	0.033	0.04
November	5.1	.82	1.99	.090	.10
December	34	1.99	4.72	.215	.25
January	91	3.07	13.0	.591	.68
February	235	3.21	22.5	1.02	1.06
March	335	10.7	102	4.64	5.35
April	314	14	56.4	2.56	2.86
May	100	10	32.9	1.49	1.72
June	365	16	76.5	3.47	3.87
July	84	4.6	22.0	1.00	1.15
August	3.9	1.51	2.42	.110	.13
September	4.6	1.39	2.30	.105	.12
The year	365	.51	28.1	1.28	17.33

GENESEE RIVER AT SCIO, N. Y.

LOCATION.—At steel highway bridge one-fourth mile above Vandermark Creek, half a mile above Scio, Allegany County, and 1 mile above Knight Creek.

DRAINAGE AREA.—297 miles (measured on map issued by United States Geological Survey, scale, 1:500,000).

RECORDS AVAILABLE.—June 12, 1916, to September 30, 1917.

GAGE.—Vertical staff attached to downstream face of left bridge abutment; read by Raymond Sisson.

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

CHANNEL AND CONTROL.—Coarse gravel; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.1 feet July 2 (discharge, 3,710 second-feet); minimum discharge recorded, 26 second-feet February 13.

1916–17: Maximum stage recorded, 8.7 feet at 8 a. m. June 17, 1916 (discharge, about 9,800 second-feet); minimum stage recorded, 0.60 foot August 25, 26, 1916 (discharge, 25 second-feet).

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during much of period December to March. Rating curve well defined between 25 and 5,500 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records good; winter records fair.

Discharge measurements of Genesee River at Scio, N. Y., 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	E. D. Burchard	0.78	53.4	Mar. 12	E. D. Burchard	5.59	4,480
26	do	.80	56.2	12	do	4.84	3,340
Dec. 30[a]	C. S. DeGolyer	1.66	120	12	do	4.40	2,790
Jan. 20[a]	do	2.34	98	28	C. C. Covert	3.11	1,390
Feb. 10[a]	E. D. Burchard	2.08	65.4	May 31	E. D. Burchard	2.19	679
Mar. 12	do	5.78	4,670	31	do	2.17	675

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Genesee River at Scio, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	41	69	438	140	130	720	1,680	194	690	412	490	815
2	41	64	361	100	120	464	1,490	186	600	3,710	361	990
3	47	69	220	70	100	438	1,400	154	545	1,400	298	720
4	45	57	265	85	100	302	920	147	490	815	247	464
5	43	61	242	190	110	386	885	331	438	660	228	386
6	43	57	220	2,000	100	990	990	850	438	545	198	336
7	38	59	242	1,000	100	600	990	690	3,050	464	186	298
8	43	64	242	340	110	220	850	630	1,780	660	114	307
9	41	69	265	340	90	198	750	630	2,100	815	412	283
10	41	66	198	340	46	198	572	850	1,580	660	220	229
11	49	64	178	320	48	1,150	545	630	1,680	885	162	194
12	45	98	158	280	46	3,310	630	545	1,150	690	121	170
13	53	114	240	280	26	1,070	572	490	815	518	132	151
14	49	158	140	220	40	990	660	438	660	464	1,680	125
15	45	121	150	280	60	750	490	412	572	412	1,150	118
16	43	108	160	260	90	630	464	283	545	326	690	91
17	43	108	60	260	110	990	361	312	464	283	518	88
18	43	111	90	200	160	750	361	279	412	251	386	88
19	55	77	60	120	180	518	336	260	386	885	298	88
20	53	77	65	90	180	490	312	545	288	720	247	88
21	49	59	70	90	160	850	288	412	274	412	216	85
22	53	55	60	95	130	690	302	600	242	293	172	80
23	51	59	90	220	100	990	274	600	220	260	322	69
24	66	386	60	220	90	2,560	242	545	1,310	386	336	61
25	53	220	75	280	100	920	229	572	438	361	216	61
26	43	224	90	190	140	1,230	202	490	312	490	198	61
27	61	202	95	180	2,100	1,580	202	518	780	464	162	72
28	66	220	180	100	720	1,490	186	1,070	386	279	128	83
29	61	690	170	110	.....	1,150	174	1,230	720	1,880	143	83
30	64	572	120	110	.....	920	288	955	490	1,150	336	83
31	66	.....	120	100	.....	920	.....	750	.....	690	361	.....

NOTE.—Discharge, Dec. 13 to Feb. 27, estimated because of ice from discharge measurements, weather records, study of gage-height graph and comparison with records for stations at St. Helena and Jones Bridge.

Monthly discharge of Genesee River at Scio, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 297 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	66	38	49.5	0.167	0.19
November	572	55	145	.488	.54
December	438	60	165	.556	.64
January	2,000	70	278	.936	1.08
February	2,100	26	196	.660	.69
March	3,310	198	918	3.09	3.56
April	1,680	174	588	1.98	2.21
May	1,230	147	535	1.80	2.08
June	3,050	220	795	2.68	2.99
July	3,710	251	717	2.41	2.78
August	1,680	121	346	1.16	1.34
September	990	61	226	.762	.85
The year	3,710	26	415	1.40	18.95

GENESEE RIVER AT ST. HELENA, N. Y.

LOCATION.—At steel highway bridge in St. Helena, Wyoming County, 5½ miles below Portageville and site of proposed storage dam of New York Conservation Commission and 9½ miles above mouth of Canaseraga Creek.

DRAINAGE AREA.—1,030 square miles.

RECORDS AVAILABLE.—August 14, 1908, to September 30, 1917.

GAGE.—Gurley seven-day water-stage recorder, installed July 22, 1916. Prior to that date a chain gage fastened to upstream side of bridge, middle span, installed August 14, 1908, and a Gurley printing water-stage recorder, installed August 24, 1911. Water-stage recorder inspected and chain gage read by Herman Piper.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Gravel and rocks; shifting occasionally.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 8.70 feet at 11 a. m. March 12 (discharge, 16,700 second-feet); minimum stage, from water-stage recorder, 1.80 feet at 1 a. m. October 2 (discharge, 50 second-feet).

1908–1917: Maximum stage, from water-stage recorder, 12.81 feet at 8 a. m. May 17, 1916 (discharge, 43,500 second-feet); minimum stage recorded, 1.70 feet at 5 p. m. October 5 and 8 a. m. October 17, 1913 (discharge, about 18 second-feet).

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

ACCURACY.—Stage-discharge relation not permanent. Rating curve for water-stage recorder, used October 1 to March 12 and September 17–30, well defined between 75 and 2,000 second-feet and fairly well defined between 2,000 and 30,000 second-feet; rating curve for chain gage, used March 12 to September 16, well defined between 500 and 1,600 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for days of great range in stage, when it was determined by averaging results obtained by applying to rating table gage heights for 2-hour periods. Records good.

Discharge measurements of Genesee River at St. Helena, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height.		Discharge.	Date.	Made by—	Gage height.		Discharge.
		Chain.	Hook.				Chain.	Hook.	
		Feet.	*Feet.*	*Sec.-ft.*			*Feet.*	*Feet.*	*Sec.-ft.*
Dec. 29[a]	C. S. De Golyer..	4.08	4.03	990	May 26	E. D. Burchard..	3.96	4.00	1,440
Jan. 29[b]	.....do.....	5.09	5.07	300	June 22	.....do.....	3.18	3.31	648
Feb. 22[b]	.....do.....	5.03	5.04	459	27	C. S. De Golyer..	4.72	4.91	2,500
Mar. 16	E. D. Burchard..	4.40	4.22	2,010	Sept. 14	J. W. Moulton...	2.72	2.70	338
Apr. 13	C. S. De Golyer..	4.24	4.45	1,800	14	.....do.....	2.72	2.70	321
May 18	E. D. Burchard..	3.24	3.24	707	26	.....do.....	2.51	2.49	198
18	.....do.....	3.24	3.24	717					

[a] Measurement made through incomplete ice cover.
[b] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Genesee River at St. Helena, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	81	177	1,760	420	900	4,180	5,850	482	2,510	1,040	1,200	550
2	104	189	1,190	460	900	2,740	7,610	550	2,340	3,450	940	1,480
3	111	201	890	380	650	2,090	4,810	590	2,030	3,660	760	2,030
4	110	209	738	380	480	1,480	3,050	496	1,360	2,030	590	1,040
5	107	167	672	1,100	440	738	2,340	760	1,140	1,300	454	670
6	104	193	624	5,000	320	680	2,680	2,030	1,480	1,040	428	670
7	134	174	530	4,200	280	792	4,330	3,250	9,990	895	386	670
8	84	160	457	2,400	280	921	3,050	2,340	4,330	1,420	332	1,090
9	142	159	436	2,800	220	820	2,510	1,610	4,100	1,810	326	1,040
10	100	180	436	1,900	170	765	1,880	2,510	5,320	1,360	590	670
11	124	229	429	1,400	320	5,200	1,680	1,880	7,610	3,880	392	496
12	114	236	370	850	320	15,500	2,100	1,360	3,250	2,180	314	416
13	126	239	328	650	280	4,330	1,610	990	2,180	1,420	309	368
14	209	259	260	700	260	3,880	1,300	1,040	1,610	3,250	428	326
15	195	325	220	700	220	3,450	1,200	850	1,300	3,660	2,680	356
16	198	415	260	600	220	2,030	940	670	1,140	1,540	2,030	270
17	180	376	220	460	220	3,050	940	715	1,040	1,040	1,040	247
18	170	350	190	360	260	3,450	940	670	940	1,040	760	234
19	170	312	170	340	340	1,960	850	590	1,140	1,250	590	234
20	228	396	170	360	460	1,740	850	990	940	1,140	468	590
21	285	485	170	400	500	3,450	805	1,360	715	895	392	392
22	299	436	170	500	420	3,050	760	1,300	590	760	386	292
23	275	376	130	650	380	4,100	760	1,880	510	670	368	247
24	236	1,590	150	700	420	10,700	670	1,480	4,570	510	410	238
25	224	1,310	170	750	600	4,570	630	2,030	2,030	895	550	220
26	196	910	200	380	3,200	4,570	590	1,360	1,300	670	356	204
27	173	810	220	340	10,600	5,060	510	1,140	2,510	940	326	204
28	170	810	360	240	7,270	5,320	496	2,680	1,420	760	276	212
29	113	2,480	900	280	.....	4,100	489	4,810	990	4,570	386	216
30	175	2,740	700	360	.....	3,250	454	3,450	1,260	4,810	404	200
31	169	.....	500	600	.....	3,050	.....	2,180	.....	1,810	550	.....

NOTE.—Discharge, Dec. 14 to Feb. 26, estimated because of ice from discharge measurements, weather records, study of gage-height graph and comparison with records for Scio, Jones Bridge and Rochester. Record Mar. 13 to Sept. 16 obtained by using mean daily gage height determined from 2 readings of chain gage per day; water-stage recorder in operation during rest of year.

Monthly discharge of Genesee River at St. Helena, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 1,030 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	299	81	165	0.160	0.18
November	2,740	159	563	.547	.61
December	1,760	130	452	.439	.51
January	5,000	240	989	.960	1.11
February	10,600	170	1,100	1.07	1.11
March	15,500	680	3,580	3.47	4.00
April	7,610	454	1,890	1.84	2.05
May	4,810	482	1,550	1.50	1.73
June	9,990	510	2,390	2.32	2.59
July	4,810	510	1,800	1.75	2.02
August	2,680	276	627	.609	.70
September	2,030	204	529	.513	.57
The year	15,500	81	1,340	1.30	17.18

GENESEE RIVER AT JONES BRIDGE, NEAR MOUNT MORRIS, N. Y.

LOCATION.—At highway bridge known as Jones Bridge, 1½ miles below Canaseraga Creek, 1¾ miles above mouth of Beads Creek, 5 miles below Mount Morris, Livingston County, and 6 miles by river above Geneseo.

DRAINAGE AREA.—1,410 square miles.

RECORDS AVAILABLE.—May 22, 1903, to April 30, 1906; August 12, 1908, to December 31, 1913; July 12, 1915, to September 30, 1917.

GAGE.—Gurley seven-day water-stage recorder installed September 11, 1915, on right bank 60 feet downstream from bridge. Prior to 1915 a chain gage fastened to upstream side of highway bridge was used. Datum of water-stage recorder, 2.73 feet higher than that of chain gage (540.00 feet Conservation Commission datum). Recorder inspected by Theron S. Trewer.

DISCHARGE MEASUREMENTS.—Made from footbridge erected on lower chord of upstream bridge truss.

CHANNEL AND CONTROL.—Sandy clay; likely to shift but, as shown by discharge measurements, fairly permanent in recent years.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 23.5 feet at 2.30 p. m. March 12 (discharge, 31,800 second-feet); minimum stage, from water-stage recorder, 0.63 foot at 6 p. m. October 2 (discharge, 92 second-feet).

1902–1917: Maximum stage recorded, 25.44 feet at noon May 17, 1916 (discharge, 55,100 second-feet); minimum stage recorded, 2.7 feet at 6 p. m. August 29, 1909 (discharge, about 18 second-feet). See paragraph headed "Records available" for limits of periods of no records.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Some diurnal fluctuation due to operation of mills at Mount Morris is observable during extremely low water.

ACCURACY.—Stage-discharge relation practically permanent between dates of shifting; affected by ice for much of January, February, and March. Rating curve well defined between 150 and 7,000 second-feet and fairly well defined between 7,000 and 60,000 second-feet. Operation of water-stage recorder satisfactory throughout year. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting recorder graph or, for days of considerable fluctuation, by discharge integrator.

Discharge measurements of Genesee River at Jones Bridge, near Mount Morris, N. Y., 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. 27	E. D. Burchard	1.29	259	May 23	E. D. Burchard	4.74	2,210
Jan. 1[a]	C. S. De Golyer	3.38	620	23	do	4.75	2,230
18[b]	E. D. Burchard	4.18	487	25	do	5.12	2,370
Feb. 16[b]	C. C. Covert	2.38	302	June 20	do	3.74	1,550
Mar. 9	O. W. Hartwell	8.99	1,140	29	do	4.10	1,680
15	E. D. Burchard	12.25	4,990	July 14	do	7.25	3,870
30	O. W. Hartwell	7.49	4,040	Aug. 24	C. S. De Golyer	2.09	613
30	do	7.05	3,720				

[a] Measurement made through incomplete ice cover.
[b] Measurement made through complete ice cover.

NOTE.—Gage heights of discharge measurements July 28 and Aug. 5, 1915, as published in Water-Supply Paper 404, p. 69, are in error. Correct gage height of measurement July 28 is 3.96 feet; that for Aug. 5 is 6.01 feet.

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Daily discharge, in second-feet, of Genesee River at Jones Bridge, near Mount Morris, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	166	254	1,860	650	1,700	6,000	5,990	715	2,540	1,600	2,080	765
2	118	288	1,240	700	1,800	2,800	7,130	740	3,030	3,510	1,200	1,200
3	154	271	962	650	1,600	1,600	6,420	790	2,150	5,560	915	1,960
4	160	305	780	600	950	1,000	3,900	740	1,780	2,610	815	1,370
5	161	254	730	800	650	1,100	2,820	953	1,420	1,840	700	920
6	152	271	680	7,000	600	1,100	3,190	2,180	1,720	1,420	640	815
7	153	264	612	5,500	500	1,200	4,390	3,630	9,440	1,600	565	815
8	139	246	545	3,400	480	1,200	3,900	2,960	9,360	1,660	525	1,190
9	125	254	502	2,600	480	1,100	3,240	2,150	4,800	2,220	506	1,420
10	183	254	502	1,900	400	1,100	2,340	2,680	4,980	2,000	665	920
11	149	288	502	1,300	340	3,200	2,020	2,280	8,530	4,030	640	715
12	161	323	460	900	300	14,000	2,410	1,720	4,630	3,240	515	615
13	165	341	379	750	280	13,000	2,410	1,480	2,890	2,150	470	540
14	231	360	340	850	280	8,000	1,780	1,300	2,220	3,130	520	484
15	254	399	300	800	280	5,500	1,480	1,080	1,780	5,710	1,990	448
16	271	502	400	600	280	2,000	1,360	948	1,540	2,410	2,080	399
17	271	502	420	500	280	2,000	1,250	892	1,420	1,660	1,330	381
18	254	460	400	460	400	3,200	1,170	892	1,220	1,540	948	365
19	238	419	360	400	500	1,700	1,110	815	2,310	1,600	790	361
20	264	460	320	320	650	1,500	1,080	1,030	1,300	1,780	690	815
21	360	545	340	340	700	3,400	1,080	1,480	1,280	1,300	615	740
22	399	568	340	420	700	3,400	1,030	1,420	1,000	1,300	555	492
23	399	502	280	460	650	4,890	975	2,010	865	1,000	565	403
24	341	978	260	600	700	10,700	975	1,900	3,510	840	590	369
25	323	1,560	320	850	1,000	8,560	865	2,150	3,330	892	590	357
26	305	1,020	360	750	1,800	5,530	815	1,900	1,980	1,030	550	334
27	254	935	420	500	7,500	5,530	790	1,480	4,220	920	452	319
28	254	830	500	380	10,000	6,630	765	2,630	2,710	1,150	416	327
29	225	1,580	1,000	380	.....	4,970	715	5,780	1,720	2,800	470	323
30	186	2,480	1,200	550	.....	4,130	690	4,500	1,660	8,150	565	371
31	238	.....	850	900	.....	3,310	.....	2,960	.....	2,570	615	.....

NOTE.—Discharge, Dec. 14 to Mar. 22, determined, because of ice, from discharge measurements, weather records, study of gage height graph and comparison with records for Rochester and St. Helena. Discharge, Aug. 19, 24 and 25, estimated; no gage-height record.

Monthly discharge of Genesee River at Jones Bridge, near Mount Morris, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 1,410 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	399	118	228	0.162	0.19
November	2,480	246	590	.419	.47
December	1,860	260	586	.416	.48
January	7,000	320	1,190	.844	.97
February	10,000	280	1,280	.908	.95
March	14,000	1,000	4,300	3.05	3.52
April	7,130	690	2,270	1.61	1.80
May	5,780	715	1,880	1.33	1.53
June	9,440	865	3,040	2.16	2.41
July	8,150	840	2,360	1.67	1.92
August	2,080	416	794	.563	.65
September	1,960	271	681	.483	.54
The year	14,000	118	1,600	1.13	15.43

GENESEE RIVER AT ROCHESTER, N. Y.

LOCATION.—At Elmwood Avenue Bridge at north end of South Park, 3½ miles below mouth of Black Creek, 3½ miles above center of city of Rochester, Monroe County, and 7½ miles above mouth of river.

DRAINAGE AREA.—2,360 square miles.

RECORDS AVAILABLE.—February 9, 1904, to September 30, 1917. Fragmentary records prior to this period published in Water-Supply Papers 24, 65 and 97.

GAGE.—Gurley water-stage recorder installed in December, 1910, in the pump house on right bank, immediately below the bridge. Recorder inspected by George A. Bailey. Prior to December, 1910, a staff gage bolted to downsteam end of first pier from right abutment. Elevation of zero of gage, 506.848 feet, Barge Canal datum, and 245.591 feet, Rochester City datum.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge. Prior to 1904 measurements and elevation of water surface taken in conjunction with the city of Rochester.

CHANNEL AND CONTROL.—Smooth gravel; apparently permanent.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 7.38 feet at 7 p. m. March 14 (discharge, 14,200 second feet); minimum stage, from water stage recorder, 0.95 foot at 12 p. m. October 9 (discharge, 214 second-feet.)

1904–1917: Maximum stage, from water-stage recorder, 15.3 feet at midnight March 30, 1916 (discharge, 48,300 second-feet); minimum stage from water-stage recorder, 0.71 foot from 10 p. m. September 30 to 4 a. m. October 1, 1913 (discharge, 154 second-feet.

ICE.—Stage-discharge relation affected by ice during a large part of the period from December to March.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 2,000 and 44,000 second-feet. Operation of water-stage recorder satisfactory throughout year. Daily discharge ascertained by applying to rating table mean daily gage height obtained by averaging hourly gage heights. Open-water records good; other records fair.

COOPERATION.—Water-stage recorder inspected by an employee of the Rochester Railway & Light Co.

Discharge measurements of Genesee River at Rochester, N. Y., 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]	C. S. De Golyer	1.71	859	Mar. 16	E. D. Burchard	5.27	8,090
17[a]	E. D. Burchard	2.20	756	May 16	do	2.04	1,490
Feb. 7[a]	do	2.00	794	17	do	1.94	1,320
Mar. 8[a]	O. W. Hartwell	2.04	1,220	June 20	do	3.22	3,430

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Genesee River at Rochester, N. Y., for the year ending Sept. 30, 1917.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	282	375	1,880	1,100	950	9,500	4,800	1,100	3,580	2,760	2,760	880
2	258	375	1,370	850	1,500	7,000	8,600	1,110	3,490	3,400	1,880	1,060
3	266	393	1,110	800	2,000	4,600	8,600	1,110	3,300	6,050	1,440	1,210
4	274	402	980	800	1,800	3,200	7,030	1,160	2,680	5,350	1,250	2,060
5	274	411	884	800	1,300	2,400	4,700	1,160	2,260	3,210	1,020	2,000
6	290	393	800	1,400	950	1,600	4,600	2,180	2,260	2,260	932	2,900
7	274	411	740	5,500	750	1,200	7,280	3,780	5,460	2,040	860	2,620
8	282	411	718	4,400	500	1,200	7,540	4,380	13,300	2,080	788	1,040
9	243	384	685	2,600	500	1,500	6,050	3,490	10,300	2,590	729	1,180
10	243	393	608	2,000	500	1,700	4,600	2,760	6,580	3,030	696	1,740
11	290	402	586	1,800	480	2,400	3,400	3,120	11,500	3,120	812	1,370
12	266	402	641	1,300	440	8,060	3,120	2,590	11,200	5,020	824	1,070
13	274	470	597	1,000	420	13,000	3,580	2,100	6,530	3,780	707	884
14	282	520	510	850	460	14,000	3,210	1,880	4,380	2,940	824	788
15	306	520	520	850	480	13,000	2,590	1,650	3,210	5,000	908	707
16	314	553	402	900	500	8,870	2,260	1,440	2,680	5,400	2,340	652
17	366	630	348	850	460	5,930	2,100	1,290	2,340	2,940	2,180	608
18	393	641	430	750	420	6,530	2,000	1,240	2,020	2,340	1,520	586
19	366	575	402	700	500	6,050	1,840	1,230	2,260	2,760	1,150	597
20	375	586	402	650	750	4,280	1,760	1,270	3,120	2,850	944	575
21	366	619	393	600	950	4,490	1,710	1,640	2,340	2,500	848	824
22	402	685	411	600	1,100	5,810	1,640	2,060	1,940	2,020	764	1,290
23	440	788	470	750	1,100	5,700	1,540	2,260	1,590	1,800	685	980
24	520	1,230	520	850	1,000	8,330	1,510	2,760	2,340	1,440	685	729
25	490	1,520	375	700	1,200	12,400	1,470	2,760	4,700	1,180	696	674
26	450	1,070	375	1,100	1,500	8,870	1,340	3,030	3,400	1,240	707	641
27	430	1,110	430	1,100	4,400	7,030	1,280	2,500	5,240	1,370	696	586
28	411	1,040	460	850	11,000	7,540	1,240	2,180	6,050	1,300	660	564
29	375	1,920	500	650	.....	7,540	1,150	4,600	3,880	1,440	630	553
30	348	2,500	750	650	.....	6,290	1,100	6,780	2,850	5,020	650	564
31	348	.....	1,200	700	.....	5,020	.....	5,240	.....	5,930	740	.....

NOTE.—Discharge, Dec. 28 to Mar. 11, estimated because of ice from discharge measurements, weather records, study of gage-height graph and comparison with similar studies for St. Helena and Jones Bridge. Discharge estimated, because of no gage heights, for the following periods: June 9, 10, July 15, 16, and Aug. 28 to Sept. 2.

Monthly discharge of Genesee River at Rochester, N. Y., for the year ending Sept. 30, 1917.

[Drainage Area, 2,360 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	520	243	339	0.144	0.17
November	2,500	375	724	.307	.34
December	1,880	348	661	.280	.32
January	5,500	600	1,240	.525	.61
February	11,000	420	1,350	.572	.60
March	14,000	1,200	6,290	2.67	3.08
April	8,600	1,100	3,450	1.46	1.63
May	6,780	1,100	2,450	1.04	1.20
June	13,300	1,590	4,560	1.93	2.15
July	6,050	1,180	3,040	1.29	1.49
August	2,760	630	1,040	.441	.51
September	2,900	553	1,060	.449	.50
The year	14,000	243	2,190	.928	12.60

CANASERAGA CREEK NEAR DANSVILLE, N. Y.

LOCATION.—At highway bridge 1 mile west of Dansville, Livingston County, 2,200 feet below mouth of Mill Brook and about 22 miles above mouth of creek.

DRAINAGE AREA.—167 square miles (measured by engineers of the State of New York Conservation Commission).

RECORDS AVAILABLE.—July 21, 1910, to December 31, 1912; July 10, 1915, to June 30, 1917, when station was discontinued.

GAGE.—Vertical staff at downstream side of left abutment; datum lowered 4.77 feet (to Conservation Commission datum, 640.00 feet) July 10, 1915. Gage read by Floyd Harter.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Sand and gravel; shifting frequently.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.3 feet at 7 a. m. June 11 (discharge, about 2,380 second-feet); minimum stage recorded, 5.2 feet several times during October and November (discharge, about 15 second-feet).

1910–1912 and 1915–1917: Maximum stage recorded, 13.0 feet at 9.30 p. m. May 16, 1916 (discharge, determined from logarithmic extension of rating curve roughly, 6,600 second-feet); minimum stage recorded, 5.2 feet several times during October and November, 1916.

ICE.—Stage-discharge relation affected by ice; observations of stage discontinued during winter.

ACCURACY.—Stage-discharge relation not permanent; frequent discharge measurements necessary for determination of discharge; affected by ice December to March. Rating curve not well defined. Gage read to half tenths twice daily. Daily discharge October 1 to December 12 ascertained by applying daily gage height to rating table; March 1 to June 30, by shifting-control method. Records fair.

Discharge measurements of Canaseraga Creek near Dansville, N. Y., 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]	E. D. Burchard	6.15	44.7	July 12	C. S. DeGolyer	7.00	407
Mar. 9	O. W. Hartwell	6.00	98.7	12	do	6.92	344
29	do	6.88	365	16	E. D. Burchard	6.57	203
29	do	6.88	371	16	do	6.55	204
May 22	E. D. Burchard	6.38	178	31	C. C. Covert	6.45	143
22	do	6.38	177	Aug. 25	C. S. DeGolyer	5.94	52.7
June 23	do	6.20	112	Sept. 20	E. D. Burchard	6.32	132
23	do	6.20	116	20	do	6.30	127

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Canaseraga Creek near Dansville, N. Y., for the period Oct. 1, 1916, to June 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.
1	32	18	50	1,030	730	39	315
2	28	15	39	928	730	36	210
3	21	16	28	653	291	34	165
4	20	15	26	538	271	36	165
5	19	18	25	460	175	80	187
6	18	16	23	443	281	382	257
7	18	15	25	162	276	271	1,780
8	18	15	42	82	231	198	1,000
9	18	16	25	69	109	240	465
10	18	16	25	95	136	253	1,260
11	16	16	25	1,330	125	162	2,240
12	15	19	24	920	125	131	1,540
13	25	28	24	355	120	125	1,020
14	32	23	24	257	112	100	716
15	18	21	24	139	107	90	495
16	16	20	22	65	102	75	281
17	15	21	22	69	102	79	136
18	18	20	22	218	102	75	267
19	18	21	22	214	97	73	1,700
20	23	20	22	125	86	136	1,100
21	23	23	20	114	71	109	590
22	21	30	20	90	65	158	206
23	20	42	20	597	60	168	86
24	21	102	20	1,140	56	206	1,380
25	20	128	20	558	68	179	438
26	20	54	20	372	125	191	410
27	18	36	24	432	66	223	1,180
28	16	68	26	366	58	253	525
29	16	71	28	460	45	231	410
30	15	59	24	286	43	912	236
31	15	.....	22	149	.....	674	.....

NOTE.—Discharge, Dec. 12-31, estimated because of ice from one discharge measurement, weather records and study of gage-height graph. Discharge for January and February not computed because of ice.

Monthly discharge of Canaseraga Creek near Dansville, N. Y., for the period Oct. 1, 1916, to June 30, 1917.

[Drainage area, 167 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	32	15	19.7	0.118	0.14
November	128	15	32.7	.196	.22
December	50	20	25.3	.151	.17
March	1,330	65	410	2.45	2.82
April	730	43	166	.994	1.11
May	912	34	191	1.14	1.31
June	2,240	86	692	4.14	4.62

CANASERAGA CREEK AT GROVELAND STATION, N. Y.

LOCATION.—At highway bridge at Groveland Station, Livingston County.

DRAINAGE AREA.—195 square miles (measured by engineers of State of New York Conservation Commission.)

RECORDS AVAILABLE.—August 5, 1915, to September 30, 1916; February 28 to September 30, 1917.

GAGE.—Chain gage near center of downstream side of bridge. Prior to March 30, 1916, inclined staff on right bank about 400 feet above bridge, at practically same datum (560.00 feet, Conservation Commission datum). Gage read by L. J. Dagon and Thomas Maimone.

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

CHANNEL AND CONTROL.—Creek flows through improved channel which is in gravel and is likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.5 feet from 2 to 3 p. m. July 29 (discharge, 4,170 second-feet); minimum stage recorded, 6.7 feet at 6 p. m. August 20 and 8 a. m. and 6 p. m. August 26, 27 (discharge, 47 second-feet).

1915–1917: Maximum stage recorded July 29, 1917; minimum stage recorded, 6.5 feet from 6 p. m. September 21 to 6 p. m. September 22, 1916 (discharge 36 second-feet).

ICE.—Stage-discharge relation affected by ice. Observations of stage suspended during winter.

ACCURACY.—Stage-discharge relation permanent; affected by ice December to March. Rating curve well defined between 35 and 3,000 second-feet. Gage read by half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except those for floods of several days' duration, when stage-discharge relation may be affected by backwater.

Discharge measurements of Canaseraga Creek at Groveland Station, N. Y., 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.*
Mar. 29	O. W. Hartwell	9.16	432	July 13	E. D. Burchard	8.28	240
May 19	E. D. Burchard	7.16	89.3	13	do	8.28	234
19	do	7.15	90.8	Aug. 25	C. D. De Golyer	6.83	60.2
June 21	do	8.40	276	Sept. 20	E. D. Burchard	7.80	182
July 11	C. S. De Golyer	9.39	443	20	do	7.73	169

Daily discharge, in second-feet, of Canaseraga Creek at Groveland Station, N. Y., for the year ending Sept. 30, 1917.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	675	675	.....	238	292	.....	83
2	.....	517	555	.....	221	328	.....	.....
3	.....	441	460	.....	171	274	.....	.....
4	.....	422	292	.....	139	171	.....	.....
5	.....	365	238	.....	139	147	78	.....
6	.....	.....	328	.....	196	147	72	.....
7	.....	.....	.....	.....	1,130	238	72	.....
8	.....	441	.....	.....	517	274	72	.....
9	.....	403	.....	.....	403	256	72	.....
10	.....	346	221	.....	1,730	204	67	.....
11	.....	1,050	212	.....	695	655	58	.....
12	.....	1,170	328	.....	403	441	54	.....
13	.....	460	274	.....	274	274	72	.....
14	.....	403	204	.....	204	517	62	.....
15	.....	328	171	.....	109	441	62	.....
16	.....	221	163	.....	163	292	62	.....
17	.....	365	139	.....	132	221	62	.....
18	.....	328	132	.....	116	187	62	.....
19	.....	221	124	89	635	292	54	.....
20	.....	221	102	155	256	171	47	.....
21	.....	346	124	147	274	328	54	.....
22	.....	292	109	171	171	171	72	.....
23	.....	384	109	238	139	132	54	.....
24	.....	955	109	196	655	109	72	.....
25	.....	460	89	221	346	109	54	.....
26	.....	441	95	171	256	116	47	.....
27	3,010	517	102	274	292	147	47	50
28	955	517	95	575	365	109	50	50
29	.....	403	83	595	310	955	78	54
30	.....	328	83	384	238	479	204	62
31	.....	292	.....	346	.....	196	109	.....

NOTE.—No gage-height record Oct. 1 to Feb. 26, Mar. 6, 7, Apr. 7–9, May 1–18, Aug. 1–4 and Sept. 2–26; mean discharge estimated as follows: Mar. 6 and 7, 400 second-feet; Apr. 7–9, 300 second-feet; Aug. 1–4, 110 second-feet.

Monthly discharge of Canaseraga Creek at Groveland Station, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 195 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
March	1,170	221	455	2.33	2.69
April	675	83	217	1.11	1.24
June	1,730	109	364	1.87	2.09
July	955	109	280	1.44	1.66
August	204	47	74.5	.382	.44

CANASERAGA CREEK AT SHAKERS CROSSING, N. Y.

LOCATION.—At highway bridge at Shakers Crossing, about a mile above mouth, and 1¼ miles northeast of Mount Morris, Livingston County.

DRAINAGE AREA.—347 square miles (measured by engineers of New York State Conservation Commission).

RECORDS AVAILABLE.—Occasional current-meter measurements 1904–1915: continuous record of gage height and occasional current-meter measurements July 13, 1915, to September 30, 1917.

GAGE.—Gurley seven-day water-stage recorder on the left bank, just below bridge. Datum of gage same as that established on Genesee River at Jones Bridge near Mount Morris July 12, 1915 (540.00 feet Conservation Commission datum). Recorder inspected by Mrs. Wm. Russell.

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

CHANNEL AND CONTROL.—Firm gravel; not likely to shift; subject to backwater from Genesee River.

ICE.—Stage-discharge relation affected by ice.

EXTREMES OF STAGE.—Maximum stage during year, from water-stage recorder, 25.10 feet at 4 p. m. March 12; minimum stage, from water-stage recorder, 7.95 feet at 11 p. m. October 30.

1915–1917: Maximum stage, from water-stage recorder, 28.92 feet at 1 p. m. May 17, 1916; minimum stage, from water-stage recorder, 7.95 feet at 11 p. m. October 30, 1916.

Data on extent and duration of backwater from Genesee River too meager to permit accurate determination of discharge.

Discharge measurements of Canaseraga Creek at Shakers Crossing, N. Y., 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. 28	E. D. Burchard	7.99	47.5	July 11	C. S. DeGolyer	13.93	1,090
28	do	7.99	49.3	14	E. D. Burchard	11.77	966
Jan. 18[a]	do	9.58	223	Aug. 23	C. S. DeGolyer	9.03	227
Mar. 8[b]	O. W. Hartwell	11.22	367	Sept. 20	E. D. Burchard	9.39	379
28	do	14.11	913	20	do	9.51	405
May 21	E. D. Burchard	9.63	360				

[a] Measurement made through complete ice cover. [b] Measurement made through partial ice cover.

Daily gage height, in feet, of Canaseraga Creek at Shakers Crossing, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8.25	8.06	9.29	8.91	10.72	17.65	13.81	9.03	10.34	.....	9.52	8.94
2	8.12	8.40	9.00	9.03	10.47	14.22	14.64	8.99	10.57	12.67	9.15	9.12
3	8.22	8.73	8.67	9.01	9.94	12.44	14.02	9.02	9.74	12.84	9.10	9.78
4	8.19	8.70	8.79	9.11	9.69	11.62	11.61	8.98	9.56	.....	9.09	8.98
5	8.22	8.35	8.80	9.50	9.67	11.52	10.58	9.71	9.25	.....	8.75	8.88
6	8.20	8.70	8.68	15.34	9.61	11.08	11.48	10.83	9.79	.....	9.09	8.91
7	8.24	8.72	8.65	12.50	9.55	11.16	12.64	11.81	17.40	.....	9.09	8.89
8	8.27	8.67	8.68	10.09	9.55	11.18	11.83	10.93	16.13	10.50	9.04	9.70
9	8.15	8.66	8.69	9.58	9.60	11.37	11.19	10.15	12.48	10.50	9.05	9.41
10	8.33	8.73	8.51	9.38	9.59	11.02	10.27	10.51	12.53	9.95	9.01	9.03
11	8.25	8.86	8.63	9.17	9.62	13.55	10.04	9.92	15.91	12.57	8.94	8.89
12	8.25	8.47	8.67	9.35	9.58	23.60	10.57	9.58	12.34	11.33	8.58	8.80
13	8.27	8.70	8.63	9.38	.....	22.47	10.28	9.26	10.65	10.18	8.65	8.78
14	8.60	8.89	8.65	9.41	.....	17.76	9.80	9.31	9.92	11.54	9.15	8.72
15	8.69	8.92	8.89	9.49	.....	14.86	9.27	9.22	9.44	13.56	9.96	8.67
16	8.74	8.87	8.91	9.48	.....	11.18	9.49	9.15	9.38	10.48	9.45	8.44
17	8.71	8.80	8.50	9.46	9.69	11.79	9.41	9.13	9.18	9.72	8.80	8.68
18	8.62	8.81	8.73	9.47	9.94	12.71	9.32	9.10	9.25	9.85	8.78	8.65
19	8.56	8.55	8.80	9.48	10.17	10.50	9.33	9.10	11.66	10.04	8.75	8.69
20	8.88	8.72	8.78	9.55	10.29	10.14	9.31	9.15	10.26	9.66	8.75	9.33
21	9.04	8.84	8.73	9.49	10.10	12.05	9.24	9.48	10.13	9.59	8.48	9.06
22	8.83	8.78	8.80	9.54	10.09	11.52	8.85	9.60	9.54	9.72	8.91	8.84
23	8.43	8.75	8.88	9.66	10.10	12.93	9.11	10.00	9.27	9.72	8.85	8.75
24	8.06	9.05	8.57	9.70	10.23	17.82	9.19	9.92	12.50	9.10	8.91	8.71
25	8.03	9.24	8.57	9.70	10.48	15.82	9.08	10.10	11.30	9.20	8.80	8.66
26	8.01	8.76	8.84	9.55	11.34	13.33	9.11	9.66	10.50	9.00	8.74	8.63
27	8.01	8.95	8.88	9.44	17.88	13.50	9.08	9.35	13.52	9.20	8.72	8.55
28	8.00	8.95	9.00	9.39	21.11	14.41	9.05	11.22	.....	9.02	8.70	8.59
29	8.00	9.45	9.40	9.44	.....	12.83	8.51	13.80	.....	11.52	8.84	8.60
30	7.98	10.03	9.27	9.73	.....	12.05	9.04	12.36	.....	15.38	9.08	8.50
31	8.00	.....	8.80	10.20	.....	11.21	.....	10.72	.....	10.15	9.12	.....

NOTE.—Intake to float well stopped by silt June 28 to July 1, July 4–10, and July 31 to August 22. Gage heights for following periods are mean of two observations per day on staff gage: July 8–10 and July 31 to Aug. 22.

KESHEQUA CREEK NEAR SONYEA, N. Y.

LOCATION.—About 400 feet above Delaware, Lackawanna & Western Railroad bridge and half a mile below gaging station formerly maintained at Sonyea, Livingston County.

DRAINAGE AREA.—74 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 29, 1915, to October 31, 1917, when station was discontinued. July 22, 1910, to December 31, 1912, at former station at Sonyea.

GAGE.—Staff, in two sections; inclined section graduated from 3.0 to 6.0 feet; vertical section graduated from 6.0 to 17.0 feet; read by Fred Mott and Mrs. Rose Feathers.

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

CHANNEL AND CONTROL.—Gravel, probably fairly permanent.

EXTREMES OF DISCHARGE.—1915–1917: Maximum stage recorded, 13.15 feet at 7 a. m. March 28, 1916 (discharge not determined); minimum stage recorded, 3.8 feet several times during October, 1916 (discharge practically zero).

ICE.—Stage-discharge relation affected by ice. Observations of stage suspended during winter.

ACCURACY.—Stage-discharge relation probably permanent; affected by ice during large part of the period December to March. Rating curve well defined between 1 and 350 second-feet and fairly well defined between 350 and 1,300 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Keshequa Creek near Sonyea, N. Y., 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. 18[a]	E. D. Burchard	4.69	14.2	May 25	E. D. Burchard	4.95	61.6
Mar. 9	O. W. Hartwell	4.89	65.8	June 21	do	4.80	53.0
30	do	5.15	90.4	21	do	4.79	51.8
30	do	5.12	88.7	Aug. 1	C. C. Covert	4.26	11.5
May 25	E. D. Burchard	4.95	62.2	24	C. S. DeGolyer	4.12	5.72

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Keshequa Creek near Sonyea, N. Y., for the periods Oct. 1 to Dec. 31, 1916, and Aug. 1 to Oct. 31, 1917.

Day.	Oct.	Nov.	Dec.	Aug.	Sept.	Oct.	Day.	Oct.	Nov.	Dec.	Aug.	Sept.	Oct.
1	3.0	1.5	8.7	22	14	9.3	16	0	4.5	10	14	12	47
2	1.5	1.5	14	21	19	15	17	0	3.9	14	10	10	27
3	1.5	1.5	14	16	37	12	18	0	3.0	12	10	9.3	23
4	1.5	1.5	14	12	19	19	19	0	5.3	8.7	10	14	65
5	1.5	3.0	15	19	16	35	20	.2	4.5	10	10	30	164
6	0	4.5	15	12	18	30	21	0	5.3	8.7	11	19	71
7	0	5.3	15	16	27	24	22	.8	4.5	8.7	10	16	45
8	0	4.5	15	9.3	99	26	23	1.5	4.5	12	10	12	78
9	0	5.3	15	9.3	49	44	24	1.5	5.3	14	5.3	10	369
10	0	4.5	15	10	21	22	25	1.5	7.9	16	8.7	9.3	714
11	0	4.5	14	12	19	23	26	1.5	10	16	7.0	7.0	329
12	0	6.6	15	15	16	26	27	1.5	10	16	5.3	8.7	349
13	0	4.5	15	14	16	34	28	1.5	8.7	21	4.9	9.3	290
14	.8	5.3	12	21	10	22	29	3.0	10	30	8.7	8.7	851
15	0	4.5	10	10	12	44	30	1.5	12	30	19	9.3	538
							31	1.5	.....	28	23	.....	181

NOTE.—No record Apr. 1 to June 30, owing to unreliable gage readings.

Monthly discharge of Keshequa Creek near Sonyea, N. Y., for the periods Oct. 1 to Dec. 31, 1916, and Aug. 1 to Oct. 31, 1917.

[Drainage area, 74 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
October	3.0	0	0.832	0.011	0.013
November	12	1.5	5.26	.071	.079
December	30	8.7	14.9	.201	.232
1917.					
August	23	4.9	12.4	.168	.19
September	99	7.0	19.2	.259	.29
October	851	9.3	146	1.97	2.27

CANADICE LAKE OUTLET NEAR HEMLOCK, N. Y.

LOCATION.—At foot of Canadice Lake, Livingston County. Outlet flows into Genesee River through Canadice Lake Outlet and Honeoye Creek.

DRAINAGE AREA.—12.6 square miles, of which 1.0 square mile is lake surface.

RECORDS AVAILABLE.—April, 1903, to September 30, 1917.

GAGE.—Hook, in channel above weir.

CHANNEL AND CONTROL.—Outflow is measured over a standard thin-edged weir with a 5-foot crest and two end contractions so arranged with needle timbers at the ends that the length may be increased to 14.96 feet. No end contractions during high water. The weir crest stands 3.14 feet above the stream channel, which is artificial with a plank bottom and vertical sides, and the crest is never submerged by back-water. Two additional rectangular gates, each one foot square with three complete contractions and a fourth incomplete contraction at the bottom.

ICE.—Stage-discharge relation not affected by ice as the pool above the weir is free from ice throughout the winter.

DIVERSIONS.—No water is diverted from Canadice Lake above the station.

REGULATION.—Outflow of lake is regulated by bulkhead and gates at dam above weir.

ACCURACY.—Stage-discharge relation permanent. Rating curve used is expressed by Francis formula. Corrections are made for velocity of approach for high stages. Gage read to hundredths once daily. Records good.

COOPERATION.—Data collected, computed, and furnished for publication by the city engineer of Rochester.

Monthly discharge of Canadice Lake Outlet near Hemlock, N. Y., for the year ending Sept. 30, 1917.

Month.	Mean discharge.	Mean elevation of lake above low water mark.	Month.	Mean discharge.	Mean elevation of lake above low-water mark.
	Sec.-feet.	*Feet.*		*Sec.-feet.*	*Feet.*
October	0.095	1.328	May	13.170	2.211
November	2.085	1.269	June	20.156	2.287
December	3.634	.946	July	22.756	2.608
January	3.684	.965	August	4.197	2.135
February	3.934	1.032	September	3.320	1.788
March	16.289	2.144			
April	25.572	2.028	The year	9.908	1.728

NOTE.—Terminal water surface for year was 0.25 foot higher than that for the previous year, corresponding to a gain in storage of 7,508,350 cubic feet, or a discharge of 0.238 second-feet for the year. This correction applied to the above mean for the year gives 10.146 second-feet.

OWASCO LAKE OUTLET NEAR AUBURN, N. Y.

LOCATION.—On the farm of Charles H. Pearce, 2 miles below center of Auburn, Cayuga County, and 3¾ miles below State dam at outlet of Owasco Lake.

DRAINAGE AREA.—206 square miles (measured on topographic maps).

RECORDS AVAILABLE.—November 17, 1912, to September 30, 1917.

GAGE.—Gurley water-stage recorder in a concrete shelter on left bank, on the farm of Charles H. Pearce. Recorder inspected by Charles H. Pearce.

DISCHARGE MEASUREMENTS.—Made by wading directly opposite the gage, or from a cable at same section.

CHANNEL AND CONTROL.—A low concrete control has been constructed about 15 feet below the gage. Crest of control is 1 foot wide and the slopes of both upstream and downstream faces are ½:1. A small horizontal apron built on a level with the bed of the stream extends down stream 2½ feet from toe of dam. Mean elevation of the left end of the dam for a distance of 50 feet is gage height 1.28 feet; the remaining 50 feet of the crest of the dam is at a gage height 2.13 feet.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 3.47 feet from 8.15 to 8.30 a. m. June 30 (discharge, 1,070 second-feet); minimum stage not recorded.

1912-1917: Maximum stage, 6.4 feet during period March 25-30, 1913, determined by leveling from flood marks (discharge, 2,750 second-feet); minimum stage, from water-stage recorder, 1.41 feet at 1 a. m. October 15, 1915 (discharge, 5.6 second-feet).

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

DIVERSIONS.—An average flow of about 10 second-feet is pumped from Owasco Lake for the municipal water supply of the city of Auburn. Proportion returning to stream above the gaging station is not known.

REGULATION.—Large diurnal fluctuation in flow during low-water periods due to operation of mills in the city of Auburn; seasonal flow regulated at the State dam.

ACCURACY.—Stage-discharge relation permanent; not affected by ice during year. Rating curve well defined between 1 and 1,700 second-feet. Operation of the water-stage recorder satisfactory throughout year, except during periods indicated in footnote to daily-discharge table. Daily discharge ascertained by averaging the hourly discharge. Records excellent except for periods of no gage-height records and when there was leakage under control. See footnote to daily-discharge table.

Discharge measurements of Owasco Lake outlet near Auburn, N. Y., during the year ending Sept. 30, 1917.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 9	2.16	173	Nov. 9	2.12	159	Feb. 5	2.34	221
Nov. 9	1.69	67.2	Nov. 13	2.18	156	May 15	2.63	359
Nov. 9	2.00	138						

Daily discharge, in second-feet, of Owasco Lake outlet near Auburn, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	38.0	95.7	96.5	104	.....	163	758	339	448	926	.....	278
2	103	89.7	90.1	112	.....	158	776	324	434	919	.....	248
3	98.0	88.8	55.0	109	.....	152	787	307	402	899	.....	241
4	100	102	106	92.2	.....	181	830	303	401	854	.....	255
5	98.8	10.0	98.8	119	.....	177	814	313	407	825	.....	242
6	99.1	61.8	96.5	116	175	178	836	323	406	698	.....	234
7	80.1	67.0	93.0	89.4	173	158	836	342	447	599	.....	230
8	57.0	70.8	87.9	116	161	172	824	366	551	579	.....	245
9	103	69.3	82.5	119	165	.....	811	404	745	573	.....	245
10	85.8	82.1	58.7	118	158	.....	807	397	760	562	.....	247
11	91.6	91.0	108	130	.....	.....	789	374	855	506	.....	241
12	92.5	24.9	98.2	120	.....	.....	761	360	908	493	.....	236
13	.....	112	93.3	130	.....	.....	730	334	859	495	.....	228
14	.....	87.1	97.9	120	.....	.....	723	351	805	394	176	221
15	.....	83.6	102	147	.....	.....	685	335	.....	273	197	217
16	.....	90.3	87.7	.....	.....	.....	686	341	.....	286	194	189
17	.....	82.9	75.1	.....	.....	275	704	.....	.....	346	214	212
18	.....	75.3	113	.....	.....	270	671	.....	.....	425	222	203
19	.....	56.1	107	.....	.....	282	644	.....	.....	419	211	207
20	.....	97.4	102	.....	169	291	634	.....	.....	418	242	207
21	.....	88.5	103	.....	164	317	591	.....	.....	397	235	198
22	.....	87.3	109	.....	171	364	545	.....	.....	357	236	180
23	.....	83.3	97.0	.....	166	444	454	.....	677	320	232	182
24	.....	82.6	69.3	.....	162	543	355	.....	663	305	223	197
25	.....	71.5	84.7	.....	209	633	294	.....	658	262	236	185
26	.....	59.2	117	.....	184	704	350	340	726	234	188	181
27	.....	96.3	108	.....	169	738	348	318	914	232	229	177
28	.....	85.2	101	.....	160	791	398	342	918	222	211	176
29	.....	122	114	.....	.....	807	380	377	939	220	221	186
30	.....	68.4	91.5	.....	.....	755	356	399	941	237	253	174
31	92.4	.....	75.4	.....	.....	771	.....	432	.....	260	270	.....

NOTE.—During November a leak was discovered under the control, discharging between 20 and 25 second-feet. This was assumed to have started October 12. The leak was repaired November 5. Daily discharge Oct. 31 to Nov. 4 includes this leakage. Mean discharge estimated for following periods because recorder was not in operation: Oct. 13-30, 82.0 second-feet; Jan. 16-31, 135 second feet; Feb. 1-5, 155 second-feet; Feb. 11-19, 160 second-feet; March 9-16, 220 second-feet; May 17-25, 340 second-feet; June 15-22, 740 second-feet; Aug. 1-13, 230 second-feet. Discharge, July 31 and Aug. 31, estimated.

Monthly discharge of Owasco Lake outlet near Auburn, N. Y., for the year ending Sept. 30, 1917.

[Drainage area 206 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	103	.....	84.4	0.410	0.47
November	122	[a]10.0	79.4	.385	.43
December	117	[b]55.0	94.2	.457	.53
January	.....	[b]89.4	126	.612	.71
February	209	.....	164	.796	.83
March	807	152	358	1.74	2.01
April	836	294	639	3.10	3.46
May	432	303	348	1.69	1.95
June	941	401	693	3.36	3.75
July	926	[b]220	469	2.28	2.63
August	.....	176	225	1.09	1.26
September	278	[b]174	215	1.04	1.16
The year	941	10.0	291	1.41	19.19

[a] Estimated. [b] Sunday.

WEST BRANCH OF ONONDAGA CREEK AT SOUTH ONONDAGA, N. Y.

LOCATION.—At highway bridge in South Onondaga, Onondaga County, about 1¾ miles above mouth of creek and about 10 miles above Syracuse.

DRAINAGE AREA.—20.8 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 22, 1916, to September 30, 1917.

GAGE.—Staff on downstream side of right abutment of bridge.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Fine and coarse gravel; probably shifting.

EXTREMES OF STAGE.—Maximum stage recorded, 2.86 feet at 7.05 a. m. March 12; minimum stage recorded, 0.90 foot at 6.45 p. m. September 24 and 6.35 a. m. September 25.

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

Data inadequate for determination of discharge.

Discharge measurements of West Branch of Onondaga Creek at South Onondaga, N. Y., 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. 30	E. D. Burchard	1.22	9.58	May 15	E. D. Burchard	1.27	20.6
30	.....do	1.20	8.83	June 13	O. W. Hartwell	1.36	24.6

Daily gage height, in feet, of West Branch of Onondaga Creek at South Onondaga, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.13	1.36	1.27	.....	1.92	1.36	1.37	1.54	1.01	1.06
2	1.11	1.23	1.24	.....	2.0	1.34	1.33	1.56	1.01	1.03
3	1.1	1.2	1.21	.....	2.01	1.30	1.30	1.38	1.00	1.01
4	1.06	1.16	1.24	.....	1.77	1.27	1.28	1.33	1.00	.98
5	1.08	1.36	1.34	.....	1.59	1.53	1.30	1.27	1.00	.97
6	1.04	1.27	1.28	.....	1.75	1.69	1.38	1.23	.99	1.02
7	1.04	1.19	1.22	1.4	1.91	1.54	2.06	1.21	.99	.99
8	1.04	1.18	1.23	1.39	1.71	1.44	2.07	1.19	.97	1.02
9	1.05	1.21	1.24	1.4	1.60	1.39	1.65	1.23	1.04	.98
10	1.08	1.29	1.32	1.41	1.52	1.33	1.51	1.31	1.03	1.04
11	1.03	1.22	1.3	2.3	1.49	1.33	1.52	1.29	1.01	.98
12	1.03	1.17	1.29	2.66	1.49	1.49	1.42	1.26	.98	.98
13	1.13	1.17	1.23	2.07	1.47	1.34	1.33	1.32	.95	.97
14	1.28	1.20	1.2	1.83	1.43	1.29	1.29	1.33	1.18	.95
15	1.15	1.25	1.19	1.68	1.42	1.26	1.28	1.48	1.06	.95
16	1.09	1.18	1.12	1.64	1.42	1.25	1.41	1.45	.99	.95
17	1.13	1.19	1.14	1.87	1.39	1.28	1.29	1.27	1.01	1.02
18	1.09	1.25	1.23	1.78	1.37	1.24	1.25	1.22	.98	1.01
19	1.15	1.25	1.22	1.59	1.39	1.21	1.26	1.21	.97	.95
20	1.17	1.29	1.19	1.69	1.54	1.54	1.36	1.16	.95	.99
21	1.36	1.26	1.2	1.87	1.47	1.37	1.33	1.16	.99	.95
22	1.19	1.17	1.18	1.89	1.36	1.44	1.22	1.14	.97	.94
23	1.15	1.34	1.22	2.14	1.34	1.44	1.16	1.12	.95	.94
24	1.10	1.45	1.28	2.59	1.34	1.37	1.39	1.09	1.04	.92
25	1.15	1.29	1.26	2.09	1.29	1.34	1.42	1.08	.98	.91
26	1.19	1.19	1.25	2.13	1.32	1.28	1.87	1.06	.96	.93
27	1.11	1.19	1.31	2.13	1.38	1.3	2.37	1.07	.97	.97
28	1.16	1.23	1.44	2.14	1.31	1.32	1.64	1.12	.95	1.03
29	1.09	1.22	1.36	2.09	1.27	1.81	1.68	1.10	1.12	1.01
30	1.16	1.31	1.24	1.85	1.38	1.59	1.55	1.07	1.05	1.10
31	1.10	.....	1.21	1.75	.....	1.38	.....	1.03	1.01	.....

NOTE.—Observations suspended because of ice, Jan. 1 to Mar. 6.

BLACK RIVER NEAR BOONVILLE, N. Y.

LOCATION.—At highway bridge about 1 mile above mouth of Sugar River, 2 miles northeast of Boonville, Oneida County, and 2 miles, by river, downstream from Hawkinsville.

DRAINAGE AREA.—303 square miles (measured on topographic maps).

RECORDS AVAILABLE.—February 16, 1911, to September 30, 1917.

GAGE.—Chain near center of left span, downstream side of bridge; staff gage on right abutment used for high-water readings; read by W. D. Charbonneau.

DISCHARGE MEASUREMENTS.—Made from a cable about half a mile above gage or by wading near the cable.

CHANNEL AND CONTROL.—Rough and full of boulders; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.8 feet at 4 p. m. June 12 (discharge, 5,240 second-feet); minimum stage recorded 3.02 feet at 4 p. m. August 5 (discharge 28 second-feet).

1911–1917: Maximum stage (determined by leveling from flood mark) about 12.5 feet during night of March 28, 1913 (discharge, about 10,000 second-feet); minimum stage recorded, 3 feet at 8 a. m. September 29 and November 8, 1913, and October 8, 1914 (discharge, 27 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION AND DIVERSION.—The State dam at Forestport, about 8 miles upstream, provides a reservoir with a capacity of about 2,000,000,000 cubic feet. Water is diverted from this reservoir during the navigation season through the Forestport Feeder, flowing west to a basin in Boonville. The Black River canal flows north from this basin entering Black River at the foot of Lyons Falls. A spillway from the basin overflows into Mill Creek, a tributary of Black River. Water flowing through these two channels returns to the river below the gaging station, thus passing around it. The Black River canal also flows south from Boonville, passing out of the Black River drainage and entering the summit level of the Erie canal (or Barge canal) at Rome.

Occasional discharge measurements have been made at three points to indicate the distribution of the diverted water. The water entering Boonville through the Forestport Feeder has been measured at the highway bridge about 1 mile northeast of Boonville. During October, 1915, two water-stage recorders were installed on this canal to obtain a continuous record of flow, which is published as a separate station "Forestport Feeder near Boonville, N. Y." The water flowing north from the basin through the Black River canal has been measured at the highway bridge just below the lock into this canal near the railroad station. The water flowing south from the basin has been measured at a private farm bridge about 1 mile southeast of Boonville. During September, 1915, two water-stage recorders were installed on this canal to obtain a continuous record of the flow, which is published as a separate station, "Black River canal (flowing south) near Boonville, N. Y."

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during a large part of the period December to March, inclusive. Rating curve well defined between 35 and 2,800 second-feet and fairly well defined between 2,800 and 4,500 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good, except for periods when the stage-discharge relation was affected by ice, for which they are fair.

Discharge measurements of Black River near Boonville, N. Y., 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]	A. H. Davison	5.37	344	Mar. 9[b]	A. H. Davison	5.65	390
Feb. 10[b]	do	5.24	301	June 4	O. W. Hartwell	5.35	565

[a] Measurement made through incomplete ice cover.
[b] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Black River near Boonville, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	335	194	2,740	300	600	500	3,620	855	855	1,290	56	680
2	352	335	2,380	280	550	700	3,880	920	580	1,460	52	450
3	305	490	1,460	260	550	750	4,010	990	605	1,140	49	370
4	262	580	1,060	280	480	600	3,490	1,210	580	855	40	238
5	205	535	1,140	300	420	500	2,740	1,290	680	630	31	184
6	194	335	1,370	380	400	460	2,740	1,140	1,210	490	33	184
7	145	194	1,460	380	380	460	2,860	1,210	1,840	370	36	174
8	111	164	1,290	320	360	480	2,620	990	2,380	335	63	205
9	97	136	1,210	380	320	380	2,500	920	2,860	205	145	174
10	78	184	1,140	440	300	400	2,160	1,060	3,490	154	205	111
11	90	194	990	340	300	600	1,370	1,210	4,140	250	216	90
12	111	184	795	320	280	700	920	1,290	5,100	680	127	84
13	127	194	735	550	260	800	735	1,060	4,960	490	111	56
14	164	216	605	850	240	700	680	920	4,540	470	104	59
15	184	194	535	1,200	220	750	605	920	4,010	390	84	70
16	216	184	500	1,000	240	750	630	795	2,620	450	72	97
17	227	194	460	950	200	600	795	735	1,460	305	97	90
18	194	205	440	900	190	550	1,060	680	855	174	111	63
19	250	127	420	850	180	420	1,370	630	535	111	119	56
20	490	66	400	750	170	280	2,500	605	535	66	111	49
21	680	72	340	750	170	300	3,880	580	735	119	97	90
22	735	90	360	850	170	380	4,410	680	990	164	119	111
23	605	194	420	800	170	500	4,010	920	795	127	490	127
24	410	920	360	800	150	950	3,620	605	680	97	2,980	97
25	305	1,040	320	800	140	1,800	3,360	1,940	630	90	2,380	84
26	305	855	300	800	190	1,900	4,010	2,380	795	66	795	78
27	275	450	300	800	500	1,800	4,010	2,620	450	59	335	59
28	238	227	260	750	700	1,800	2,980	2,270	580	72	250	84
29	205	490	260	700	.....	1,840	2,050	2,050	735	68	390	53
30	184	1,740	300	650	.....	2,160	1,210	1,940	990	70	630	63
31	205	.....	260	650	.....	2,860	.....	1,540	.....	53	855	.....

NOTE.—Discharge, Dec. 16 to Mar. 28 estimated, because of ice, from discharge measurements, weather records, and study of gage-height graph.

Monthly discharge of Black River near Boonville, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 303 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	735	78	267	0.882	1.02
November	1,740	66	366	1.21	1.35
December	2,740	260	794	2.62	3.02
January	1,200	260	625	2.06	2.38
February	700	140	315	1.04	1.08
March	2,860	280	893	2.95	3.40
April	4,410	605	2,490	8.22	9.17
May	2,620	580	1,190	3.93	4.53
June	5,100	450	1,710	5.64	6.29
July	1,460	53	365	1.20	1.38
August	2,980	31	361	1.19	1.37
September	680	49	144	.475	.53
The year	5,100	31	793	2.62	35.52

NOTE.—Water diverted past this station by the Forestport feeder is not included in the above table.

BLACK RIVER AT BLACK RIVER, N. Y.

LOCATION.—About one-fourth mile below concrete-arch highway bridge and power plant of Northern New York Utilities Co. and three-fourths mile below village of Black River, Jefferson County.

DRAINAGE AREA.—1,870 square miles (measured on topographic maps).

RECORDS AVAILABLE.—March 24 to September 30, 1917.

GAGE.—Vertical staff, in two sections, spiked to large cedar tree on left bank about one-fourth mile below highway bridge; read by Erwin W. Hart.

DISCHARGE MEASUREMENTS.—Made from cable about 100 yards above gage.

CHANNEL AND CONTROL.—Solid rock.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of record, 13.4 feet from 6 p. m. April 4 to 7 a. m. April 5 (discharge, 19,300 second-feet); minimum stage recorded, 1.05 feet at 2.45 p. m. July 29, when a current-meter measurement was made (discharge, about 16 second-feet).

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

REGULATION.—Seasonal distribution of flow is regulated by Beaver River flow, Fulton Chain lakes, Forestport reservoir and other storage reservoirs in the upper portion of the drainage basin. Some diurnal fluctuation at low stages due to mills and power plants above station.

DIVERSIONS.—Water is diverted from Black River into Forestport Feeder at Forestport. A portion of this water returns to river through various spillways and through Black River canal (flowing north). The remainder passes out of the drainage basin through Black River canal (flowing south); the record at the station on Black River canal (flowing south) at Boonville indicates the amount of this diversion. See also "Regulation and Diversion" in description of station on Black River near Boonville.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 500 and 18,000 second-feet. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except for days of low discharge, for which they may be poor.

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Discharge measurements of Black River at Black River, N. Y., 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. 1	A. H. Davison	10.78	12,600	July 28	E. D. Burchard	3.87	1,150
1	do	10.83	12,800	29	do	3.73	1,060
6	do	12.66	17,300	29	do	3.72	1,060
7	do	12.21	16,400	29	do	3.25	711
7	do	11.96	15,300	29	do	3.11	625
11	do	9.16	9,090	29	do	1.18	25.6
June 7	O. W. Hartwell	5.83	3,460	Sept. 30	do	3.33	794
July 14	C. C. Covert	5.58	3,050	30	do	3.51	857
28	E. D. Burchard	3.88	1,150				

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

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		12,600	7,990	6,700	4,550	1,370	2,240
2		14,600	7,610	6,180	5,030	1,180	2,300
3		17,300	8,180	5,350	4,710	1,180	2,860
4		19,300	8,570	5,190	3,250	1,180	3,250
5		19,000	8,370	4,250	3,250	1,020	2,600
6		17,600	7,990	3,670	2,990	1,020	2,120
7		15,800	7,610	3,530	2,730	880	1,680
8		13,800	6,880	4,250	2,500	778	1,680
9		12,000	6,180	5,510	2,250	1,020	1,370
10		9,990	5,510	6,180	2,200	1,270	1,370
11		9,170	5,350	7,610	2,360	1,680	1,470
12		8,180	5,510	8,570	2,860	1,790	1,470
13		7,240	5,670	9,170	3,530	1,680	1,100
14		6,730	5,840	11,500	3,120	845	845
15		6,010	5,350	11,500	2,240	880	950
16		5,190	4,870	9,990	2,240	950	797
17		5,030	4,870	8,180	2,120	2,120	1,370
18		5,030	4,250	7,060	1,900	1,680	880
19		6,180	3,950	6,010	1,790	1,470	1,370
20		6,880	3,530	4,710	1,270	1,470	1,270
21		9,780	3,670	4,100	1,470	1,680	1,180
22		12,600	4,100	4,400	1,680	2,240	1,270
23		16,000	4,250	4,710	1,680	2,120	1,270
24		15,800	4,870	4,250	1,370	2,600	1,270
25	8,370	14,600	5,510	3,530	1,470	3,120	620
26	10,600	13,400	5,840	3,530	1,680	3,670	1,270
27	13,800	11,500	5,840	3,120	1,470	2,730	1,100
28	17,300	10,400	5,670	3,120	1,270	2,360	1,180
29	18,100	9,370	5,670	2,860	880	2,010	1,100
30	16,000	8,570	5,670	3,670	1,180	1,900	745
31	14,100	.....	6,520	.....	1,180	2,240	.....

NOTE.—Daily discharge estimated Apr. 8-10.

Monthly discharge of Black River at Black River, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 1,870 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
April	19,300	5,030	10,400	5.56	6.20
May	8,570	3,530	5,860	3.13	3.61
June	11,500	2,860	5,750	3.07	3.42
July	5,030	880	2,330	1.25	1.44
August	3,670	778	1,680	.898	1.04
September	3,250	620	1,470	.786	.88

NOTE.—See "Regulation" and "Diversion" in station description.

FORESTPORT FEEDER NEAR BOONVILLE, N. Y.

LOCATION.—Slope station at lower end of feeder, above point where it enters the basin at Boonville, Oneida County.

RECORDS AVAILABLE.—Occasional discharge measurements 1900 and 1905–1915; continuous record October 30, 1915, to September 30, 1917. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGES.—Two Gurley seven-day water-stage recorders, with natural scale for gage heights. Gage No. 1 is at downstream end of left abutment of steel highway bridge in village of Hawkinsville; gage No. 2 is on left bank, just below a farm bridge about a mile above the basin at Boonville; they are 2.53 miles apart. The float wells are 1½ by 2 feet, inside dimensions, and the bottoms are about 1½ feet below normal elevation of water surface in canal. These gages and the two in the Black River canal (flowing south) near Boonville are all set at the same datum; recorder at gage No. 1 inspected by Mrs. Anna Zwahlen; that at gage No. 2 inspected by Charles Nugent.

DISCHARGE MEASUREMENTS.—Made from the steel highway bridge at gage No. 1 in Hawkinsville.

DETERMINATION OF DISCHARGE.—Daily discharge determined by use of Chezy formula. The coefficient, "C," is computed from each current-meter measurement and is plotted on a curve showing the variation of "C" through the season. A smooth curve drawn through the plotted points shows the coefficients for intervening days. The other factors in the Chezy formula are obtained from gage-height records and cross-section of the canal.

DIVERSIONS.—One spillway takes water from the Forestport feeder just below gage No. 2 and a second spillway takes water from the basin in Boonville. Both discharge into Mill Creek, which enters Black River below the Boonville gaging station. No spillway between gage No. 1 and gage No. 2. Other spillways in the feeder above gage No. 1 discharge into Black River above the gaging station. Therefore, this station indicates the total amount of water diverted past the gaging station on Black River near Boonville, and the sum of this record and the record for the Black River near Boonville indicates the total run-off of the Black River basin above these gaging stations.

REGULATION.—Flow in the feeder is regulated at the outlet of Forestport reservoir.

ICE.—No flow in the canal during the winter season.

ACCURACY.—Records good except for days on which discharge varies widely from the mean, for which they are fair.

Discharge measurements of Forestport feeder near Boonville, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height in feet.		Discharge.	Date.	Made by—	Gage height in feet.		Discharge.
		Gage No. 1.	Gage No. 2.				Gage No. 1.	Gage No. 2.	
				Sec.-ft.					*Sec.-ft.*
Oct. 12	A. H. Davison	3.321	1.952	262	July 13	C. C. Covert	3.19	1.842	273
31	E. D. Burchard	3.556	2.146	288	27	E. D. Burchard	2.998	1.742	225
31	do	3.547	2.138	291	27	do	3.016	1.746	225
31	do	3.532	2.142	290	Aug. 15	do	3.280	1.848	252
31	do	3.528	2.130	289	15	do	3.280	1.844	251
Nov. 24	A. H. Davison	3.325	1.885	278	Sept. 3	C. C. Covert	2.90	1.56	205
June 2	O. W. Hartwell	2.47	.....	189	26	E. D. Burchard	3.045	1.774	216
4	do	2.49	1.49	185	26	do	3.038	1.766	219
12	do	2.40	1.14	195					

Daily discharge, in second-feet, of Forestport feeder near Boonville, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	June.	July.	Aug.	Sept.	Day.	Oct.	Nov.	June.	July.	Aug.	Sept.
1	237	293	150	265	233	225	16	231	.....	263	276	252	227
2	232	300	189	257	245	218	17	238	.....	258	276	250	220
3	258	303	210	260	234	227	18	248	.....	251	271	233	226
4	245	297	193	296	228	254	19	257	.....	306	261	228	238
5	247	291	273	289	217	246	20	248	.....	308	255	227	235
6	250	291	287	300	212	221	21	229	.....	278	246	233	235
7	253	286	297	294	224	221	22	248	.....	293	241	254	237
8	255	290	330	280	231	233	23	244	.....	285	245	230	235
9	251	287	314	280	248	226	24	256	.....	276	247	265	243
10	255	299	302	287	238	233	25	256	.....	276	256	229	231
11	252	300	320	269	230	241	26	259	.....	282	245	239	222
12	253	305	195	207	231	238	27	234	.....	282	244	217	231
13	262	311	261	254	245	230	28	275	.....	277	266	208	245
14	245	.....	286	278	246	217	29	277	.....	295	241	227	242
15	232	.....	276	280	243	229	30	277	.....	295	240	220	252
							31	291	.....	.....	244	214	.....

NOTE.—Discharge, Nov. 14–30, estimated at 284 second-feet. Feeder dry from December to May.

Monthly discharge, in second-feet, of Forestport feeder, near Boonville, N. Y., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	291	229	251
November	311	.....	289
December	0	0	0
January	0	0	0
February	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	330	a 150	270
July	300	207	263
August	265	212	233
September	254	217	233
The year	330	0	129

a Estimated.

BLACK RIVER CANAL (FLOWING SOUTH) NEAR BOONVILLE, N. Y.

LOCATION.—Slope station in summit level of Black River canal, near Boonville, Oneida County.

RECORDS AVAILABLE.—Occasional discharge measurements 1900 and 1905–1915; continuous record September 16, 1915, to September 30, 1917.

GAGES.—Two Gurley seven-day water-stage recorders with natural scale for gage heights; they are 1.81 miles apart. Gage No. 1 is on right bank (opposite towpath) about 50 feet downstream from collector's office in Boonville; gage No. 2 is on right bank (opposite towpath) about 300 yards above Lock 70 and 50 yards above spillway from the canal into Lansing Kill. These gages and the two gages in the Forestport feeder near Boonville are set to the same datum. Recorders inspected by Philip Joynt.

DISCHARGE MEASUREMENTS.—Made from the steel and concrete highway bridge in the village of Boonville, a short distance below gage No. 1.

DETERMINATION OF DISCHARGE.—Daily discharge determined by use of Chezy formula. The coefficient "C" is computed from each current-meter measurement and plotted on a curve showing the variation of "C" through the season. A smooth curve drawn through the plotted points shows the coefficient for intervening days. The other factors in the Chezy formula are obtained from gage-height records and cross-section of canal.

DIVERSIONS.—No diversions between gage No. 1 and gage No. 2. Records obtained at this station indicate the quantity of water diverted for the canal from the Black River basin into the Mohawk River basin.

REGULATION.—Flow in canal is regulated by operation of spillway and sluice gates at Lock 70 and also by discharge of Forestport feeder into the basin at Boonville.

ICE.—No flow in canal during winter season.

ACCURACY.—Records good.

Discharge measurements of Black River canal (flowing south) near Boonville, N. Y., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height in feet.		Discharge.	Date.	Made by—	Gage height in feet.		Discharge.
		Gage No. 1.	Gage No. 2.				Gage No. 1.	Gage No. 2.	
				Sec.-ft.					*Sec.-ft.*
Oct. 13	A. H. Davison...	1.630	1.135	198	July 13	C. C. Covert.....	1.52	.....	190
31	E. D. Burchard..	1.640	1.090	251	26	E. D. Burchard..	1.491	1.126	180
Nov. 1	.....do.....	1.680	1.162	257	27	.....do.....	1.434	1.074	181
1	.....do.....	1.689	1.712	254	27	.....do.....	1.438	1.978	178
1	.....do.....	1.708	1.168	254	Aug. 15	.....do.....	1.432	.930	180
1	.....do.....	1.700	1.160	254	15	.....do.....	1.440	.940	176
23	A. H. Davison...	1.240	.930	149	15	.....do.....	1.428	.940	182
June 2	O. W. Hartwell..	1.100	.....	157	Sept. 3	C. C. Covert.....	1.181	.545	145
5	.....do.....	1.600	1.265	245	25	E. D. Burchard..	1.571	1.110	172
12	.....do.....	.840	.670	140	25	.....do.....	1.559	1.106	174

Daily discharge, in second-feet, of Black River canal (flowing south) near Boonville, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	June.	July.	Aug.	Sept.	Day.	Oct.	Nov.	June.	July.	Aug.	Sept
1.....	190	251	130	197	181	151	16.....	192	.....	.....	192	183	162
2.....	185	253	157	176	173	173	17.....	188	.....	.....	186	185	164
3.....	208	254	170	185	178	175	18.....	200	.....	.....	177	181	168
4.....	202	249	145	184	180	172	19.....	226	.....	.....	178	172	171
5.....	207	241	211	196	177	161	20.....	225	.....	.....	180	176	169
6.....	206	244	207	191	178	163	21.....	200	.....	.....	181	179	172
7.....	198	244	229	183	178	165	22.....	213	.....	.....	179	177	170
8.....	207	241	245	195	176	168	23.....	215	.....	177	175	172	171
9.....	202	244	236	186	186	169	24.....	215	.....	174	182	173	175
10.....	205	263	220	194	178	166	25.....	222	.....	177	183	171	166
11.....	204	244	244	180	174	173	26.....	228	.....	188	182	165	175
12.....	197	248	140	154	176	167	27.....	212	.....	184	174	143	172
13.....	209	255	.....	190	182	169	28.....	236	.....	183	189	141	174
14.....	191	262	.....	189	187	162	29.....	243	.....	181	175	165	174
15.....	191	.....	.....	193	180	168	30.....	234	.....	180	169	164	181
							31.....	250	.....	.....	176	146	.....

NOTE.—Discharge Nov. 15-30 estimated at 166 second-feet. Canal dry from December to May. Discharge June 13-22 estimated at 190 second-feet.

Monthly discharge, in second-feet, of Black River canal (flowing south) near Boonville, N. Y., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.
October	250	185	210
November	263		205
December	0	0	0
January	0	0	0
February	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	245	a 130	189
July	197	a 154	183
August	187	141	173
September	181	151	169
The year	263	0	94.4

a Estimated.

MOOSE RIVER AT MOOSE RIVER, N. Y.

LOCATION.—In the village of Moose River, Lewis County, about 3 miles downstream from McKeever, 5 miles below mouth of South Branch of Moose River, and nearly 20 miles above junction of Black and Moose rivers at Lyons Falls.

DRAINAGE AREA.—370 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 5, 1900, to September 30, 1917.

GAGE.—Staff in two sections on left bank a short distance above the cable; read by Mrs. Martha Hannan and H. W. Hoch. Gage datum was lowered 0.17 foot February 28, 1903, and again 5.00 feet on January 1, 1913.

DISCHARGE MEASUREMENTS.—Made from a cable a short distance below gage.

CHANNEL AND CONTROL.—Cobblestones and boulders; fairly permanent. Current smooth; depth comparatively uniform. Ice and logs occasionally jam above the station on a small island.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.2 feet at 8 a. m. June 12 (discharge, about 7,460 second-feet); minimum stage recorded 5.05 feet at 8 a. m. August 5 and 6 (discharge, 58 second-feet).

1900–1917: Maximum stage recorded, 16.3 feet during the afternoon of March 27, 1913, determined by leveling from flood marks (discharge, about 16,500 second-feet); minimum stage recorded, 4.94 feet July 21, 23, 25, 26, and 27, 1913 (discharge, about 42 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—A timber dam at McKeever, 3 miles upstream, is used for power and for the regulation of flow during log driving. Seasonal distribution of flow affected by operation of the State dam at Old Forge. This regulation is indicated by a record from station "Middle Branch of Moose River at Old Forge."

ACCURACY.—Stage-discharge relation practically permanent; affected by ice for a large part of the period from December to March. Rating curve fairly well defined between 100 and 5,500 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fairly good except for periods when the discharge is low or the stage-discharge relation is affected by ice for which they are fair.

Discharge measurements of Moose River at Moose River, N. Y., 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. 7	A. H. Davison	6.27	383	Feb. 9[a]	A. H. Davison	7.02	333
11	do	6.08	331	Mar. 8[a]	do	7.64	465
Jan. 12[a]	do	6.80	367	June 5	O. W. Hartwell	7.22	781

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Moose River at Moose River, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	715	460	2,270	440	320	650	2,090	2,270	1,750	910	176	352
2	540	460	1,520	650	360	700	3,060	2,180	1,590	1,080	164	230
3	500	580	670	280	320	700	4,490	2,090	760	1,020	216	500
4	460	625	965	280	320	300	3,740	1,910	965	1,080	216	500
5	460	422	965	280	460	550	3,280	1,520	860	1,080	69	386
6	386	625	1,830	340	340	440	2,460	1,020	860	860	126	289
7	404	580	1,590	340	320	460	2,460	1,380	965	580	146	304
8	121	500	1,260	550	320	420	1,910	1,320	1,140	500	114	289
9	422	500	1,450	480	340	300	1,750	1,450	1,750	580	304	87
10	352	540	1,910	380	420	80	1,200	1,450	1,520	500	404	304
11	289	760	1,520	400	220	240	1,320	1,450	3,060	500	670	289
12	289	580	1,200	380	600	320	1,450	1,450	6,310	910	230	151
13	289	580	1,080	380	500	480	1,320	1,590	2,860	670	352	151
14	289	500	810	340	420	550	1,140	1,450	2,360	500	320	216
15	500	500	760	600	340	440	715	1,590	2,090	441	230	189
16	441	500	670	850	320	460	860	1,830	1,910	500	259	138
17	460	500	600	700	260	480	1,020	1,590	1,910	540	259	352
18	404	500	550	750	380	320	1,200	1,450	2,090	441	289	259
19	422	386	600	700	280	480	1,590	1,260	1,450	386	151	244
20	422	460	600	440	360	460	3,740	1,140	1,200	386	304	259
21	1,200	404	550	340	400	480	5,630	1,450	1,450	441	164	230
22	1,320	460	400	460	460	480	5,320	1,260	1,320	176	103	202
23	965	386	420	460	420	500	4,230	1,140	1,140	336	320	87
24	760	2,270	340	420	380	700	3,620	1,260	580	320	126	352
25	580	2,660	130	400	220	750	3,060	1,380	965	320	422	230
26	404	1,080	480	340	550	950	2,660	1,520	860	289	500	202
27	422	910	340	380	480	1,200	2,560	810	1,020	202	289	259
28	500	860	380	160	500	2,660	2,180	1,450	860	230	320	244
29	336	810	340	300	.....	2,560	1,590	1,750	810	164	244	289
30	460	1,670	400	340	.....	2,270	2,000	2,460	760	336	289	103
31	460	.....	220	300	.....	2,000	.....	2,180	.....	289	320	.....

NOTE.—Discharge Dec. 17 to Mar. 27 estimated, because of ice, from discharge measurements, weather records, and study of gage-height graph.

Monthly discharge of Moose River at Moose River, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 370 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,320	121	502	1.36	1.57
November	2,660	386	736	1.99	2.22
December	2,270	130	865	2.34	2.70
January	850	160	434	1.17	1.35
February	600	220	379	1.02	1.06
March	2,660	80	754	2.04	2.35
April	5,630	715	2,450	6.62	7.39
May	2,460	810	1,550	4.20	4.84
June	6,310	580	1,570	4.25	4.74
July	1,080	164	534	1.44	1.66
August	670	69	261	.706	.81
September	500	87	256	.692	.77
The year	6,310	69	858	2.32	31.46

MIDDLE BRANCH OF MOOSE RIVER AT OLD FORGE, N. Y.

LOCATION.—About 300 feet below highway bridge and 400 feet below State dam at Old Forge, Herkimer County.

DRAINAGE AREA.—51.5 square miles (measured on topographic maps).

RECORDS AVAILABLE.—November 9, 1911, to September 30, 1917.

GAGE.—Vertical staff on left bank 300 feet below highway bridge; read by Jacob Edick.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading near gage.

CHANNEL AND CONTROL.—Bed near gage composed of stone and gravel. Control is rock ledge about 200 feet below gage; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.9 feet at 8 a. m. and 5 p. m. June 16 (stage-discharge relation affected by backwater from Moose River). Maximum discharge, 405 second-feet, computed from records at Old Forge dam. Minimum stage occurs when the gates of the dam are closed, discharge being due to leakage and discharge through the fish hatchery.

1911–1917: Maximum stage recorded, 6.3 feet March 28, 1913; stage-discharge relation affected by backwater from Moose River; discharge computed from records at dam, 760 second-feet.

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

REGULATION.—Flow controlled by dam.

ACCURACY.—Stage-discharge relation practically permanent between dates of shift; not affected by ice. Rating curve well defined from 20 to 400 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying to rating table mean daily gage height weighted on days of changing gates from records of gate opening at dam. Records good except those computed from gate openings at the dam, which are fair.

Discharge measurements of Middle Branch of Moose River at Old Forge, N. Y., 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. 18	A. H. Davison	0.33	2.88	July 18	C. C. Covert	1.68	38.5
18	do	3.35	426	Aug. 16	E. D. Burchard	1.17	23.6
18	do	3.35	443	16	do	1.50	61.1
June 5	O. W. Hartwell	1.15	23.3				

Daily discharge, in second-feet, of Middle Branch of Moose River at Old Forge, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	165	135	30	44	75	142	207	198	142	173	25	30
2	165	135	35	45	75	142	198	198	26	173	25	30
3	165	135	35	46	75	142	195	198	26	173	25	30
4	165	135	32	47	75	142	194	150	37	173	25	28
5	165	135	33	49	75	142	193	26	67	136	25	30
6	165	135	37	51	75	142	192	32	200	60	25	28
7	165	135	47	52	75	142	190	43	200	60	50	26
8	165	135	53	56	75	142	190	59	150	65	110	25
9	157	135	58	55	75	135	190	150	80	65	110	80
10	142	115	60	56	75	135	190	207	225	173	110	23
11	142	80	60	56	75	135	190	207	307	350	110	22
12	150	80	62	58	70	135	190	207	405	158	110	26
13	150	80	55	60	70	135	190	207	405	65	110	80
14	150	80	45	70	70	135	190	207	405	44	110	104
15	150	80	40	70	70	135	190	205	405	34	110	104
16	142	80	40	70	69	135	190	165	405	30	110	104
17	142	80	40	70	68	135	182	135	405	33	110	104
18	142	80	40	70	122	135	182	135	290	135	92	104
19	142	75	40	70	165	135	182	97	165	210	61	104
20	150	80	40	70	157	135	182	26	173	100	61	104
21	150	80	40	75	157	135	180	26	173	25	63	104
22	150	38	41	75	157	165	190	30	173	25	65	104
23	142	24	42	75	150	182	210	40	173	25	65	98
24	142	26	43	75	150	182	220	59	181	40	65	98
25	142	27	43	75	142	182	223	182	181	30	60	98
26	142	28	43	75	142	182	225	200	181	25	48	98
27	142	28	43	75	142	182	225	200	173	25	26	98
28	142	28	43	75	142	182	225	200	173	25	23	98
29	142	28	43	75	.....	190	225	200	173	25	23	98
30	142	29	43	75	.....	198	207	200	173	25	27	98
31	142	.....	44	75	.....	198	.....	225	.....	25	29	.....

NOTE.—Discharge Apr. 3–8, 21–26, May 14, 15, 26–30, June 6, 7, 12–17, July 11, 18, 19, Sept. 1–3, and 5–8 determined, because of backwater from Moose River or logs on control, from records at Old Forge dam.

Monthly discharge of Middle Branch of Moose River at Old Forge, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 51.5 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	165	142	150	2.91	3.36
November	135	24	83.0	1.61	1.80
December	62	30	43.5	.845	.97
January	75	44	64.2	1.25	1.44
February	165	68	102	1.98	2.06
March	198	135	153	2.97	3.42
April	225	180	198	3.84	4.28
May	225	26	142	2.76	3.18
June	405	26	209	4.06	4.53
July	350	25	87.3	1.70	1.96
August	110	23	64.8	1.26	1.45
September	104	22	72.6	1.41	1.57
The year	405	22	114	2.21	30.02

BEAVER RIVER AT STATE DAM NEAR BEAVER RIVER, N. Y.

LOCATION.—At concrete storage dam at outlet of Beaver River flow, about 7½ miles west of Beaver River postoffice, Herkimer County, and 7 miles above Beaver Lake at Number Four.

DRAINAGE AREA.—176 square miles (measured on topographic maps).

RECORDS AVAILABLE.—May 11, 1908, to September 30, 1917.

GAGES.—Elevation of water surface in the reservoir is determined by a staff gage in two sections, on the west corner of the gage house; read by James Dunbar, gate tender. The mean elevation of the crest of the spillway is at gage height 16.96 feet. Prior to September 28, 1913, elevation of water surface was determined by measuring the distance from the water surface to a reference point set at the elevation of the crest of the spillway. Widths of sluice gate openings determined by measuring on the gate stems the distance they have been raised.

DISCHARGE MEASUREMENTS.—Current-meter measurements made from a temporary foot bridge at the mouth of the outlet tunnel, below the gates. Discharge over the spillway has not been measured.

DETERMINATION OF DISCHARGE.—Records include the discharge through one or more of four 4-foot circular sluice gates, when opened, the discharge over the spillway, and the discharge through the logway at the west end of the spillway. The sluice gates have been rated by current-meter measurements made at different lake elevations but no measurements have been made of the discharge over the spillway or through the logway. Theoretic coefficients based on the Cornell experiments [1] have been used to compute ratings for the spillway and logway.

REGULATION.—At ordinary stages the discharge of Beaver River is completely regulated by the operation of the sluice gates.

EXTREMES OF STAGE.—Maximum elevation of water surface in reservoir recorded during year, 18.8 feet on April 22; minimum stage recorded 4.5 feet on October 19.

1908–1917: Maximum elevation of water surface in reservoir, 19.46 feet March 29, 1913; minimum stage, 2.9 feet September 29 and October 1, 1913.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 1,960 second-feet April 23; minimum discharge, zero, during periods when gates were closed and there was no flow over spillway.

1908–1917: Maximum discharge, 3,300 second-feet on May 2, 1911.

ACCURACY.—Stage-discharge relation permanent; probably not affected by ice. Rating curves for sluice gates well defined. Lake gage read to half tenths once daily. The accuracy of computations depends to a large extent on the care with which the gates were set to the recorded openings. Records fair.

Discharge measurements of Beaver River at State dam near Beaver River, N. Y., during the year ending Sept. 30, 1917.

[Made by A. H. Davison.]

Date.	Gate.		Lake gage height.	Discharge.	Date.	Gate.		Lake gage height.	Discharge.
	No.	Opening.				No.	Opening.		
		Inches.	*Feet.*	*Sec.-ft.*			*Inches.*	*Feet.*	*Sec.-ft.*
Oct. 10	4	48	6.22	131	Oct. 10	1	36	6.40	123
10	4	36	6.22	118	10	1	45	6.39	137
10	4	24	6.24	99.8	10	3	12	6.39	50.5
10	4	12	6.28	51.2	10	3	24	6.42	95.6
10	1	12	6.36	52.8	11	3	36	6.50	118
10	1	24	6.39	98.0					

NOTE.—All measurements made from temporary bridge at mouth of tunnel.

[1] U. S. Geol. Survey Water-Supply Paper 200.

Monthly discharge of Beaver River at State dam near Beaver River, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 176 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	167	93	126	0.716	0.83
November	206	113	172	.977	1.09
December	244	210	237	1.35	1.56
January	241	234	238	1.35	1.56
February	237	216	228	1.30	1.35
March	243	212	216	1.23	1.42
April	1,960	246	1,080	6.14	6.85
May	1,010	368	588	3.34	3.85
June	1,260	368	562	3.19	3.56
July	412	139	211	1.20	1.38
August	256	83	221	1.26	1.45
September	243	213	231	1.31	1.46
The year	1,960	83	342	1.94	26.36

STREAMS TRIBUTARY TO ST. LAWRENCE RIVER.

EAST BRANCH OF OSWEGATCHIE RIVER AT NEWTON FALLS, N. Y.

LOCATION.—600 feet below lower dam of Newton Falls Paper Co., in Newton Falls, St. Lawrence County, 4 miles above mouth of Little River and 10 miles below outlet of Cranberry Lake.

DRAINAGE AREA.—166 square miles (measured by engineers of New York Conservation Commission).

RECORDS AVAILABLE.—October 6, 1912, to September 30, 1917.

GAGE.—Vertical staff on left bank 600 feet above lower dam; read by Alfred Renaud and Henay Van Waldick.

DISCHARGE MEASUREMENTS.—Made by wading, or from cable 30 feet upstream from gage.

CHANNEL AND CONTROL.—Small boulders and rock covered with waste from pulp mill; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.8 feet at 6.30 p. m. June 12 and 14 (discharge, 894 second-feet); minimum stage is reached nearly every Sunday during low-water period when paper mills shut down.

1912–1917; maximum stage recorded, 6.1 feet at 5.15 p. m. March 28, 1913 (discharge, 2,200 second-feet).

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

REGULATION.—Some diurnal fluctuation in flow caused by operation of paper mills. Seasonal flow largely controlled by storage at Cranberry Lake.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice during year. Rating curve well defined between 20 and 1,200 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying to the rating table weighted mean gage height based on observer's notes concerning operation of paper mills. Records good.

The following discharge measurement was made through incomplete ice cover by A. H. Davison:

January 18, 1918: Gage height, 1.83 feet; discharge, 282 second-feet.

Daily discharge, in second-feet, of East Branch of Oswegatchie River at Newton Falls, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	119	262	350	223	304	262	242	460	350	150	180	350
2	282	326	350	350	282	223	282	402	402	262	304	210
3	326	304	223	350	326	148	350	460	300	304	188	402
4	304	326	350	304	75	99	402	588	376	188	490	376
5	188	93	376	262	262	205	376	658	376	180	196	350
6	262	223	376	223	350	282	350	554	350	180	196	304
7	262	304	376	171	282	304	402	554	350	188	188	304
8	304	242	376	242	242	223	262	588	402	100	376	326
9	262	326	350	326	155	196	350	588	350	196	376	200
10	282	326	242	304	171	205	326	460	300	223	350	262
11	262	350	376	304	282	223	304	402	490	223	376	376
12	262	99	460	262	350	196	350	402	894	242	200	304
13	262	350	430	326	402	171	350	326	852	196	350	282
14	242	304	402	155	402	242	282	522	852	205	350	205
15	148	262	402	262	376	242	205	588	810	119	304	262
16	223	326	402	304	196	282	242	460	810	402	350	205
17	350	326	99	304	180	223	223	402	350	223	304	402
18	326	326	304	304	282	126	242	350	376	188	304	402
19	350	155	402	304	304	223	304	402	522	171	326	402
20	326	326	402	148	205	205	326	304	430	180	402	402
21	262	350	402	140	223	188	554	350	402	223	262	402
22	196	326	402	282	205	262	460	326	402	188	180	402
23	304	326	350	304	163	326	554	315	402	171	223	300
24	304	350	99	304	112	326	460	304	300	262	376	430
25	350	376	126	326	54	140	376	262	376	302	350	350
26	304	188	588	304	242	262	376	350	402	402	205	402
27	326	326	376	304	326	460	350	304	376	402	460	304
28	304	350	376	75	304	460	376	460	304	376	402	350
29	81	402	350	262	.....	430	350	460	205	200	304	304
30	196	376	326	350	.....	402	460	304	304	304	326	304
31	223	.....	112	326	.....	376	.....	402	.....	350	304	.....

NOTE.—No gage-height record, discharge estimated for the following days: May 23, June 3, 10, 17, 24, July 1, 8, 29, Aug. 12, Sept. 2, 9, and 23.

Monthly discharge of East Branch of Oswegatchie River at Newton Falls, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 166 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	350	81	264	1.59	1.83
November	402	93	298	1.79	2.00
December	588	99	340	2.05	2.36
January	350	75	271	1.63	1.88
February	402	54	252	1.52	1.58
March	460	99	255	1.54	1.78
April	554	205	350	2.11	2.35
May	658	262	429	2.58	2.97
June	894	205	447	2.69	3.00
July	402	100	235	1.42	1.64
August	460	180	307	1.85	2.13
September	430	200	329	1.98	2.21
The year	894	54	315	1.90	25.73

NOTE.—Table shows run-off as regulated at Cranberry Lake and by paper mills at Newton Falls.

OSWEGATCHIE RIVER NEAR HEUVELTON, N. Y.

LOCATION.—2½ miles above Heuvelton, St. Lawrence County, 3 miles below Rensselaer Falls, and 7 miles above mouth of Indian River (outlet to Black Lake).

DRAINAGE AREA.—961 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 23, 1916, to September 30, 1917.

GAGE.—Gurley seven-day water-stage recorder on the right bank, about 2½ miles above Heuvelton, installed September 16, 1916. Prior to this date gage height was determined by measuring the distance from a reference point to the water surface. Recorder inspected by George Todd.

CHANNEL AND CONTROL.—Solid rock.

EXTREMES OF DISCHARGE.—Maximum stage, from water-stage recorder, 7.6 feet from 9 to 12 a. m. March 30 (discharge, 11,700 second-feet); minimum stage from water-stage recorder, 0.91 foot at 11 p. m. October 16 (discharge 320 second-feet).

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

REGULATION.—Some diurnal fluctuation due to operation of mills at Renssalaer Falls and above. Seasonal flow regulated by storage in Cranberry Lake.

ACCURACY.—Stage-discharge relation permanent except as affected by ice January 11 to March 22. Rating curve well defined between 400 and 15,000 second-feet. Operation of water-stage recorder satisfactory throughout the year. Daily discharge June 23 to September 15, 1916, ascertained by applying to rating table daily gage height obtained from two observations of stage per day; discharge September 16, 1916, to September 30, 1917, except for period of ice effect, ascertained by applying to rating table mean daily gage height obtained from gage-height graph. Open-water records good; winter records fair.

Discharge measurements of Oswegatchie River near Heuvelton, N. Y., 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. 27	A. H. Davison	2.00	1,190	Apr. 9	A. H. Davison	4.48	4,880
Jan. 16[a]	do	2.15	1,320	13	do	2.95	2,390
Feb. 14[a]	do	1.72	698	July 16	C. C. Covert	1.43	681
Mar. 12[a]	do	1.99	995	Aug. 14	E. D. Burchard	1.24	506
30	do	7.60	11,600	14	do	1.22	504
30	do	7.59	11,700	Sept. 27	do	1.30	556
Apr. 5	do	5.51	6,870	28	do	1.26	534

[a] Measurement made through incomplete ice cover.

Daily discharge, in second-feet, of Oswegatchie River near Heuvelton, N. Y., for period June 23, 1916, to Sept. 30, 1917.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1916.					1916.				
1	.....	881	602	485	16	.....	622	548	392
2	.....	836	622	459	17	.....	662	513	340
3	.....	881	622	478	18	.....	746	548	398
4	.....	836	548	440	19	.....	836	548	325
5	.....	746	387	145	20	.....	928	513	340
6	.....	746	387	180	21	.....	881	548	376
7	.....	746	446	478	22	.....	881	478	375
8	.....	702	446	499	23	1,550	836	446	375
9	.....	662	478	478	24	1,430	836	472	376
10	.....	622	478	446	25	1,340	836	414	376
11	.....	622	478	478	26	1,170	791	414	409
12	.....	662	548	360	27	1,130	702	404	452
13	.....	622	622	414	28	1,080	746	409	440
14	.....	622	662	414	29	1,080	702	340	466
15	.....	585	622	446	30	1,020	662	433	440
					31	.....	746	466	.....

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916–17.												
1	414	570	1,230	734	1,000	1,000	9,700	1,840	1,980	918	592	746
2	409	548	1,300	710	1,100	1,300	8,100	1,980	1,840	1,060	562	800
3	479	541	1,320	710	1,100	1,400	7,050	2,180	1,690	1,160	485	900
4	694	608	1,310	678	1,100	1,300	6,850	2,320	1,510	1,040	420	900
5	686	710	1,230	719	1,100	1,300	6,850	2,110	1,410	1,000	446	890
6	646	818	1,230	890	1,000	1,300	6,850	2,180	1,410	918	513	890
7	585	836	1,510	1,120	950	1,300	6,250	2,040	1,300	827	499	845
8	534	791	1,840	1,410	850	1,100	5,860	1,910	1,290	746	485	782
9	485	746	1,910	1,490	800	1,100	4,920	1,840	1,370	678	472	818
10	452	737	1,910	1,480	750	1,100	4,040	1,730	1,600	630	459	719
11	466	710	2,040	1,400	700	1,100	3,370	1,630	3,590	630	446	638
12	459	719	2,180	1,400	650	1,000	2,750	1,580	4,920	694	426	638
13	446	845	2,180	1,400	650	1,000	2,390	1,680	4,920	800	485	615
14	426	854	1,910	1,300	600	1,000	2,180	1,910	4,650	755	485	600
15	392	764	1,650	1,300	600	1,100	1,910	1,980	4,300	694	492	615
16	382	728	1,410	1,300	650	1,100	1,720	1,980	3,700	686	478	570
17	433	854	1,240	1,300	750	1,100	1,540	1,840	3,130	702	485	592
18	578	662	1,240	1,400	800	1,300	1,400	1,630	2,600	737	478	520
19	600	654	1,140	1,300	750	1,500	1,330	1,550	2,180	737	541	534
20	578	608	890	1,200	750	1,500	1,430	1,330	1,910	694	548	520
21	638	662	881	1,100	650	1,400	1,910	1,230	1,580	764	492	492
22	686	630	863	1,000	700	1,500	2,600	1,140	1,410	630	478	506
23	773	615	863	900	750	2,460	3,210	1,260	1,330	578	485	.....
24	900	670	836	800	700	5,670	3,370	1,280	1,230	646	459	.....
25	947	702	800	750	600	8,540	3,210	1,430	1,120	622	485	.....
26	918	893	800	800	600	11,000	2,820	1,680	985	630	592	.....
27	835	1,190	755	800	700	11,400	2,530	1,730	909	608	881	.....
28	752	1,310	710	800	900	11,200	2,390	1,840	947	570	890	506
29	670	1,370	702	850	.....	11,400	2,180	1,690	909	555	800	520
30	646	1,300	782	900	.....	11,700	2,040	1,910	928	555	719	513
31	570	.....	758	950	.....	11,000	.....	2,040	.....	555	728	.....

NOTE.—Discharge, Sept. 22 and 23, 1916, estimated. Discharge, Jan. 11 to Mar. 24, estimated, because of ice, from discharge measurements, weather records, study of gage height graph, and comparison with open-water records for Harrisville. Discharge Sept. 23–27, 1917, estimated at 500 second-feet.

Monthly discharge of Oswegatchie River near Heuvelton, N. Y., for the period July 1, 1916, to Sept. 30, 1917.

[Drainage area, 961 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1916.					
July	928	585	748	0.779	0.90
August	662	340	500	.520	.60
September	499	145	403	.419	.47
1916–17.					
October	947	382	596	.620	.71
November	1,370	541	788	.820	.91
December	2,180	702	1,270	1.32	1.52
January	1,490	678	1,060	1.10	1.27
February	1,100	600	795	.828	.86
March	11,700	1,000	3,590	3.73	4.30
April	9,700	1,330	3,760	3.91	4.36
May	2,320	1,140	1,760	1.83	2.11
June	4,920	909	2,090	2.17	2.42
July	1,160	555	736	.766	.88
August	890	420	542	.564	.65
September	900	492	623	.645	.72
The year	11,700	382	1,470	1.53	20.71

WEST BRANCH OF OSWEGATCHIE RIVER NEAR HARRISVILLE, N. Y.

LOCATION.—At highway bridge near Geers Corners, 2½ miles downstream from Harrisville, Lewis County.

DRAINAGE AREA.—245 square miles (measured on topographic maps and map of New York, issued by U. S. Geol. Survey; scale, 1:500,000).

RECORDS AVAILABLE.—July 1, 1916, to September 30, 1917.

GAGE.—Vertical staff in three sections on the right bank; section graduated from 0.0 to 3.3 feet about 25 feet below bridge, and two sections graduated from 3.3 to 10.1 feet, on downstream side of bridge abutment. Gage read by Frank Osborne.

DISCHARGE MEASUREMENTS.—Made from cable 200 feet upstream from bridge, or by wading.

CHANNEL AND CONTROL.—Rocky and rough; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.1 feet at 6.30 a. m. and 6 p. m. March 28 (discharge, 4,880 second-feet); minimum stage recorded, 1.10 feet at 6 p. m. August 11 (discharge, 42 second-feet).

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

REGULATION.—Operation of pulp mill at Harrisville causes some diurnal fluctuation.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined between 50 and 4,000 second-feet. Gage read to half tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of West Branch of Oswegatchie River near Harrisville, N. Y., 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. 17[a]	A. H. Davison	2.95	440	Apr. 3	A. H. Davison	6.47	2,960
Feb. 12[a]	do	1.82	128	8	do	5.10	1,700
Mar. 10[a]	do	2.30	246	12	do	3.70	797
Apr. 2	do	5.62	2,220	June 8	O. W. Hartwell	2.97	455
2	do	5.70	2,210				

[a] Measurement made through incomplete ice cover.

Daily discharge, in second-feet, of West Branch of Oswegatchie River near Harrisville, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	370	135	560	208	440	335	1,960	650	650	480	85	370
2	290	182	560	220	440	370	2,130	600	560	422	85	370
3	245	220	520	195	480	388	3,090	650	440	370	85	352
4	195	320	440	195	405	405	3,410	700	480	260	64	352
5	170	335	480	195	335	305	2,890	750	440	232	79	245
6	146	335	650	290	290	320	2,490	650	405	195	62	195
7	79	305	850	352	275	320	2,040	700	405	146	50	245
8	85	275	800	370	245	260	1,800	650	480	170	50	220
9	63	245	700	440	220	275	1,420	600	750	124	51	170
10	63	260	850	480	245	305	1,150	560	850	146	70	170
11	85	305	1,030	460	275	275	970	560	970	146	91	170
12	66	305	970	422	195	275	850	650	1,280	195	56	158
13	98	320	750	290	195	320	750	750	1,490	275	124	146
14	85	290	650	290	195	335	650	750	1,210	220	70	106
15	208	195	560	388	170	305	600	750	970	170	78	85
16	195	245	560	405	170	305	560	700	750	182	58	91
17	158	245	650	440	170	320	480	650	650	158	74	74
18	124	220	460	440	170	335	560	560	520	170	62	106
19	135	182	370	405	158	275	650	480	440	208	63	106
20	170	124	305	370	158	335	800	405	405	208	64	106
21	245	124	275	388	158	352	1,350	480	405	232	91	79
22	405	124	220	335	146	335	1,960	460	370	182	79	98
23	405	158	220	305	124	388	1,880	560	335	208	66	106
24	370	335	275	275	146	850	1,720	650	290	195	85	70
25	320	480	232	275	146	1,210	1,350	750	275	124	440	79
26	260	650	232	245	158	2,310	1,090	850	305	146	388	77
27	220	560	208	208	195	3,520	850	850	245	170	275	91
28	220	560	220	245	335	4,880	750	800	245	124	232	60
29	208	480	232	158	.....	3,980	750	800	220	124	170	91
30	170	460	245	260	.....	3,090	700	850	388	91	220	146
31	170	.....	220	370	.....	2,400	.....	800	.....	62	352	.....

Monthly discharge of West Branch of Oswegatchie River near Harrisville, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 245 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	405	63	194	0.792	0.91
November	650	124	299	1.22	1.36
December	1,030	208	493	2.01	2.32
January	480	158	320	1.31	1.51
February	480	124	237	.967	1.01
March	4,880	260	957	3.91	4.51
April	3,410	480	1,390	5.67	6.23
May	850	405	665	2.71	3.12
June	1,490	220	574	2.34	2.61
July	480	62	198	.808	.93
August	440	50	123	.502	.58
September	370	60	158	.645	.72
The year	4,880	50	468	1.91	25.81

RAQUETTE RIVER AT PIERCEFIELD, N. Y.

LOCATION.—Half a mile below dam of International Paper Co. at Piercefield, St. Lawrence County, and about three-fourths mile above head of Black Rapids.

DRAINAGE AREA.—723 square miles (all but 16 square miles measured on topographic maps).

RECORDS AVAILABLE.—August 20, 1908, to September 30, 1917.

GAGE.—Stevens water-stage recorder installed October 22, 1912 in a galvanized sheet-iron house over a concrete well on right bank about one-half mile below dam. Prior to January 1, 1913, the following gages were used: August 20, 1908 to August 20, 1910, vertical staff fastened to an old pine stump; August 20, 1910, to December 31, 1912, chain fastened to same stump and having same datum until June 1, 1911, when datum of chain gage was lowered 2 feet. Water-stage recorder was set at this datum. Recorder inspected by M. O. Wood.

DISCHARGE MEASUREMENTS.—Made from a cable three-fourths mile below gage, just above Black Rapids.

CHANNEL AND CONTROL.—Channel opposite gage is a deep pond with no perceptible velocity. Control is at head of Black Rapids.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 9.75 feet at 9 a. m. April 30 (discharge, 4,950 second-feet); minimum stage, from water stage recorder, 1.69 feet at 6 p. m. October 29 (discharge, 48 second-feet.)

1908–1917: Maximum stage, from water-stage recorder, 11.68 feet at 3 a. m. April 1, 1913 (discharge, 7,100 second-feet); minimum stage, from water-stage recorder, 0.85 foot at 11 a. m. September 2, 1913 (discharge, about 10 second- feet).

ICE.—Rapids that form control rarely freeze; measurements made when the pond was covered with ice indicate that the stage-discharge relation was not affected.

REGULATION.—Large diurnal fluctuation in flow caused by operation of dam during low and medium stages. Numerous lakes in upper part of drainage basin afford considerable storage, most of which is so controlled, that the effect on the seasonal distribution of flow is large.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined between 50 and 7,000 second-feet. Operation of water-stage recorder satisfactory throughout the year. Daily discharge ascertained by use of discharge integrator. Records good.

COOPERATION.—Water-stage recorder inspected by an employee of the International Paper Co.

Discharge measurements of Raquette River at Piercefield, N. Y., 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. 2	A. H. Davison	3.92	474	Jan. 13	A. H. Davison	5.16	948
2	do	3.99	481	Apr. 17	do	7.85	2,820
8	do	1.83	59.1	17	do	7.84	2,830
14	do	2.31	109	17	do	7.81	2,780
14	do	2.29	104	June 1	O. W. Hartwell	7.51	2,470
15	do	1.96	69.1	July 27	C. C. Covert	5.40	986

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Daily discharge, in second-feet, of Raquette River at Piercefield, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	62	428	872	1,030	895	545	1,530	4,700	2,450	2,350	486	524
2	200	377	940	1,060	895	530	2,150	4,540	2,260	2,300	485	234
3	230	395	655	900	895	545	2,670	4,380	2,510	2,260	522	101
4	230	425	1,080	1,070	390	266	3,040	4,270	2,460	1,740	492	383
5	230	246	1,100	989	639	408	3,380	4,180	2,480	2,110	235	516
6	225	395	1,040	879	895	562	3,680	3,970	2,440	2,060	416	520
7	140	425	1,330	540	686	647	4,260	3,900	2,400	1,890	542	510
8	65	440	1,290	742	545	545	3,690	3,750	2,500	1,570	532	525
9	250	425	1,380	892	715	562	4,050	3,580	2,500	1,760	480	236
10	236	425	1,030	878	895	530	3,980	3,420	2,340	1,530	354	349
11	233	460	1,430	906	348	249	3,870	3,350	2,750	1,480	337	500
12	235	271	1,590	800	700	476	3,780	3,220	3,220	1,460	194	481
13	227	457	1,560	723	880	620	3,640	3,060	3,480	1,420	276	465
14	156	515	1,580	476	880	624	3,380	3,070	3,600	1,390	366	334
15	70	515	1,550	897	870	617	3,180	2,950	3,740	920	370	325
16	198	500	1,580	918	870	610	3,080	2,880	3,810	1,330	353	186
17	253	500	966	918	784	608	2,820	2,790	3,750	1,260	363	291
18	245	500	1,560	918	238	268	2,730	2,720	3,830	1,060	370	498
19	244	294	1,590	900	428	530	2,580	2,660	3,810	944	224	490
20	243	441	1,390	872	562	623	2,740	2,470	3,680	655	293	475
21	336	470	1,380	425	545	633	3,030	2,500	3,620	534	372	508
22	180	470	1,380	661	562	620	3,480	2,470	3,540	516	368	496
23	359	485	1,300	756	545	696	3,900	2,450	3,350	368	430	257
24	380	500	564	918	545	500	4,280	2,410	3,080	535	525	337
25	380	530	700	848	273	222	4,630	2,390	3,230	535	570	518
26	395	350	1,240	940	414	821	4,830	2,400	3,070	510	260	503
27	365	652	1,370	895	562	1,060	4,900	2,290	2,840	524	380	500
28	443	830	1,370	448	562	1,160	4,880	2,420	2,660	538	496	492
29	214	830	1,380	760	.....	1,190	4,850	2,420	2,600	274	530	487
30	428	872	1,200	918	.....	2,490	4,830	2,420	2,520	407	522	230
31	485	.....	573	918	.....	1,590	.....	2,470	.....	510	520	.....

Monthly discharge of Raquette River at Piercefield, for the year ending Sept. 30, 1917.

[Drainage area, 723 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	485	62	256	0.354	0.41
November	872	246	481	.665	.74
December	1,590	564	1,220	1.69	1.95
January	1,070	425	832	1.15	1.33
February	895	238	643	.890	.93
March	2,490	249	689	.953	1.10
April	4,900	1,530	3,590	4.96	5.53
May	4,700	2,290	3,110	4.30	4.96
June	3,830	2,260	3,020	4.18	4.66
July	2,350	274	1,180	1.63	1.89
August	570	194	408	.565	.65
September	525	101	409	.566	.63
The year	4,900	62	1,320	1.83	24.78

NOTE.—Minimum discharge for each month occurred on Sunday.

ST. REGIS RIVER AT BRASHER CENTER, N. Y.

LOCATION.—Near steel highway bridge in Brasher Center, St. Lawrence County, 5 miles downstream from Brasher Falls, 6¼ miles below junction of East and West branches of St. Regis River and about 12 miles above mouth.

DRAINAGE AREA.—621 square miles (measured on Post Route map).

RECORDS AVAILABLE.—August 22, 1910, to September 30, 1917.

GAGES.—Staff, with inclined and vertical sections, on right bank about 600 feet above bridge; installed June 24, 1916. Prior to this date, chain on right-hand downstream side of bridge. Gages not at same datum; subject to different controls. Gage read by George Myers.

DISCHARGE MEASUREMENTS.—Made from a cable at the staff gage, installed in June 1916. Previously made from the highway bridge, or by wading.

CHANNEL AND CONTROL.—Bed at cable composed of small boulders and coarse gravel; large boulders and gravel, and very rough at bridge; fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.58 feet at 5 p. m. April 3 (discharge, 6,030 second-feet); minimum stage recorded 5.25 feet at 5 p. m. August 8 (discharge about 34 second-feet).

1910–1917: Maximum stage recorded, 9.1 feet at 7 a. m. March 27, 1914 (discharge, 16,200 second-feet); minimum stage recorded, August 8, 1917.

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

ACCURACY.—Stage-discharge relation practically permanent, except as affected by ice December 12 to March 25. Rating curves well defined between 200 and 6,000 second-feet. Gage read to quarter-tenths twice daily. Daily discharge, except for period of ice effect, ascertained by applying mean daily gage height to rating table. Open-water records good; winter records fair.

Discharge measurements of St. Regis River at Brasher Center, N. Y., 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. 15[a]	A. H. Davison	7.12	544	Apr. 4	A. H. Davison	9.39	5,600
Feb. 15[a]	do	7.02	332	10	do	7.73	2,390
Mar. 13[a]	do	7.09	487	14	do	7.25	1,680
29	do	8.72	4,150	Sept. 1	C. C. Covert	6.27	473
29	do	8.70	4,120				

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of St. Regis River at Brasher Center, N. Y., for the year ending Sept. 30, 1917,

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	571	395	695	190	300	650	3,350	1,730	1,050	870	100	675
2	552	395	940	240	300	600	4,540	1,590	930	930	55	645
3	395	395	810	240	360	550	5,850	1,520	1,050	810	50	758
4	322	452	752	260	380	650	5,400	1,590	1,180	645	50	685
5	335	418	940	300	340	650	4,960	1,450	1,050	567	44	492
6	322	395	1,050	380	340	500	4,750	1,240	1,050	492	61	492
7	372	372	875	500	300	400	4,330	1,050	990	456	50	340
8	283	410	940	600	320	400	3,530	1,120	1,240	492	37	291
9	322	350	940	500	360	400	3,170	1,310	1,660	474	50	319
10	259	380	1,050	460	320	380	2,340	1,180	1,730	456	75	372
11	237	514	940	480	340	340	1,880	1,050	2,180	348	130	404
12	283	571	1,000	400	340	400	1,800	1,310	2,500	520	202	348
13	270	452	850	300	340	500	1,730	1,660	2,880	645	158	348
14	372	350	750	280	300	500	1,590	1,730	2,880	492	121	291
15	395	283	800	300	280	400	1,310	1,880	2,500	492	215	270
16	444	322	850	380	300	360	1,120	1,520	2,340	456	372	232
17	452	270	320	600	220	360	930	1,050	2,030	492	456	202
18	452	328	340	500	280	480	1,240	810	1,450	456	348	158
19	478	350	300	480	260	550	1,590	870	1,120	372	254	170
20	495	365	340	440	220	600	2,030	810	930	388	372	242
21	810	350	260	500	240	600	2,660	930	758	586	456	291
22	1,050	372	240	420	300	500	3,170	1,180	990	474	548	456
23	940	322	260	320	300	700	3,170	1,730	810	372	645	520
24	695	590	240	340	320	1,300	3,170	1,660	810	404	548	388
25	571	1,300	240	440	300	2,500	2,500	1,730	758	319	456	270
26	495	752	200	500	340	3,920	2,180	1,730	665	270	348	232
27	452	642	180	380	480	4,330	1,880	1,730	685	270	291	319
28	395	600	220	380	800	4,960	1,590	1,590	685	319	372	291
29	350	642	200	260	.....	3,920	1,520	1,450	665	254	319	372
30	365	611	240	320	.....	2,830	1,660	1,310	758	202	348	404
31	342	.....	260	320	.....	2,660	.....	1,240	.....	158	548	.....

NOTE.—Discharge Dec. 12 to Mar. 25, estimated, because of ice from discharge measurements, weather records and study of gage-height graph.

Monthly discharge of St. Regis River at Brasher Center, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 621 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,050	237	454	0.731	0.84
November	1,300	270	465	.749	.84
December	1,050	180	581	.936	1.08
January	600	190	387	.623	.72
February	800	220	332	.535	.56
March	4,980	340	1,220	1.96	2.26
April	5,850	930	2,700	4.35	4.85
May	1,880	810	1,380	2.22	2.56
June	2,880	665	1,340	2.16	2.41
July	930	158	467	.752	.87
August	645	37	261	.420	.48
September	758	158	376	.605	.68
The year	5,850	37	830	1.34	18.15

RICHELIEU RIVER AT FORT MONTGOMERY, ROUSES POINT, N. Y.

LOCATION.—Inside the fort, three-eighths mile south of international boundary, about half a mile below outlet of Lake Champlain, and 1 mile northeast of Rouses Point, Clinton County.

DRAINAGE AREA.—7,870 square miles, including 436 square miles of water surface (from annual report of New York State Engineer and Surveyor).

RECORDS AVAILABLE.—1875 to 1917.

GAGE.—Staff, inside of fort; read by Thomas Bourke. Elevation of gage zero, 92.50 feet above mean sea level.

EXTREMES OF STAGE.—Maximum elevation recorded during year, 98.25 feet at 10 a. m. April 8 and 9; minimum elevation recorded, 93.3 feet at 10 a. m. November 20 and 21.

1869–1917: Maximum elevation recorded, 103.28 feet April, 1869;[1] minimum elevation recorded, 91.9 feet November 13, 1908.

COOPERATION.—Gage heights observed under direction of the Corps of Engineers of the United States Army and reported weekly to the United States Geological Survey.

Daily gage height, in feet, of Richelieu River at Fort Montgomery, Rouses Point, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.15	1.05	1.20	1.90	1.95	1.80	4.50	5.45	4.15	3.70	2.55	1.85
2	1.15	1.00	1.30	1.75	1.95	1.80	4.90	5.30	3.75	3.65	2.55	1.85
3	1.20	1.00	1.40	1.80	1.95	1.80	5.10	5.15	3.70	3.60	2.55	1.75
4	1.20	1.00	1.60	1.80	1.95	1.80	5.35	5.10	3.65	3.50	2.45	1.70
5	1.25	1.00	1.55	1.80	1.95	1.85	5.45	5.05	3.65	3.50	2.35	1.65
6	1.15	1.00	1.55	1.80	1.95	1.85	5.60	5.00	3.60	3.50	2.35	1.80
7	1.20	1.05	1.50	1.85	2.00	1.85	5.70	4.95	3.60	3.50	2.30	1.60
8	1.20	1.20	1.55	1.85	1.95	1.90	5.75	4.90	3.60	3.50	2.35	1.60
9	1.00	1.20	1.75	1.80	1.95	1.90	5.75	4.80	3.50	3.50	2.35	1.65
10	1.05	.95	1.70	1.75	1.95	1.85	5.65	4.60	3.50	.....	2.25	1.50
11	1.05	.90	1.70	1.75	1.95	1.85	5.65	4.60	3.50	3.50	2.25	1.50
12	1.05	.90	1.70	1.85	1.90	1.90	5.65	4.55	4.00	3.35	2.20	1.75
13	1.40	.85	1.70	1.80	1.90	1.95	5.60	4.55	4.25	3.35	2.25	1.50
14	.85	.85	1.80	1.80	1.90	1.90	5.50	4.60	4.40	3.25	2.25	1.45
15	1.10	.90	1.80	1.80	1.90	1.90	5.45	4.40	4.35	3.25	2.25	1.40
16	.90	.90	1.75	1.85	1.90	1.90	5.35	4.40	4.40	3.25	2.20	1.35
17	1.10	1.05	1.80	1.90	1.90	2.00	5.25	4.40	4.35	3.10	2.15	1.35
18	.90	.90	1.80	1.90	1.90	1.95	5.20	4.40	4.35	3.05	2.10	1.30
19	1.20	.90	1.80	1.85	1.85	1.95	5.10	4.30	4.40	3.05	2.10	1.35
20	.95	.80	1.80	1.90	1.85	1.95	5.35	4.15	4.35	3.05	2.30	1.30
21	1.00	.80	1,75	1.85	1.85	1.90	5.40	4.10	4.40	3.05	2.10	1.30
22	1.05	.90	1.75	1.90	1.80	1.90	5.45	4.10	4.35	3.15	2.10	1.25
23	1.10	.95	1.75	1.95	1.80	2.00	5.50	4.20	4.30	3.05	2.15	1.35
24	1.10	1.00	1.80	1.95	1.80	2.15	5.45	4.20	4.20	3.00	2.10	1.35
25	1.15	.90	1.75	1.95	1.80	2.40	5.50	4.00	4.10	3.00	2.15	1.30
26	1.20	.95	1.80	1.95	1.80	2.70	5.55	3.90	4.15	3.00	2.10	1.30
27	1.10	1.30	1.80	1.95	1.80	3.05	5.50	3.80	4.00	2.95	2.10	1.30
28	1.05	1.15	1.80	1.95	1.80	3.50	5.35	3.80	3.90	2.75	2.00	1.30
29	1.35	1.10	1.80	2.00	.....	3.85	5.35	3.80	3.90	2.75	1.95	1.25
30	1.20	1.05	1.80	1.95	.....	4.10	5.35	3.75	3.75	2.70	1.85	1.25
31	1.05	.....	1.85	1.95	.....	4.30	.....	3.80	.....	2.60	1.80	.....

SARANAC RIVER NEAR PLATTSBURG, N. Y.

LOCATION.—At Indian Rapids power plant (formerly known as Lozier dam) of Plattsburg Gas & Electric Co., about 6 miles above mouth of river at Plattsburg, Clinton County.

DRAINAGE AREA.—607 square miles (measured on topographic maps).

RECORDS AVAILABLE.—March 27, 1903, to September 30, 1917.

[1] Hoyt, J. C., Stream measurements, 1903, North Atlantic, St. Lawrence River and Great Lakes drainage: U. S. Geol. Survey Water-Supply Paper 97, p. 340, 1904.

GAGES.—Crest gage a vertical staff on the angle of the wing wall at the end of the racks. Datum raised 0.76 foot August 20, 1906. Tailrace gage a vertical staff spiked to timber work dike between tailrace and river and about 50 feet below power house. Records of kilowatt output are obtained by watt meter on switchboard at half-hour intervals. Inclined staff gage at cable station, a quarter of a mile below dam. Gages and watt meters read by power-house operators.

DISCHARGE MEASUREMENTS.—Made from a cable at head of Indian Rapids, one quarter mile below dam. Low-water measurements made by wading under cable or in tailrace.

DISCHARGE RATING.—Records include flow over concrete spillway 171.25 feet in crest length, a rating for which has been prepared for use of coefficients.[a] derived from experiments made in the hydraulic laboratory of Cornell University on a model section of the dam; the discharge through two power units equipped with 300 kilowatt generators which have been rated by current meter measurements; and the discharge through two 5-foot waste gates when open. Occasional observations are made on the inclined staff gage at the cable as a check on the ratings of spillway and turbines.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 5,400 second-feet April 3; minimum daily discharge 100 second-feet August 29.

1908–1917: Maximum daily discharge recorded, 6,410 second-feet, April 20 1914; minimum daily discharge recorded, 90 second-feet, September 28, 1914.

SPECIAL STUDY.—A portable water-stage recorder was operated at the cable for a short period in July, 1914. Mean daily discharge computed from its record agreed very closely with mean daily discharge derived from power-plant ratings.

ICE.—The crest of the spillway is kept free from ice so that the stage-discharge relation is not affected.

REGULATION.—The lakes and ponds on the main stream and tributaries above the station comprise a water surface area of about 25.5 square miles. The actual storage afforded by these reservoirs has been largely increased by the State dam at Lower Saranac Lake, the operation of which affects the distribution of flow throughout the year.

ACCURACY.—Discharge measurements made during the year indicate that the ratings of spillway and turbines have not changed. Discharge over the spillway ascertained by applying to rating table mean gage heights for 6-hour periods. Discharge through the turbines ascertained by applying to their ratings, the mean kilowatt output and head for 12-hour periods. Records fair.

COOPERATION.—Gage-height records and watt meter readings furnished by Plattsburg Gas & Electric Co., Herbert A. Stutchbury, superintendent.

Discharge measurements of Saranac River near Plattsburg, N. Y., 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. 4	O. W. Hartwell	4.58	4,560	Apr. 6	O. W. Hartwell	3.98	3,310
4	do	4.53	4,470	6	do	3.90	3,000
4	do	4.44	4,240	Aug. 30[b]	C. C. Covert	1.83	309
4	do	4.45	4,300				

[a] Horton, R. E., Weir experiments, coefficients, and formulas: U. S. Geol. Survey Water-Supply Paper 200, pp. 98–100, 1907.

[b] Measurement made in tailrace; no appreciable flow over spillway.

Daily discharge, in second-feet, of Saranac River near Plattsburg, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	230	370	660	460	520	820	3,400	1,250	1,060	1,140	270	400
2	370	400	580	470	560	780	4,600	1,140	1,000	1,160	290	330
3	270	370	500	580	490	660	5,400	1,450	920	1,080	470	380
4	270	330	580	560	350	500	4,300	1,300	1,200	980	430	280
5	280	270	580	490	500	660	3,500	1,250	740	960	290	230
6	250	450	660	680	380	580	3,000	1,120	840	940	400	270
7	310	380	640	580	540	540	3,000	1,250	860	980	260	245
8	195	420	660	640	580	600	2,350	1,120	1,100	760	240	380
9	360	410	600	620	540	600	1,850	1,060	1,300	820	320	245
10	380	560	680	660	480	540	1,700	1,080	1,040	680	450	300
11	360	410	700	580	300	440	1,220	1,060	1,500	800	310	230
12	270	300	800	540	540	540	1,450	1,200	2,600	740	260	250
13	360	340	560	460	350	360	1,220	1,140	2,250	780	260	205
14	310	410	620	410	460	540	1,200	930	2,000	840	210	250
15	270	410	700	640	580	470	1,220	1,020	1,800	700	320	260
16	360	380	560	580	600	540	1,160	980	1,450	900	320	210
17	300	390	380	620	540	530	1,140	920	1,500	680	400	310
18	390	350	640	640	380	480	1,160	980	1,450	660	450	280
19	360	310	460	560	480	620	1,350	760	1,350	840	300	290
20	380	340	500	540	380	480	1,900	740	1,250	740	340	1,180
21	520	360	680	420	410	500	2,450	800	1,400	700	270	840
22	400	310	560	540	390	560	2,800	860	1,240	660	290	620
23	680	360	480	420	400	560	2,500	1,100	1,120	660	290	440
24	400	430	390	520	460	820	2,300	1,250	920	660	320	470
25	400	560	500	560	370	900	2,050	1,080	1,140	940	310	300
26	450	230	500	480	480	1,650	1,800	1,180	1,060	580	260	310
27	460	450	440	400	560	2,500	1,700	1,060	920	580	540	250
28	450	480	560	350	760	3,300	1,700	900	920	640	210	740
29	290	520	580	520	.....	3,200	1,400	820	1,100	740	100	840
30	500	640	540	460	.....	2,900	1,400	1,100	1,300	640	210	920
31	360	.....	310	540	.....	2,400	.....	1,040	.....	700	270	.....

Monthly discharge of Saranac River near Plattsburg, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 607 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	680	[a] 195	361	0.595	0.69
November	640	[a] 230	405	.667	.74
December	800	[a] 210	568	.936	1.08
January	680	[a] 350	533	.878	1.01
February	760	[a] 300	478	.787	.82
March	3,300	[a] 440	1,010	1.66	1.91
April	5,400	1,140	2,210	3.64	4.06
May	1,450	[a] 740	1,060	1.75	2.02
June	2,600	740	1,280	2.11	2.35
July	1,160	580	796	1.31	1.51
August	470	100	312	.514	.59
September	1,180	205	408	.672	.75
The year	5,400	100	782	1.29	17.53

[a] Sunday.

AUSABLE RIVER AT AUSABLE FORKS, N. Y.

LOCATION.—In village of Ausable Forks, Clinton County, immediately below junction of East and West branches and about 15 miles above mouth of river.

DRAINAGE AREA.—444 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 17, 1910, to September 30, 1917.

GAGE.—Chain on left bank 1,000 feet below junction of East and West branches; read by A. S. Baker.

DISCHARGE MEASUREMENTS.—Made from a cable 1½ miles below gage, or by wading either near the cable or a short distance above the gage.

CHANNEL AND CONTROL.—Stone and gravel; occasionally shifting. Channel divided by an island opposite the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.95 feet at 6 p. m., April 2 (discharge, 7,580 second-feet); minimum discharge, 110 second-feet, February 18.

1910–1917: Maximum stage recorded, 10.2 feet in the evening of March 27, 1913 (discharge, roughly 25,000 second-feet); minimum stage recorded, 3.0 feet at 7 a. m. July 21, 1912 (discharge, practically zero).

SPECIAL STUDY.—A portable water-stage recorder was installed at this station and a continuous gage-height record obtained July 11 to September 30, 1914, which showed a continual small fluctuation in stage, It was shown that monthly mean discharge based on a semidaily gage heights is in error as follows: July 11–31, 3.5 per cent; August, 4.1 per cent; September, 1914, 0.5 per cent. Some of the determinations of daily discharge showed greater errors, but these were largely compensating.

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

ACCURACY.—Stage-discharge relation probably permanent between dates of shifting; affected by ice for short periods from December to March. Rating curve fairly well defined between 175 and 3,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Ausable River at Ausable Forks, N. Y., 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. 17	C. C. Covert	3.67	287	Apr. 5	O. W. Hartwell	4.99	2,280
Jan. 22[a]	A. H. Davison	3.90	274	5	do	4.97	2,210
Feb. 16[a]	do	3.74	170	Aug. 28	C. C. Covert	3.52	160
Mar. 14[a]	do	3.64	213				

[a] Measurement made through complete ice cover.

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

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	484	287	1,110	260	160	460	2,490	1,160	2,160	851	345	319
2	371	280	776	260	160	380	6,800	1,200	1,620	751	955	1,070
3	287	336	526	260	220	340	5,890	1,100	2,490	536	1,530	407
4	242	336	465	260	280	280	3,190	1,350	2,160	446	2,720	287
5	196	302	851	260	300	260	2,160	851	1,440	465	2,270	250
6	208	319	1,350	300	220	220	1,830	800	1,440	336	1,620	242
7	189	280	825	340	160	220	1,730	739	1,160	287	2,160	227
8	202	272	634	300	120	200	1,440	1,100	1,730	257	2,050	214
9	214	302	702	300	120	200	984	599	1,530	221	2,490	202
10	208	484	1,070	340	180	180	800	839	1,620	214	388	257
11	221	465	668	280	130	180	851	727	5,310	214	287	214
12	214	388	600	280	320	220	679	1,200	5,600	287	214	221
13	202	336	420	200	240	220	1,260	1,160	2,840	398	221	208
14	234	272	360	180	220	220	764	984	1,830	319	202	227
15	319	234	300	650	220	220	578	1,100	1,620	264	214	170
16	272	242	260	550	260	220	557	929	1,130	250	242	132
17	302	221	240	500	120	260	567	903	984	221	227	177
18	302	250	220	360	110	240	588	1,070	1,040	214	.....	183
19	250	227	220	440	220	240	955	2,070	702	189	.....	170
20	407	272	200	340	170	280	2,490	3,070	679	142	.....	916
21	1,260	196	200	280	160	240	6,190	1,940	1,440	157	.....	702
22	788	234	200	280	170	319	5,310	1,260	567	164	.....	465
23	557	264	200	320	130	465	3,320	1,530	484	153	177	319
24	426	1,730	200	220	130	1,060	3,070	1,440	1,230	202	189	272
25	354	750	200	140	120	1,260	1,730	1,260	2,050	153	189	250
26	354	550	240	140	160	1,440	1,440	1,260	484	214	177	221
27	319	400	426	140	800	2,380	1,210	1,350	345	157	189	202
28	264	340	354	130	500	3,950	1,100	727	319	153	183	214
29	242	360	300	140	.....	2,050	1,130	1,530	336	153	189	354
30	214	1,130	280	150	.....	1,350	1,440	3,320	2,050	157	257	294
31	257	.....	280	130	.....	998	.....	3,320	.....	132	272	.....

NOTE.—Discharge Nov. 25–29, Dec. 12–26, and Dec. 29 to Mar. 21, estimated, because of ice, from discharge measurements, weather records, and study of gage-height graph. Discharge Aug. 18–22, estimated because of no gage-height record, 220 second-feet.

Monthly discharge of Ausable River at Ausable Forks, N. Y., for the year ending Sept. 30, 1917.

[Drainage area, 444 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,260	189	334	0.752	0.87
November	1,730	196	402	.905	1.01
December	1,350	200	473	1.07	1.23
January	650	130	282	.635	.73
February	800	100	218	.491	.51
March	3,950	180	663	1.49	1.72
April	6,800	557	2,080	4.68	5.22
May	3,320	727	1,350	3.04	3.50
June	5,600	319	1,610	3.63	4.05
July	851	142	279	.629	.73
August	2,720	177	679	1.53	1.76
September	1,070	132	313	.704	.79
The year	6,800	100	724	1.63	22.12

WEST BRANCH OF AUSABLE RIVER NEAR NEWMAN, N. Y.

LOCATION.—On farm of James Dudley, about 4 miles northeast of Newman, Essex County, and 4 miles below confluence at Lake Placid.

DRAINAGE AREA.—116 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 7, 1916, to September 30, 1917.

GAGE.—Staff, in two sections, on the right bank near the residence of Mr. Dudley. Lower section is inclined, graduated from 1.0 to 6.5 feet; the upper section is vertical graduated from 6.55 to 10.1 feet; read by James Dudley.

DISCHARGE MEASUREMENTS.—Made by wading or from cable 300 feet above gage.

CHANNEL AND CONTROL.—Solid rock.

EXTREMES OF STAGE.—Maximum stage recorded, 6.2 eet at 6 p. m. June 22; minimum stage recorded, 1.7 feet at 7 p. m. June 28.

Data inadequate for determination of discharge.

Discharge measurements of West Branch of Ausable River near Newman, N. Y., 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.*
Aug. 3	A. H. Davison	2.64	61	Apr. 16	A. H. Davison	3.22	162
Jan. 20[a]	do	3.08	105	Aug. 29	C. C. Covert	2.78	92
Apr. 16	do	3.11	131				

[a] Measurement made through complete ice cover.

Daily gage height, in feet, of West Branch of Ausable River at Newman, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	May.	June.	July.	Aug.	Sept.
1	3.12	2.75	3.68	3.9	4.25	3.35	2.3	2.85
2	2.85	2.9	3.3	3.98	4.4	3.35	2.4	3.18
3	2.82	2.98	3.52	3.8	4.85	3.15	2.3	2.85
4	2.72	2.85	3.4	3.82	4.1	3.22	2.4	2.72
5	2.8	2.82	3.25	3.52	3.85	2.95	2.4	2.65
6	2.52	2.82	3.95	3.48	3.95	2.9	2.32	2.68
7	2.72	2.72	3.55	3.5	3.68	2.98	2.35	2.8
8	2.68	2.7	3.48	3.35	4.1	2.7	2.88	2.68
9	2.68	3.05	3.45	3.28	4.35	2.78	2.85	2.62
10	2.68	3.35	3.85	3.52	3.72	2.7	3.08	2.62
11	2.65	3.1	3.55	3.45	4.52	2.62	2.65	2.6
12	2.5	2.88	3.38	3.82	5.6	2.88	2.62	2.58
13	2.7	2.8	3.05	3.78	4.4	2.9	2.68	2.82
14	3.22	2.75	3.42	3.75	4.08	2.85	2.42	2.58
15	2.82	2.88	3.4	4.0	3.88	2.78	2.52	2.38
16	2.7	2.8	3.2	3.65	3.8	2.7	2.58	2.42
17	2.85	2.85	2.82	3.5	3.75	2.72	2.65	2.45
18	2.82	2.72	2.85	3.9	3.75	2.65	2.7	2.42
19	2.82	2.8	2.8	3.6	2.8	2.75	2.62	2.52
20	3.68	2.72	2.75	4.4	3.8	2.7	2.6	3.98
21	4.1	2.52	2.65	4.32	4.02	2.65	2.6	3.25
22	3.45	2.5	2.65	3.8	4.1	2.68	2.58	2.95
23	3.15	2.65	2.88	4.22	3.98	2.6	2.52	2.78
24	2.92	4.95	2.95	4.15	3.85	2.42	2.58	2.72
25	2.65	3.72	2.75	3.88	3.75	2.68	2.58	2.68
26	2.9	3.4	2.92	3.85	3.8	2.65	2.55	2.52
27	2.85	3.15	2.95	3.72	3.75	2.52	2.52	2.52
28	2.75	3.02	2.98	4.02	3.62	2.5	2.45	2.78
29	2.65	2.98	2.98	4.12	3.52	2.4	2.65	2.98
30	2.62	3.82	2.85	4.42	4.68	2.45	2.82	2.88
31	2.6	.....	2.85	4.52	.....	2.48	3.02	.....

NOTE.—Gage-height observations suspended because of ice, Jan. 1 to Apr. 30.

LAKE GEORGE AT ROGERS ROCK, N. Y.

LOCATION.—At boathouse in a small bay on north side of steamboat landing at Rogers Rock, Essex County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 10, 1913, to September 30, 1917.

GAGE.—Vertical staff fastened to a pile in the back end of the boathouse. Datum 3.15 feet[1] below crest of dam at outlet of lake; read once daily by George O. Cook.

EXTREMES OF STAGE.—Maximum stage recorded during year, 4.05 feet June 14, 15, 16, and 21; minimum stage recorded, 1.2 feet on November 21 and December 22. 1913–1917 maximum stage recorded, 4.98 feet on May 2, 1914; minimum stage recorded 1.2 feet on November 21 and December 22, 1916.

REGULATION.—The elevation of lake surface is regulated by the operation of gates and wheels at the dam at the outlet of the lake at Ticonderoga.

COOPERATION.—Gage-height record for current year furnished by International Paper Co.

Daily gage height, in feet, of Lake George at Rogers Rock, N. Y., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.05	1.52	1.38	1.4	1.7	1.65	2.48	3.18	3.2	4.03	3.57	2.88
2	2.02	1.55	1.32	1.35	1.72	1.6	2.5	3.25	3.12	4.0	3.53	2.9
3	1.92	1.52	1.35	1.3	1.7	1.62	2.7	3.2	3.15	3.95	3.52	2.87
4	1.95	1.5	1.4	1.32	1.72	1.6	2.8	3.12	3.18	3.9	3.48	2.85
5	1.98	1.5	1.42	1.35	1.65	1.58	2.88	3.12	3.15	3.87	3.4	2.8
6	1.92	1.48	1.5	1.42	1.7	1.55	2.88	3.1	3.1	3.85	3.35	2.82
7	1.90	1.52	1.4	1.45	1.68	1.6	2.98	3.15	3.15	3.85	3.33	2.78
8	1.95	1.5	1.38	1.42	1.65	1.65	3.0	3.2	3.2	3.87	3.37	2.75
9	1.85	1.48	1.38	1.4	1.68	1.68	3.02	3.18	3.2	3.78	3.4	2.8
10	1.82	1.45	1.38	1.3	1.65	1.68	3.0	3.22	3.22	3.77	3.33	2.7
11	1.82	1.42	1.4	1.35	1.65	1.7	2.98	3.18	3.25	3.75	3.3	2.68
12	1.80	1.35	1.35	1.38	1.65	1.68	3.0	3.1	3.8	3.8	3.25	2.65
13	1.82	1.3	1.32	1.4	1.7	1.6	3.02	3.08	4.00	3.78	3.23	2.62
14	1.70	1.38	1.4	1.5	1.7	1.62	3.0	3.1	4.05	3.77	3.25	2.6
15	1.72	1.3	1.35	1.52	1.68	1.68	3.0	3.0	4.05	3.75	3.22	2.55
16	1.68	1.35	1.42	1.58	1.72	1.68	3.05	3.1	4.0	3.8	3.2	2.53
17	1.88	1.35	1.35	1.62	1.7	1.7	3.0	3.05	3.98	3.78	3.18	2.5
18	1.52	1.35	1.4	1.68	1.65	1.75	3.0	3.02	4.05	3.75	3.15	2.47
19	1.58	1.38	1.35	1.68	1.62	1.72	3.0	3.1	4.02	3.82	3.1	2.5
20	1.6	1.15	1.32	1.7	1.6	1.7	3.05	3.0	4.0	3.8	3.0	2.5
21	1.75	1.2	1.3	1.8	1.55	1.68	3.12	3.0	4.05	3.78	3.15	2.48
22	1.70	1.3	1.2	1.72	1.6	1.68	3.18	3.02	4.0	3.8	2.98	2.4
23	1.72	1.3	1.3	1.7	1.65	1.7	3.2	3.05	3.98	3.75	2.95	2.45
24	1.7	1.35	1.4	1.75	1.65	1.75	3.15	3.02	3.95	3.7	3.0	2.45
25	1.78	1.4	1.42	1.72	1.6	1.8	3.12	3.0	3.95	3.72	3.07	2.43
26	1.72	1.3	1.35	1.72	1.65	1.9	3.1	3.02	3.98	3.75	3.0	2.42
27	1.68	1.3	1.42	1.68	1.6	2.0	3.15	3.0	4.0	3.65	2.98	2.4
28	1.65	1.35	1.4	1.7	1.62	2.2	3.12	3.02	3.92	3.63	3.0	2.38
29	1.6	1.4	1.35	1.72	.....	2.38	3.12	3.1	3.98	3.6	2.97	2.37
30	1.5	1.4	1.3	1.75	.....	2.4	3.15	3.08	4.02	3.57	2.88	2.35
31	1.52	.....	1.35	1.72	.....	2.45	.....	3.18	.....	3.53	2.85	.....

LAKE CHAMPLAIN AT BURLINGTON, VT.

LOCATION.—On south side of roadway leading to dock of Champlain Transportation Co., at foot of King street, Burlington.

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

GAGE.—Staff. Comparisons of gage readings indicate that zero of gage at Burlington is at practically the same elevation as that of gage at Fort Montgomery—92.5 feet above mean sea level. Gage read by employee of the Champlain Transportation Co.

[1] Determined by levels; supersedes the estimated datum previously published.

EXTREMES OF STAGE.—Maximum stage recorded during year, 6.20 feet April 10–11; minimum stage recorded, 0.95 foot November 24–25.

1907–1917: Maximum stage recorded, 8.20 feet on April 7, 1913; minimum stage recorded, −0.25 foot on December 4, 1908.

ICE.—Wider portions of lake not usually frozen over until the last part of January. Occasionally closure does not occur until February and in some years it lasts only for a few days. The northern end of the lake, above the outlet, is usually covered with ice from the middle of December to the middle of April.

ACCURACY.—Gage read to hundredths once a day except on Sundays; readings during winter at irregular intervals. Gage readings made when the lake is rough subject to inaccuracies due to wave action.

COOPERATION.—Gage-height record furnished through the courtesy of Mr. D. A. Loomis, general manager of the Champlain Transportation Co.

Daily gage height, in feet, of Lake Champlain at Burlington, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	1.11	1.50	1.80	.....	.....	.....	5.65	4.15	.....	2.80	1.96
2	1.25	1.13	1.52	1.80	.....	.....	5.15	5.63	4.13	4.00	2.74	.....
3	1.20	1.15	.....	.....	.....	.....	5.50	5.60	.....	3.98	2.70	1.85
4	1.20	1.15	1.60	.....	.....	.....	5.76	5.55	4.08	3.98	2.65	1.85
5	1.18	.....	1.65	.....	2.00	.....	5.87	5.48	4.02	3.95	.....	1.82
6	1.15	1.11	1.68	.....	.....	1.95	5.98	.....	3.95	3.90	2.53	1.78
7	1.13	1.05	1.75	.....	.....	.....	6.05	5.35	3.90	3.80	2.47	1.78
8	.....	1.00	1.88	1.82	.....	.....	.....	5.28	3.87	.....	2.44	1.76
9	1.05	1.00	1.92	.....	.....	.....	6.18	5.20	3.83	3.68	2.40	.....
10	1.05	1.00	.....	.....	.....	.....	6.20	5.15	.....	3.55	2.37	1.74
11	1.03	1.00	1.95	.....	.....	.....	6.20	5.08	3.98	3.50	2.30	1.74
12	1.02	.....	1.98	.....	1.98	.....	6.05	5.02	4.30	3.48	.....	1.72
13	1.02	1.05	2.00	.....	.....	1.98	5.98	.....	4.52	3.42	2.25	1.69
14	1.00	1.05	2.02	.....	.....	.....	5.90	4.95	4.65	3.38	2.25	1.68
15	.....	1.04	2.02	.....	.....	.....	.....	4.93	4.82	.....	2.20	1.65
16	1.00	1.04	2.03	.....	.....	.....	5.75	4.90	4.86	3.30	2.18	.....
17	.98	1.02	.....	.....	.....	.....	5.68	4.82	.....	3.28	2.13	1.61
18	.98	1.02	2.05	2.10	.....	.....	5.62	4.70	4.83	3.25	2.16	1.59
19	.98	.....	2.05	.....	1.95	.....	5.65	4.62	4.78	3.20	.....	1.59
20	.98	.99	2.05	.....	.....	2.05	5.70	.....	4.75	3.20	2.21	1.58
21	.98	.99	2.02	.....	.....	.....	5.72	4.45	4.72	3.18	2.24	1.62
22	.....	.97	2.02	2.10	.....	.....	.....	4.42	4.65	.....	2.28	1.60
23	1.18	.97	1.98	.....	.....	.....	5.85	4.38	4.58	3.15	2.30	.....
24	1.24	.95	.....	.....	.....	.....	5.90	4.38	.....	3.10	2.30	1.57
25	1.24	.95	.....	.....	.....	.....	5.95	4.36	4.55	3.02	2.28	1.52
26	1.21	.....	1.94	.....	1.90	2.70	5.92	4.30	4.48	2.95	.....	1.48
27	1.20	1.08	1.93	.....	.....	3.08	5.85	.....	4.35	2.92	2.20	1.46
28	1.18	1.19	1.91	.....	.....	3.74	5.80	4.22	4.30	2.90	2.13	1.46
29	.....	1.32	1.91	2.03	.....	4.28	.....	4.20	4.13	.....	2.10	1.46
30	1.14	1.36	1.90	.....	.....	4.58	5.72	4.20	4.02	2.87	2.04	.....
31	1.11	.....	.....	.....	.....	4.72	.....	4.16	.....	2.87	1.98	.....

NOTE.—Thickness of ice 100 feet from dock: Jan. 29, 5 inches; Feb. 5, 9 inches; Feb. 12, 12.5 inches; Feb. 19, 15.75 inches; Feb. 26, 17 inches; Mar. 6, 17.5 inches; Mar. 13, 17.75 inches; Mar. 20, 16.75 inches; Mar. 26, 13 inches.

OTTER CREEK AT MIDDLEBURY, VT.

LOCATION.—At railroad bridge half a mile south of railroad station at Middlebury, Addison County, 3½ miles below mouth of Middlebury River, and 3½ miles above mouth of New Haven River.

DRAINAGE AREA.—615 square miles.

RECORDS AVAILABLE.—April 1, 1903, to May 1, 1907; October 5, 1910, to September 30, 1917.

GAGE.—Chain; read by Alexander Hamilton.

DISCHARGE MEASUREMENTS.—Made from a boat just below railroad bridge, at the stone-arch highway bridge just above dam, or by wading.

CHANNEL AND CONTROL.—Channel deep; current sluggish for several miles above the station. Control for low stages is gravel and boulder rips about 800 feet below gage, probably somewhat shifting; control at high stages is near the dam 800 feet farther downstream.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.3 feet at 7.15 a. m. April 2 (discharge 3,680 second-feet); minimum stage recorded during year, 11.65 feet at 7.15 a. m. October 9 (discharge, 175 second-feet).

1903–1907 and 1910–1917: Maximum stage recorded, 21.07 feet March 30, 1913 (discharge, from extension of rating curve, about 8,000 second-feet); minimum open-water stage recorded, 11.45 feet September 15, 1913 (discharge, 138 second-feet). A somewhat lower discharge has probably occurred at various times when the stage-discharge relation has been affected by ice.

ICE.—Ice forms to a considerable thickness at the gage and occasionally at the control, affecting the stage-discharge relation.

REGULATION.—Probably little if any effect from power developments above the station. Considerable storage has been developed on tributaries near the headwaters.

ACCURACY.—Stage-discharge relation has changed somewhat in previous years, but apparently no change during 1916–17. Rating curve well defined between 200 and 4,000 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table, with corrections for ice during winter as shown in foot note to daily discharge table. Records good.

Discharge measurements of Otter Creek at Middlebury, Vt., 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	Hardin Thweatt.....	12.47	581	Mar. 30	H. H. Khachadoorian..	16.05	3,530
Feb. 19	H. H. Khachadoorian..	[a] 12.35	357	31	.....do.....	16.09	3,510
Mar. 12	.....do.....	[a] 12.90	570	31	C. H. Pierce.....	16.10	3,440
12	.....do.....	[a] 12.90	568	July 27	M. R. Stackpole.....	11.85	237

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Otter Creek at Middlebury, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	426	283	1,880	360	475	1,790	3,500	1,970	1,270	320	283	340
2	403	283	1,970	360	475	1,700	3,680	1,700	1,070	501	248	360
3	320	320	880	360	450	1,440	3,590	1,700	810	426	381	320
4	320	320	1,360	381	426	810	3,410	1,610	810	320	340	426
5	283	283	1,030	381	403	740	3,410	1,440	810	283	248	360
6	265	265	1,070	450	403	640	3,320	1,270	670	360	202	320
7	248	301	1,070	740	403	555	3,230	1,360	610	360	232	320
8	283	320	1,030	775	360	475	3,140	1,360	1,030	283	248	340
9	175	301	810	705	360	555	2,960	1,270	1,790	232	265	283
10	232	320	917	640	360	501	2,780	1,270	1,700	301	403	217
11	265	320	1,030	670	340	555	2,420	1,070	1,610	301	1,070	265
12	248	340	917	610	320	582	1,970	1,190	2,870	301	283	283
13	248	283	810	582	340	528	1,880	1,190	2,690	340	232	265
14	248	283	670	555	360	501	1,440	1,190	2,690	360	232	283
15	320	283	640	1,110	381	501	1,190	1,150	2,510	360	283	265
16	217	283	610	1,360	403	501	1,030	1,030	2,330	403	301	265
17	283	320	610	1,190	426	555	955	880	2,150	501	320	217
18	283	320	555	1,110	381	740	992	810	1,610	360	381	232
19	301	340	360	880	340	740	1,190	740	1,270	360	320	283
20	320	301	381	670	381	555	1,440	775	955	450	301	320
21	810	320	450	610	426	475	2,330	775	810	426	320	320
22	1,030	320	360	501	426	555	2,330	775	705	360	340	283
23	610	301	450	670	426	705	2,510	705	610	217	301	265
24	501	740	705	501	426	1,520	2,510	845	610	301	283	217
25	403	1,790	705	450	403	1,880	2,690	992	740	283	283	202
26	301	1,520	610	450	381	2,240	2,690	992	670	283	340	232
27	283	1,270	501	426	528	2,510	2,690	1,030	640	248	248	232
28	283	955	501	403	1,610	3,410	2,600	880	610	248	265	248
29	320	740	426	403	.....	3,410	2,510	775	582	283	265	248
30	217	775	450	426	.....	3,410	2,330	1,270	610	265	283	265
31	283	.....	360	475	.....	3,590	.....	1,440	.....	265	340	.....

NOTE.—Stage-discharge relation affected by ice Jan. 21 and Jan. 26 to Mar. 25; discharge determined from gage heights corrected for effect of ice by means of 3 discharge measurements, observer's notes, and weather records.

Monthly discharge of Otter Creek at Middlebury, Vt., 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	1,030	175	346	0.563	0.65
November	1,790	265	493	.802	.89
December	1,970	360	778	1.27	1.46
January	1,360	360	619	1.01	1.16
February	1,610	320	444	.722	.75
March	3,590	475	1,250	2.03	2.34
April	3,680	955	2,420	3.93	4.38
May	1,970	705	1,140	1.85	2.13
June	2,870	582	1,260	2.05	2.29
July	610	217	332	.540	.62
August	1,070	202	317	.515	.59
September	426	202	283	.460	.51
The year	3,680	175	807	1.31	17.77

WINOOSKI RIVER AT MONTPELIER, VT.

LOCATION.—One mile downstream from Central Vermont Railway station in Montpelier, Washington County, about three eighths of a mile above mouth of Dog River, and 1¼ miles below mouth of Worcester Branch.

DRAINAGE AREA.—420 square miles.

RECORDS AVAILABLE.—May 19, 1909, to September 30, 1917.

GAGE.—Gurley seven-day water-stage recorder installed July 4, 1914, on right bank; gage heights referred to datum by means of a hook gage inside the well; an outside staff gage is used for auxiliary readings; records June 16 to July 3, 1914, obtained from the staff gage. Chain gage at highway bridge just above the Central Vermont Railway station used from May 19, 1909, to June 30, 1914.

DISCHARGE MEASUREMENTS.—Made from a cable or by wading.

CHANNEL AND CONTROL.—Channel deep and fairly uniform in section at the gage, control is formed by sharply defined rock outcrop about 500 feet below gage.

EXTREMES OF DISCHARGE.—Maximum open-water stage during year, from water-stage recorder, 12.52 feet at 9 a. m. March 28 (discharge, from extension of rating curve, 10,600 second-feet); minimum stage from water-stage recorder, 2.96 feet at 6 a. m. October 18, and 7 a. m. November 1 (discharge 43 second-feet).

1909–1917: Maximum stage, determined by leveling from flood marks preserved on building near present gage, 17.31 feet, April 7, 1912 (discharge not determined); minimum stage from water-stage recorder, 1914-1917, 2.77 feet, August 13, 1914 and October 24, 1915 (discharge, 19 second-feet).

ICE.—Stage-discharge relation seriously affected by ice during the winter. Discharge ascertained by means of gage heights, current meter measurements, observer's notes, and weather records.

REGULATION.—Operation of power plants on main stream and tributaries above station cause large diurnal fluctuations in stage (see Water-Supply Paper 424, fig. 1, p. 41).

ACCURACY.—Stage-discharge relation practically permanent except when affected by ice. Rating curve well defined between 30 and 5,000 second-feet. Operation of water-stage recorder satisfactory during the year. Daily discharge determined by discharge integrator, except for high stages and during the period December to March, when mean daily gage heights were used. Open-water records good; winter records fair.

Discharge measurements of Winooski River at Montpelier, Vt., 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	Hardin Thweatt	[a]4.96	316	Sept. 14	M. R. Stackpole	3.57	161
Feb. 17	H. H. Khachadoorian	[a]5.13	306	14	do	3.76	242
Mar. 13	do	[a]5.25	303	15	do	3.47	153
Apr. 1	C. H. Pierce	8.16	4,140				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Winooski River at Montpelier, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	550	158	1,460	225	225	320	3,710	1,260	520	800	205	300
2	300	255	860	225	225	280	4,320	1,380	470	800	295	405
3	240	310	626	210	225	240	3,230	1,280	620	560	210	290
4	210	335	470	195	225	180	2,810	1,060	1,010	420	170	255
5	172	230	748	180	240	225	2,480	960	630	365	144	200
6	160	240	1,100	320	225	195	2,700	930	500	335	194	190
7	140	215	790	240	168	180	3,290	880	480	310	166	220
8	85	205	602	210	180	180	2,280	850	1,060	285	138	200
9	122	198	530	195	240	168	1,780	770	1,280	260	350	120
10	146	205	678	195	180	168	1,420	790	1,180	255	660	150
11	160	210	542	180	155	155	1,240	760	3,160	260	310	130
12	132	138	500	131	131	195	1,180	980	6,140	455	205	150
13	152	184	420	131	131	168	1,160	900	2,250	475	230	120
14	114	196	345	195	143	180	1,160	800	1,460	330	210	150
15	130	210	320	895	155	180	1,060	760	1,260	300	220	140
16	160	215	320	685	155	180	1,040	630	1,100	305	225	92
17	164	210	345	560	131	195	1,120	580	1,300	275	460	172
18	162	200	280	395	143	195	1,540	560	2,610	260	860	154
19	166	172	280	280	195	210	2,100	540	1,420	265	385	130
20	440	260	280	280	168	168	3,110	660	1,000	450	350	142
21	890	240	300	260	168	180	3,830	620	880	315	670	255
22	520	210	300	260	168	168	3,710	500	720	220	400	235
23	320	190	320	280	168	195	2,990	610	610	275	280	108
24	260	1,760	280	225	155	320	2,250	760	750	205	245	174
25	225	1,080	280	225	120	860	1,650	630	780	200	350	140
26	215	420	280	225	180	1,680	1,480	710	570	172	205	140
27	205	380	260	210	195	5,510	1,360	650	540	148	225	166
28	200	340	260	225	345	9,010	1,360	540	440	140	184	162
29	110	370	240	240	.....	2,990	1,280	670	700	68	205	160
30	154	1,680	240	225	.....	1,930	1,320	890	1,420	170	320	134
31	190	.....	225	210	.....	1,780	.....	670	.....	190	310	.....

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Mar. 26; discharge determined from a study of weather records, observed gage heights, and 3 discharge measurements. Discharge estimated Aug. 14–15 and Sept. 10–12.

Monthly discharge of Winooski River at Montpelier, Vt., 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	890	85	232	0.552	0.64
November	1,760	138	367	.874	.98
December	1,460	225	467	1.11	1.28
January	895	131	275	.655	.76
February	345	131	184	.438	.46
March	9,010	155	922	2.20	2.54
April	4,320	1,040	2,130	5.07	5.66
May	1,380	540	793	1.89	2.18
June	6,140	440	1,230	2.93	3.27
July	800	68	318	.757	.87
August	860	138	303	.721	.83
September	405	92	179	.426	.48
The year	9,010	68	616	1.47	19.95

DOG RIVER AT NORTHFIELD, VT.

LOCATION.—At highway bridge near Norwich University campus in Northfield, Washington County. Union Brook joins Dog River a short distance below station.

DRAINAGE AREA.—47 square miles (from surveys made by Norwich University students).

RECORDS AVAILABLE.—May 14, 1909, to September 30, 1917. Records from May 14, 1909, to August 22, 1910, obtained at lower highway bridge; those from August 23, 1910, to date at present location.

GAGES.—Gurley 7-day water-stage recorder; gage heights referred to gage datum by means of a hook gage inside the well; outside staff gage used for auxiliary readings.

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

CHANNEL AND CONTROL.—Channel composed of gravel and alluvial deposits; subject to slight shifts.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 5.78 feet at 12.30 a. m. March 28 (discharge, 1,440 second-feet); minimum stage during year, from water-stage recorder, 0.92 foot several times in August and September (discharge, 7.8 second-feet).

1910–1917: Maximum stage recorded at present site, 8.5 feet March 25, 1913 (discharge, 3,400 second-feet); minimum stage recorded, 0.60 foot September 10 and 11, 1913 (discharge, 3.0 second-feet). At the lower gage, 1909–10 flow was practically zero at various times when water was held back by dam above gage.

ICE.—River frozen over during winter.

ACCURACY.—Stage-discharge relation fairly permanent except when affected by ice. Rating curve well defined below 500 second-feet and poorly defined above. Operation of water-stage recorder satisfactory throughout year except for periods as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting gage-height graph. Records good, except those from November to March, which are estimated as stated in footnote to monthly-discharge table.

Discharge measurements of Dog River at Northfield, Vt., 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. 6	Hardin Thweatt	1.68	44.9	Apr. 2	C. H Pierce	4.12	560
Feb. 16	H. H. Khachadoorian	[a] 1.45	27.0	Sept. 15	M. R. Stackpole	1.04	12.8

[a] Stage-discharge relation affected by ice.

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Daily discharge, in second-feet, of Dog River at Northfield, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	22	22	.....	495	215	88	85	15	28
2	17	22	.....	570	235	78	90	15	31
3	15	33	.....	415	225	91	68	14	24
4	14	30	.....	402	187	95	56	13	20
5	13	25	.....	378	168	63	50	11	20
6	13	24	.....	378	185	55	47	10	21
7	12	22	.....	365	169	65	40	11	21
8	12	22	.....	285	166	162	37	10	19
9	14	22	.....	243	166	158	35	50	19
10	15	26	.....	201	158	158	35	34	18
11	14	20	.....	179	152	390	33	12	20
12	13	18	29	175	151	680	58	11	14
13	13	18	28	172	144	275	43	14	14
14	20	18	29	183	130	235	38	12	14
15	15	.....	29	179	116	185	35	15	13
16	13	.....	30	170	98	172	34	109	14
17	14	.....	32	203	86	207	28	108	12
18	14	.....	31	275	79	217	30	63	10
19	18	.....	31	390	78	152	35	37	9
20	78	.....	33	555	88	127	34	30	17
21	66	.....	31	602	77	108	26	41	18
22	35	.....	33	555	79	90	23	33	14
23	27	.....	37	465	100	74	24	28	12
24	23	.....	80	365	100	97	22	34	11
25	22	.....	147	275	102	82	20	33	10
26	20	.....	224	241	104	69	19	25	9
27	20	.....	355	235	92	46	18	22	10
28	19	.....	700	225	79	51	18	20	10
29	18	.....	365	215	118	52	16	25	11
30	18	.....	285	225	140	59	26	27	14
31	18	.....	275	.....	102	.....	19	25	.....

NOTE.—Stage-discharge relation affected by ice during winter. Operation of water-stage recorder unsatisfactory Nov. 15 to Mar. 11; daily discharge not determined. Discharge estimated Mar. 16, Apr. 22–24, 27–30, May 1, June 13, 30, July 1, 23, and Aug. 9–12.

Monthly discharge of Dog River at Northfield, Vt., for the year ending Sept. 30, 1917.

[Drainage area, 47 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	78	12	20.8	0.443	0.51
November	.....	.....	a 42	.894	1.00
December	.....	.....	a 53	1.13	1.30
January	.....	.....	a 44	.936	1.08
February	.....	.....	a 33	.702	.73
March	700	.....	a 100	2.13	2.46
April	602	170	321	6.83	7.62
May	235	77	132	2.81	3.24
June	680	46	146	3.11	3.47
July	90	16	36.8	.783	.90
August	109	10	29.3	.623	.72
September	31	9	15.9	.338	.38
The year	700		80.9	1.72	23.41

a Estimated.

NOTE.—Mean discharge, Nov. 15 to Mar. 11, estimated from a comparative study of two discharge measurements, and records of flow for White and Winooski rivers.

LAMOILLE RIVER AT CADYS FALLS, VT.

LOCATION.—About one-fourth mile below power house of Morrisville municipal electric plant, at what was formerly known as Cadys Falls, 2 miles downstream from Morrisville, Lamoille County.

DRAINAGE AREA.—280 square miles.

RECORDS AVAILABLE.—September 4, 1913 to September 30, 1917. A station was maintained at highway bridge near power plant at Cadys Falls from July 28, 1909, to July 13, 1910.

GAGES.—Barrett & Lawrence water-stage recorder in gage house on right bank, one-fourth mile below highway bridge at Cadys Falls, used to December 28, 1916; Friez water-stage recorder after December 29, 1916. Gage heights are referred to gage datum by means of a hook gage inside the well. An outside staff gage is used for auxiliary readings. From July 28, 1909, to July 13, 1910, chain gage on highway bridge was used.

DISCHARGE MEASUREMENTS.—Made from a cable or by wading.

CHANNEL AND CONTROL.—Bed smooth gravel. Well-defined gravel control 500 feet downstream from gage.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 8.36 feet at 9.30 a. m. June 12 (discharge, 4,520 second-feet); minimum stage during year, from water-stage recorder, 1.95 feet at 3 a. m. Sept. 18 (discharge, 74 second-feet).

1913–1917: Maximum stage recorded, 10.53 feet April 20, 1914, (discharge 7,250 second-feet); minimum stage recorded, 1.82 feet, August 17, 1914 (discharge, 50 second-feet).

ICE.—River freezes over for short periods during extremely cold weather; stage-discharge relation slightly affected by ice.

ACCURACY.—Stage-discharge relation practically permanent, except when affected by ice. Rating curve well defined. Operation of water-stage recorder satisfactory throughout year except for short periods as shown in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting gage-height graph, October 1 to April 30; by discharge integrator after May 1. Records good.

Discharge measurements of Lamoille River at Cadys Falls, Vt., 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	Hardin Thweatt	a 2.43	190	July 23	M. R. Stackpole	3.94	895
Mar. 10	H. H. Khachadoorian	a 2.72	198				

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Lamoille River at Cadys Falls, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	533	118	1,520	200	250	250	2,260	1,000	305	900	435	405
2	302	343	770	195	240	300	3,420	1,060	415	960	550	465
3	230	339	560	195	200	290	2,680	1,020	410	660	590	550
4	191	359	428	195	180	250	2,100	800	510	430	420	435
5	163	313	614	210	205	260	1,880	600	450	310	295	360
6	153	272	972	244	200	230	1,800	610	350	300	230	340
7	132	244	745	251	195	220	2,430	600	300	200	220	360
8	112	188	551	276	210	200	1,590	560	385	182	205	390
9	144	175	471	265	250	185	1,090	530	440	215	630	220
10	156	211	614	276	250	185	820	550	415	240	700	215
11	147	191	462	287	200	170	720	700	1,140	220	440	240
12	156	163	416	268	200	210	672	960	3,420	255	360	210
13	156	178	347	248	200	205	636	760	1,340	285	325	192
14	258	163	262	258	190	205	632	610	840	580	290	196
15	230	166	279	770	180	190	587	540	730	450	325	180
16	211	188	251	628	180	185	596	440	620	400	320	174
17	194	172	237	551	205	190	632	385	640	350	1,290	162
18	191	224	240	445	180	175	1,180	345	1,860	310	1,520	116
19	198	220	220	420	190	200	1,800	330	1,080	410	710	154
20	484	244	240	403	200	185	2,770	390	1,060	475	640	240
21	870	220	220	324	170	150	3,620	410	870	540	920	285
22	551	220	220	336	140	190	3,420	330	580	1,140	650	180
23	359	309	207	320	140	190	2,680	370	460	820	385	150
24	330	1,950	201	290	135	570	1,840	510	520	500	420	162
25	302	945	210	276	105	870	1,320	295	600	330	670	200
26	273	672	205	268	135	1,060	1,150	310	460	275	480	178
27	244	367	200	262	140	2,020	895	360	385	250	390	162
28	172	347	230	214	180	3,620	795	310	320	210	335	186
29	121	367	200	258	.....	2,100	972	350	455	290	490	205
30	129	1,590	200	262	.....	1,320	1,060	520	1,000	620	620	235
31	115	.....	200	262	.....	1,060	.....	370	.....	530	570	.....

NOTE.—Stage-discharge relation affected by ice Dec. 18–22, 25–31, Jan. 1–5, and Feb. 1 to Mar. 23; discharge determined from a study of weather records, recorded gage heights, and 2 discharge measurements. Discharge estimated Oct. 24–26 and July 14–16, 20.

Monthly discharge of Lamoille River at Cadys Falls, Vt., for the year ending Sept. 30, 1917.

[Drainage area, 280 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	533	112	252	0.900	1.04
November	1,590	118	382	1.36	1.52
December	1,520	200	403	1.44	1.66
January	770	195	312	1.11	1.28
February	250	105	188	.671	.70
March	3,620	150	562	2.01	2.32
April	3,620	587	1,600	5.71	6.37
May	1,060	295	546	1.95	2.25
June	3,420	300	745	2.66	2.97
July	1,140	182	440	1.57	1.81
August	1,520	205	530	1.89	2.18
September	550	116	252	.900	1.00
The year	3,620	105	518	1.85	25.10

GREEN RIVER AT GARFIELD, VT.

LOCATION.—At site of old dam above highway bridge at Garfield village, town of Hyde Park, Lamoille County. Green River is tributary to Lamoille River about 4 miles east of Morrisville.

DRAINAGE AREA.—20 square miles (roughly approximate).

RECORDS AVAILABLE.—January 3, 1915, to September 30, 1917.

GAGE.—Inclined staff on left bank in pool back of weir; read by P. M. Trescott.

DISCHARGE MEASUREMENTS.—Standard sharp-crested weir of compound section length of crest at gage height 0.00 is 9.0 feet; at gage height 0.83 foot, length of crest is increased 11.17 feet. Current-meter measurements made at footbridge about one-half mile downstream from weir, and at highway bridge about one-half mile above weir.

CHANNEL AND CONTROL.—A pool of considerable size is formed in the old mill pond back of the weir; at ordinary stages the velocity of approach to the weir is very small. Some water leaks around the weir in the old tail-race on left bank.

EXTREMES OF DISCHARGE.—Maximum stage during year, 3.12 feet at 9 a. m. April 22 (discharge, from extension of rating curve about 325 second-feet); minimum stage during year, 0.45 foot several times in February (discharge, 9.3 second-feet).

1915–1917: Maximum stage recorded, 3.6 feet at 9 a. m. April 22, 1915 (discharge from extension of rating curve, about 435 second-feet); minimum stage recorded, 0.35 foot at 9 a. m. February 5, 1915 (discharge, 6.3 second-feet). Rating curve revised since publication of report for 1916.

ICE.—Weir and weir crest kept clear of ice by clear fall below; stage-discharge relation not affected by ice.

REGULATION.—An old timber dam about 2 miles upstream affects flow to some extent. The dam leaks by an amount somewhat greater than the low-water flow. During prolonged low stages the surface of water in pond (103 acres) falls below crest of dam; subsequent increased flow into pond is retained until water again flows over crest, when the increased flow is apparent at gaging station.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve based on weir formula, $Q=3.33\ LH^{3}/^{2}$, with corrections determined from current-meter measurements, and with logarithmic extension above gage height 1.90 feet. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table. Records good below 130 second-feet; at the higher stages the weir is flooded and records are somewhat uncertain.

COOPERATION.—Gage-height records furnished by C. T. Middlebrook, consulting engineer, Albany, N. Y.

Discharge measurements of Green River at Garfield, Vt., 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.*
July 21	M. R. Stackpole.....	1.60	[a] 89	July 21	Hardin Thweatt.....	1.59	[b] 86

[a] Measured at footbridge one-half mile below gage.
[b] Measured at old highway bridge one-half mile above gage.

Daily discharge, in second-feet, of Green River at Garfield, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	12	16	139	12	12	9.7	98	104	24	68	35	35
2	12	16	76	12	12	9.7	156	101	20	76	34	36
3	12	19	51	13	12	10	172	89	21	62	51	36
4	11	23	32	13	11	10	148	73	20	42	41	35
5	11	21	37	13	12	10	136	65	19	29	33	34
6	11	18	75	13	11	10	128	60	17	23	30	33
7	11	16	67	12	11	11	146	55	17	19	27	32
8	11	15	47	12	12	11	116	53	20	17	25	28
9	11	14	35	13	12	11	88	49	23	16	60	26
10	11	15	42	12	11	12	62	48	29	16	116	26
11	11	14	35	11	11	12	54	60	75	14	76	24
12	10	14	30	11	10	11	47	83	203	19	43	23
13	11	14	26	12	10	12	40	74	112	16	34	22
14	13	13	24	17	10	11	36	55	77	19	32	18
15	11	13	22	19	10	12	35	44	79	78	30	12
16	12	13	19	15	9.7	12	34	35	59	72	28	12
17	12	12	19	16	9.7	12	38	30	61	47	51	12
18	11	12	17	16	9.7	12	69	28	95	34	110	12
19	12	13	16	16	9.3	12	142	26	74	29	77	12
20	16	13	16	16	9.3	12	234	27	85	79	64	14
21	27	12	16	16	9.3	13	294	27	114	86	51	14
22	40	11	16	15	9.3	13	318	24	67	132	44	13
23	30	14	16	14	9.3	14	272	27	47	115	38	13
24	22	75	16	14	9.3	18	198	30	45	54	35	13
25	19	92	16	13	9.3	17	117	30	45	36	44	12
26	17	43	15	13	9.3	22	109	35	34	29	41	12
27	16	32	15	12	10	34	95	31	29	25	37	12
28	15	30	14	13	10	97	96	27	25	27	34	14
29	14	32	13	13	.....	104	104	25	32	30	39	13
30	13	85	12	12	.....	83	108	30	64	35	37	16
31	13	.....	12	12	.....	75	.....	27	.....	38	37	.....

Monthly discharge, in second-feet, of Green River at Garfield, Vt., for the year ending Sept. 30, 1917.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October	40	10	14.8	June	203	17	54.4
November	92	11	24.3	July	132	14	44.6
December	139	12	31.8	August	116	25	46.3
January	19	11	13.6	September	36	12	20.5
February	12	9.3	10.4				
March	104	9.7	23.0	The year	318	9.3	37.9
April	318	34	123				
May	104	24	47.5				

MISSISQUOI RIVER NEAR RICHFORD, VT.

LOCATION.—About 3 miles downstream from Richford, Franklin County, 3 miles below mouth of North Branch and 2 miles above mouth of Trout River.

DRAINAGE AREA.—445 square miles.

RECORDS AVAILABLE.—May 22, 1909, to December 3, 1910, and June 26, 1911, to September 30, 1917.

GAGE.—Gurley graph water-stage recorder in gage house on left bank, about one-fourth mile above highway bridge; chain gage on highway bridge used June 26, 1911, to July 31, 1915. From May 22, 1909, to December 3, 1910, gage was just below plant of the Sweat-Comings Co. in Richford.

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

CHANNEL AND CONTROL.—Channel deep; banks not subject to overflow; stream bed composed of gravel, boulders, and ledge rock. Control is sharply defined by rock outcrop about 100 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 11.53 feet at 5 a. m. April 3 (discharge, 8,690 second-feet); minimum stage, from water-stage recorder, 2.77 feet at 6 a. m. September 28 (discharge, 191 second-feet).

1911–1917: Maximum stage recorded, 16.7 feet by chain gage March 26, 1913 (determination of discharge, 10,200 second-feet, from extension of rating curve may be subject to error); minimum stage recorded, 4.15 feet by chain gage, July 14, 1911 (discharge, 8 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; discharge determined from gage heights corrected for backwater by means of current-meter measurements, observer's notes, and weather records.

REGULATION.—Considerable daily fluctuation at low stages caused by operation of power plants at Richford.

ACCURACY.—Stage-discharge relation changed slightly, presumably when ice went out March 27. Rating curve fairly well defined below 6,000 second-feet. Operation of water-stage recorder satisfactory during the year except for occasional short periods. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspection of recorder sheets; determinations for periods for which no record was obtained, are based on comparison with records of flow of streams in adjacent drainage basins. Results good for periods when water-stage recorder was in operation, and fair for other periods and during the winter.

Discharge measurements of Missisquoi River near Richford, Vt., 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. 3	Hardin Thweatt.....	3.80	644	Apr. 2	H. H. Khachadoorian..	9.39	5,970
Dec. 31	.....do.....	[a] 4.88	381	July 25	Hardin Thweatt.....	3.65	486
Mar. 9	H. H. Khachadoorian..	[a] 4.50	288	26	M. R. Stackpole.....	3.57	417

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Missisquoi River near Richford, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,350	545	3,740	360	430	460	4,050	2,100	640	2,240	296	585
2	900	700	2,140	360	410	520	5,880	2,540	600	1,880	314	600
3	668	720	1,600	310	360	490	8,000	2,440	625	1,200	391	680
4	488	732	980	310	360	460	6,480	1,840	1,170	770	339	536
5	418	668	1,450	310	360	430	5,160	1,480	950	575	268	407
6	350	575	1,800	360	360	410	4,380	1,280	710	487	225	391
7	292	521	1,250	520	360	380	4,600	1,240	650	415	200	399
8	250	488	1,000	460	380	360	4,050	1,170	600	363	200	355
9	258	488	860	410	430	310	2,740	1,140	650	335	363	307
10	327	830	1,050	360	430	280	1,920	1,170	1,500	350	1,170	482
11	322	830	840	310	410	280	1,440	2,200	2,150	293	800	455
12	292	420	760	310	360	360	1,360	2,840	6,120	300	482	383
13	341	440	640	310	340	360	1,360	2,060	4,600	375	359	332
14	1,740	440	580	360	310	360	1,240	1,560	2,540	383	307	300
15	1,390	440	490	1,500	310	340	1,140	1,520	2,440	428	318	276
16	935	450	460	1,250	310	340	1,140	1,200	1,720	469	545	359
17	935	460	460	980	360	340	1,140	960	1,440	375	1,640	367
18	970	480	430	840	310	340	1,640	925	1,920	424	2,640	304
19	935	488	410	760	310	340	2,440	890	1,880	1,720	1,520	279
20	2,050	557	410	700	360	340	3,720	1,000	1,030	1,640	1,600	960
21	3,130	510	410	660	310	310	5,040	1,050	1,320	960	1,640	1,100
22	2,530	466	380	640	270	360	6,240	900	960	1,060	1,060	770
23	1,600	521	380	580	250	520	6,240	1,030	680	1,030	740	492
24	1,150	3,130	360	540	250	1,050	4,820	1,200	565	710	585	391
25	970	3,330	360	520	230	1,500	2,840	1,280	570	585	565	328
26	865	1,350	360	490	230	1,800	2,100	1,240	496	455	555	300
27	798	1,230	360	460	310	3,300	1,760	1,060	460	371	433	282
28	732	1,110	360	410	410	5,600	1,640	830	424	318	367	293
29	635	1,190	360	460	.....	3,200	1,720	740	469	282	355	375
30	575	3,530	360	460	.....	3,200	1,920	740	1,600	307	514	469
31	521	.....	360	430	.....	3,390	.....	710	.....	314	710	.....

NOTE.—Stage-discharge relation affected by ice from about Dec. 15 to Mar. 27. Discharge computations for this period based on gage heights corrected for effect of ice by means of two discharge measurements, observer's notes, and weather records. Discharge estimated during periods of open water as follows: Oct. 1, Nov. 3, 12–18, Dec. 3–14, Mar. 28–30, May 20–22, June 5, 7–10, July 10, Aug. 6–8.

Monthly discharge of Missisquoi River near Richford, Vt., for the year ending Sept. 30, 1917.

[Drainage area 445 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,130	250	926	2.08	2.40
November	3,530	420	921	2.07	2.31
December	3,740	360	819	1.84	2.12
January	1,500	310	540	1.21	1.40
February	430	230	340	.764	.80
March	5,600	280	1,020	2.29	2.64
April	8,000	1,140	3,270	7.35	8.20
May	2,840	710	1,370	3.08	3.55
June	6,120	424	1,380	3.10	3.46
July	2,240	282	691	1.55	1.79
August	2,640	200	694	1.56	1.80
September	1,100	282	452	1.02	1.14
The year	8,000	200	1,040	2.34	31.61

CLYDE RIVER AT WEST DERBY, VT.

LOCATION.—Just below plant of Newport Electric Light Co. at West Derby (Newport), Orleans County; about 1 mile above mouth of river.

DRAINAGE AREA.—150 square miles.

RECORDS AVAILABLE.—May 25, 1909, to September 30, 1917.

GAGES.—Barrett & Lawrence water-stage recorder on right bank used to March 8, 1917, when a Stevens 8-day water-stage recorder was installed; chain gage fastened to tree is used for auxiliary readings; gage heights referred to chain-gage datum.

DISCHARGE MEASUREMENTS.—Made by wading near gage, or from highway bridge half a mile downstream.

CHANNEL AND CONTROL.—Stream bed rough and irregular; covered with boulders and ledge rock; fall of river rapid for some distance below gage.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 3.90 feet at 3 a. m. April 25 (discharge, 1,370 second-feet); minimum stage during year from chain gage 1.98 feet at 8.20 a. m. March 20 (discharge, 86 second-feet).

ICE.—Ice covers large boulders below gage during greater part of winter and causes some backwater.

REGULATION.—Flow at ordinary stages fully controlled by two dams at West Derby, but power plant is so operated that fluctuations in stage are not great. Distribution of flow affected also by several dams above West Derby. Seymour Lake and several smaller ponds in the basin afford a large amount of natural storage, but at the present time there is little if any artificial regulation at these ponds.

ACCURACY.—Stage-discharge relation practically permanent except when affected by ice; individual current-meter measurements occasionally plot erratically, probably because of rough measuring section. Rating curve fairly well defined. Operation of water-stage recorder unsatisfactory during a part of the year on account of clock stopping, as indicated in footnote to daily-discharge table. Daily discharge ascertained by applying mean daily gage heights to rating table, using observer's reading of chain gage when recorder was not in operation (chain-gage readings to quarter-tenths twice daily). Records fair.

Discharge measurements of Clyde River at West Derby, Vt., during the year ending Sept. 30, 1917.

Date.	Made by—	Gage height, in feet.		Discharge.	Date.	Made by—	Gage height in feet.		Discharge.
		Hook gage.	Chain gage.				Hook gage.	Chain gage.	
				Sec.-ft.					*Sec.-ft.*
Oct. 4	Hardin Thweatt.	2.57	2.53	254	Apr. 3	H. H. Khachadoorian.....	3.48	3.48	886
4	.....do.....	2.57	2.53	247	July 24	M. R. Stackpole..	2.61	2.46	234
Jan. 1	.....do.....	a2.49	a2.40	170	24	Hardin Thweatt.	2.61	2.46	219
Mar. 8	H. H. Khachadoorian.....	2.60	2.15	124					

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Clyde River at West Derby, Vt., for the year ending Sept. 30, 1917.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July..	Aug.	Sept.
1	170	140	360	145	110	120	500	755	290	172	127	397
2	197	140	390	120	110	155	710	755	280	165	127	404
3	218	145	435	105	110	115	850	800	280	159	138	336
4	221	150	420	110	110	120	900	800	260	150	144	295
5	214	155	400	135	115	115	900	755	240	130	162	280
6	182	155	387	155	110	110	900	665	232	115	165	260
7	158	150	375	146	105	102	900	580	228	110	153	270
8	138	146	350	140	100	115	850	540	216	105	144	210
9	135	145	320	140	100	120	755	540	204	105	200	140
10	120	140	305	135	95	120	665	500	216	110	228	140
11	115	140	315	130	95	95	580	460	228	115	216	145
12	110	135	298	128	90	105	540	500	264	125	220	130
13	122	135	265	130	90	95	460	540	268	150	236	115
14	100	140	255	140	90	90	432	580	310	180	232	100
15	102	146	245	195	85	112	411	580	348	205	228	90
16	110	140	240	155	85	110	390	540	336	200	204	80
17	120	135	230	155	80	95	378	500	378	180	236	80
18	125	130	230	150	80	102	404	453	460	165	272	80
19	128	128	220	140	80	90	432	425	425	195	300	85
20	143	140	220	135	80	86	540	397	418	215	360	100
21	173	120	210	130	80	100	665	384	397	230	411	110
22	197	115	205	125	80	90	950	366	354	240	418	110
23	207	105	205	120	80	90	1,180	372	315	240	378	95
24	218	205	205	120	80	110	1,370	360	272	244	360	90
25	228	215	205	115	85	130	1,370	354	285	236	384	85
26	214	243	200	110	90	155	1,240	348	300	228	418	85
27	194	255	195	110	95	210	1,060	354	272	196	425	80
28	182	275	185	110	110	364	900	325	244	175	432	75
29	170	284	180	110	.....	449	800	320	200	162	453	80
30	155	350	175	110	.....	505	755	310	179	150	445	100
31	145	.....	175	110	.....	505	.....	300	.....	133	439	.....

NOTE.—Stage-discharge relation affected by ice Dec. 13 to Jan. 4 and Jan. 17 to Feb. 26; discharge determined from a study of weather records, recorded gage heights, and 1 discharge measurement. Discharge July 4–23 and Sept. 6–30 estimated by comparison with records for nearby streams.

Monthly discharge of Clyde River at West Derby, Vt., for the year ending Sept. 30, 1917.

[Drainage area 150 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	228	100	162	1.08	1.24
November	350	105	167	1.11	1.24
December	435	175	271	1.81	2.09
January	195	105	131	.873	1.01
February	115	80	93.6	.624	.65
March	505	86	157	1.05	1.21
April	1,370	378	760	5.07	5.66
May	800	300	499	3.33	3.84
June	460	179	290	1.93	2.15
July	244	105	170	1.13	1.30
August	453	127	279	1.86	2.14
September	404	75	155	1.03	1.15
The year	1,370	75	262	1.75	23.68

INDEX.

STREAM-GAGING STATIONS

AND

PUBLICATIONS RELATING TO WATER RESOURCES

PART IV. ST. LAWRENCE RIVER BASIN

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 investigations 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, professional papers, monographs, and annual reports.

The results of stream-flow measurements are now published annually in 12 parts, each part covering an area whose boundaries coincide with natural drainage features, as indicated below:

Part I. North Atlantic slope basins.
II. South Atlantic slope and eastern Gulf of Mexico basins.
III. Ohio River basin.
IV. St. Lawrence River basin.
V. Upper Mississippi River and Hudson Bay basins.
VI. Missouri River basin.
VII. Lower Mississippi River basin.
VIII. Western Gulf of Mexico basins.
IX. Colorado River basin.
X. Great Basin.
XI. Pacific slope basins in California.
XII. North Pacific slope basins, 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 list 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.
Chicago, Ill., 1404 Kimball Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Helena, Mont., Montana National Bank Building.
Denver, Colo., 403 New Post Office Building.
Topeka, Kans., Room 25, Federal Building.
Salt Lake City, Utah, 421 Federal Building
Boise, Idaho, 615 Idaho Building.
Tucson, Ariz., University of Arizona.
Austin, Tex., Capitol Building.
Portland, Oreg., 606 Post Office Building.
Tacoma, Wash., 406 Federal Building.
San Francisco, Calif., 328 Customhouse.
Los Angeles, Calif., 619 Federal Building.
Honolulu, Hawaii, 14 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director of the United States Geological Survey, Washington, D. C.

STREAM-FLOW REPORTS.

Stream-flow records have been obtained at more than 4,240 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 September, 1890.
12th A, pt. 2	do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894
16th A, pt. 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.

Stream-flow data in reports of the United States Geological Survey—Continued.

Report.	Character of data.	Year.
W 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
W 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
W 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
W 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W 75	Monthly discharge	1901.
W 82 to 85	Complete data	1902.
W 97 to 100	do	1903.
W 124 to 135	do	1904.
W 165 to 178	do	1905.
W 201 to 214	do	1906.
W 241 to 252	do	1907–8.
W 261 to 272	do	1909.
W 281 to 292	do	1910.
W 301 to 312	do	1911.
W 321 to 332	do	1912.
W 351 to 362	do	1913.
W 381 to 394	do	1914.
W 401 to 414	do	1915.
W 431 to 444	do	1916.
W 451 to 464	do	1917.

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, as a rule, be found in the reports covering the years during which the station was maintained. For example, data for Machias River at Whitneyville, 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.

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Numbers of water-supply papers containing results of stream measurements, 1899–1917.

Year.	I North Atlantic slope (St. John River to York River).	II South Atlantic and eastern Gulf of Mexico (James River to the Mississippi).	III Ohio River basin.	IV St. Lawrence River and Great Lakes basins.	V Hudson Bay and upper Mississippi River basins.	VI Missouri River basin.	VII Lower Mississippi River basin.	VIII Western Gulf of Mexico basins.	IX Colorado River basin.	X Great Basin.	XI Pacific slope basins in California.	XII North Pacific slope basins.		
												Pacific slope basins in Washington and upper Columbia River.	Snake River basin.	Lower Columbia River and Pacific slope basins in Oregon.
1899[a]	35	[b] 35, 36	36	36	36	[c] 36, 37	37	37	[d] 37, 38	38, [e] 39	38, [f] 39	38	38	38
1900[g]	47, [h] 48	48	48, [i] 49	49	49	49, [j] 50	50	50	50	51	51	51	51	51
1901	65, 75	65, 75	65, 75	65, 75	[k] 65, 66, 75	66, 75	[k] 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75
1902	82	[b] 82, 83	83	[l] 82, 83	[k] 83, 85	84	[k] 83, 84	84	85	85	85	85	85	85
1903	97	[b] 97, 98	98	97	[k]98, 99, [m]100	99	[k] 98, 99	99	100	100	100	100	100	100
1904	[n] 124, [o] 125, [p] 126	[p] 126, 127	128	129	[k] 128, 130	130, [q] 131	[k] 128, 131	132	133	133, [r] 134	134	135	135	135
1905	[n] 165, [o] 166, [p] 167	[p] 167, 168	169	170	171	172	[k] 179, 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	257	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. Estimates 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 coast 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. Estimates for 1900 in Twenty-second Annual Report, Part IV.
[h] Wissahickon and Schuylkill rivers to James River.
[i] Scioto River.
[j] Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.
[k] Tributaries of Mississippi from east.
[l] Lake Ontario and tributaries to St. Lawrence River proper.
[m] Hudson Bay only.
[n] New England Rivers only.
[o] Hudson River to Delaware River, inclusive.
[p] Susquehanna River to Yadkin River, inclusive.
[q] Platte and Kansas rivers.
[r] Great Basin in California, except Truckee and Carson river basins.
[s] Below junction with Gila.
[t] Rogue, Umpqua, and Siletz rivers only.

In these papers and in the following lists the stations are arranged in downstream order. The main stem of any river is determined by measuring or estimating its drainage area—that is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. All stations from the source to the mouth of the main stem of the river are presented first, and the tributaries in regular order from source to mouth follow, the streams in each tributary basin being listed before those of the next basin below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated on page III, and in the records for the large lakes, where it is simpler to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

PART IV. ST. LAWRENCE RIVER BASIN.

PRINCIPAL STREAMS.

The St. Lawrence River basin includes streams which drain into the Great Lakes and St. Lawrence River. The principal streams flowing directly or indirectly into Lake Superior from the United States are St. Louis, Ontonagon, Dead, and Carp rivers; streams flowing into Lake Michigan are Escanaba, Menominee, Peshtigo, Oconto, Fox, St. Joseph, and Grand rivers; into Lake Huron flow Thunder Bay, Au Sable, Rifle, and Saginaw rivers; into Lake Erie flow Huron, Maumee, Sandusky, Black, and Cuyahoga rivers. Streams flowing into Lake Ontario are Genesee, Oswego, Salmon, and Black rivers. The St. Lawrence receives Oswegatchie and Raquette rivers, Richelieu River (the outlet of Lake Champlain), and St. Francis River, whose principal tributary, Clyde River, reaches it through Lake Memphremagog. The streams of this basin drain wholly or in part the States of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Vermont, and Wisconsin.

In addition to the list of gaging stations and annotated list of publications relating specifically to the section, this part contains 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. XIX.)

GAGING STATIONS.

NOTE.—Dash following a date indicates that station was being maintained September 30, 1917. Period after date indicates discontinuance.

Streams tributary to Lake Superior:
- Brule River at mouth, Minn., 1911.
- Devil Track River at mouth, Minn., 1911.
- Cascade River at mouth, Minn., 1911.
- Poplar River at Lutsen, Minn., 1911–
- Beaver Bay River at Beaver Bay, Minn., 1911–1914.
- St. Louis River near Cloquet, Minn., 1903.
- St. Louis River near Thomson, Minn., 1909–1915.
  - Whiteface River at Meadowlands, Minn., 1909–1912.
  - Whiteface River below Meadowlands, Minn., 1912–
  - Cloquet River at Independence, Minn., 1909–
- Aminicon River near Aminicon Falls, Wis., 1914–1916.
- Brule River near Brule, Wis., 1914–
- Bad River near Odanah, Wis., 1914–
- Ontonagon River near Rockland, Mich., 1903.

Streams tributary to the St. Lawrence—Continued.
Richelieu River—Continued.
Lake Champlain—Continued.
Ausable River at Ausable Forks, N. Y., 1910–
Ausable River at Keeseville, N. Y., 1904 and 1908.
Boquet River at Willsboro, N. Y., 1904 and 1908.
Lake George at Rogers Rock, N. Y., 1913–
Lake George outlet at Ticonderoga, N. Y., 1904–5.
Poultney River at Fairhaven, Vt., 1908.
Mettawee River at Whitehall, N. Y., 1908.
Otter Creek at Middlebury, Vt., 1903–1907; 1910–
East Creek near Rutland, Vt., 1911–1913.
Winooski River above Stevens Branch, near Montpelier, Vt., 1909–1914.
Winooski River at Montpelier, Vt., 1909–
Winooski River at Richmond, Vt., 1903–1907; 1910.
Winooski River near Winooski, Vt., 1903.
Worcester Branch of Winooski River at Montpelier, Vt., 1909–1914.
Dog River at Northfield, Vt., 1909–
Dog River near Montpelier Junction, Vt., 1910.
Mad River at Moretown, Vt., 1910.
Little River near Waterbury, Vt., 1910.
Huntington River at Jonesville, Vt., 1910.
Lamoille River at Morrisville, Vt., 1909–10.
Lamoille River at Cadys Falls, near Morrisville, Vt., 1913–
Lamoille River at Johnson, Vt., 1910–1913.
Lamoille River at West Milton, Vt., 1908.
Green River at Garfield, Vt., 1915–
Missisquoi River at Richford, Vt., 1909–10.
Missisquoi River near Richford, Vt., 1911–
Missisquoi River at Swanton, Vt., 1903.
St. Francis River (by way of Lake Memphremagog and Magog River):
Clyde River at West Derby, Vt., 1909–

REPORTS ON WATER RESOURCES OF THE ST. LAWRENCE RIVER BASIN.[1]

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 from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Water-supply papers are of octavo size.

*21. Wells of Northern Indiana, by Frank Leverett. 1899. 82 pp., 2 pls. (Continued in No. 26.)

Discusses, by counties, the glacial deposits and the sources of well water; gives many well sections.

*24. Water resources of the State of New York, Part I, by G. W. Rafter. 1899. 99 pp., 13 pls. 15c.

*25. Water resources of the State of New York, Part II, by G. W. Rafter. 1899. 100 pp., 12 pls. 15c.

No. 24 contains descriptions of the principal rivers of New York and their more important tributaries and data on temperature, precipitation, evaporation, and stream flow.

No. 25 contains discussion of water-storage projects on Genesee and Hudson Rivers, power development at Niagara Falls, descriptions and early history of State canals, and a chapter on the use and value of the water powers of the streams and canals; also brief discussion of the water yield of sand areas of Long Island.

*26. Wells of southern Indiana (continuation of No. 21), by Frank Leverett. 1899. 64 pp. 5c.

Discusses, by counties, the glacial deposits and the sources of well water; contains many well sections.

30. Water resources of the Lower Peninsula of Michigan, by A. C. Lane. 1899. 97 pp. 7 pls.

Describes lake and river transportation and navigation, water powers and domestic water supplies; discusses climate, topography, geology, and well waters; compares quality and quantity of waters.

*31. Lower Michigan mineral waters, by A. C. Lane. 1899. 97 pp., 4 pls. 10c.

Treats of economic value of mineral waters and discussion and classification of analyses; contains analyses of waters of Lake Superior and of smaller lakes and rivers and of well waters from various geologic formations; also sanitary condition of drinking waters.

*57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp. (See No. 149.) 5c.

*61. Preliminary list of deep borings in the United States, Part II (Nebrasks-Wyoming), by N. H. Darton. 1902. 67 pp. 5c.

Nos. 57 to 61 contain information as to depth, diameter, yield, and head of water in borings more than 400 feet deep; under head "Remarks" give information concerning temperature, quality of water, purposes of boring, etc. The lists are arranged by States, and the States are arranged alphabetically. A second, revised, edition was published in 1905 as Water-Supply Paper 149 (q. v.)

XIV.

91. The natural features and economic development of the Sandusky, Maumee, Muskingum, and Miami drainage areas in Ohio, by B. H. and M. S. Flynn. 1904. 130 pp. 10c.

Describes the topography, geology, and soils of the areas, and discusses stream flow, dams, water powers, and public water supplies.

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[1] For stream-measurement reports, see tables on pp. IV, V, VI.

102. Contributions to the hydrology of eastern United States, 1903; M. L. Fuller, geologist in charge. 1904. 522 pp. 30c.

Contains brief reports on wells and springs of Minnesota and of lower Michigan. The report comprises tabulated well records giving information as to location, owner, depth yield, head, etc., supplemented by notes as to elevation above sea, materials 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. Superseded by 152.

Cites statutory restrictions of water pollution.

110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains:

Water resources of the Watkins Glen quadrangle, New York, by Ralph S. Tarr; pp. 134-140. Discusses the use of the surface and underground waters for municipal supplies and their quality as indicated by examination of Sixmile and Fall creeks, and sanitary analyses of well water at Ithaca.

New artesian water supply at Ithaca, New York, by F. L. Whitney, pp. 55-64.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains brief reports as follows:

Minnesota, by C. W. Hall; Wisconsin district, by Alfred R. Schultz; Lower Michigan; Illinois, by Frank Leverett; Indiana, by Frank Leverett; New York, by F. B. Weeks; Ohio, 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.

121. Preliminary report on the pollution of Lake Champlain, by M. O. Leighton. 1905. 119 pp., 13 pls. 20c.

Describes the lake and principal inflowing streams and discusses the characteristics of the water and the wastes resulting from the manufacturing processes by which the waters are polluted. Discusses also the effect of mill waste on algæ, bacteria, and fish.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Cites legislative acts relating to ground waters in Michigan and Wisconsin.

144. The normal distribution of chlorine in the natural waters of New York and New England, by D. D. Jackson. 1905. 31 pp., 5 pls. 10c.

Discusses common salt in coast and inland waters, salt as an index to pollution of streams and wells, the solutions and methods used in chlorine determinations, and the use of the normal chlorine map; gives charts and tables for chlorine in the New England States and New York.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains three brief reports pertaining chiefly to areas in the St. Lawrence River basin:

Two unusual types of artesian flow, by Myron L. Fuller. Describes (1) artesian flows from uniform, unconfined sand on Long Island, N. Y., and in Michigan; and (2) flow from jointed upper portion of limestone and other rocks in southeastern Michigan.

Water resources of the Catatonk area, New York, by E. M. Kindle. Describes topography and geology of areas southeast of Finger Lake region, New York, including part of city of Ithaca; discusses briefly the artesian wells of Ithaca, the quality of the spring water at several small towns, and of the streams used for municipal supplies and for power.

A ground-water problem in southeastern Michigan, by Myron L. Fuller. Discusses causes of failure of wells in certain areas in southeastern Michigan in 1904 and the application of the conclusions to other regions.

147. Destructive floods in the United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c.

Describes flood on Grand River, Mich. (from report of R. E. Horton), discussing streams precipitation, and temperature, discharge, damage, and prevention of future damage.

*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 to 61; mentions also principal publications relating to deep borings.

*152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Cites statutory restrictions of water pollution in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Vermont, 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.

*160. Underground-water papers, 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.

Contains brief report entitled Flowing well districts in the eastern part of the northern peninsula of Michigan, by Frank Leverett.

*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.

Contains accounts of floods on Sixmile Creek and Cayuga Inlet, N. Y. (in 1857, 1901, and 1905), and on Grand River, Mich., and estimate of flood discharge and frequency for Genesee River; gives index to literature on floods in American streams.

*182. Flowing wells and municipal water supplies in the southern portion of the southern peninsula of Michigan, by Frank Leverett and others. 1906. 292 pp., 5 pls. 50c.

*183. Flowing wells and municipal water supplies in the middle and northern portions of the southern peninsula of Michigan, by Frank Leverett and others. 1907. 393 pp., 5 pls. 50c.

Nos. 182 and 183 describe in general the geographic features, water-bearing formations, drainage, quality of water, and subterranean-water temperature, and give details concerning water supplies by counties. The report contains many analyses.

*193. The quality of surface waters in Minnesota, by R. B. Dole and F. F. Wesbrook, 1907. 171 pp., 7 pls. 25c.

Describes by river basins the topography, geology, and soils, the industrial 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.

236. The quality of surface water 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, method of examination, preparation of solutions, accuracy of estimates, and expression of analytical results; gives results of analyses of waters of Lake Superior and Lake Michigan, Kalamazoo and Grand rivers, Lake Huron, Lake Erie, Maumee River and St. Lawrence and Oswegatchie 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, course, and quality of water; includes short chapters on municipal supplies and industrial uses.

254. The underground waters of north-central Indiana, by S. R. Capps, with a chapter on the chemical character of the waters, by R. B. Dole. 1910. 279 pp., 7 pls. 40c.

Describes relief, drainage, vegetation, soils and crops, industrial development, geologic formations; sources, movements, occurrence, and volume of ground water; methods of well construction and lifting devices; discusses in detail, for each county, surface features and drainage, geology, and ground water, city, village, and rural supplies, and gives record of wells and analyses of water. Discusses also, under chemical character, methods of analyses and expression of results, mineral constituents, effects of the constituents on waters for domestic, industrial, and medicinal uses, methods of purification and chemical composition; many analyses and field assays.

364. Water analyses fron the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp. 5c.

Contains analyses of water from Caledonia Spring, New York, and from the Quincy mine, Mich.

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 positions 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 possibility of using the stream."

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 stock 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.

Annual reports 1 to 26 are royal octavo; later reports are octavo.

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:

*The potable waters of 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.

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:

*The water resources of Illinois, by Frank Leverett, pp. 695–849, pls. 108–113. 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 water for rural districts, and artesian wells :contains tabulated artesian well data and water analyses.

Eighteenth Annual Report, United States Geological Survey, 1896–97, Charles D. Walcott, Director. 1897. 5 parts in 6 volumes. *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. 33–37. Describes Wabash, Whitewater, Great Miami, Little Miami, Scioto, Hocking, Muskingum, and Beaver rivers and lesser tributaries of the Ohio in Indiana and Ohio, the streams discharging into Lake Erie and Lake Michigan, and streams flowing to the Upper Mississippi through the Illinois; discusses shallow and drift wells, the flowing wells from the drift and deeper artesian wells, and gives records of wells at many of the cities; describes the mineral springs and gives analyses of the waters; contains also tabulated lists of cities using surface waters for water works, and of cities and villages using shallow and deep well waters; discusses the source and quality of the city and village supplies, and gives precipitation tables for various points.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Pts. II, III, and V, 1899.) 6 parts in 7 volumes and separate case for maps with Pt. V. *Pt. IV. Hydrography. $1.85. Contains:

*The rock waters of Ohio, by Edward Orton, pp. 633-717, pls. 71-73. Describes the principal geologic formations of Ohio and the waters from the different strata; discusses the flowing wells at various points and the artesian wells of the deep preglacial channels in Allen, Auglaize and Mercer counties; discusses city and village supplies; gives analyses of waters from various formations.

MONOGRAPHS.

Monographs are of quarto size. They are not distributed free, but may be obtained from the Geological Survey or from the Superintendent of Documents at the prices given. An asterisk (*) indicates that the Survey's stock of the paper is exhausted. (See Finding lists, pp. 89, 118.)

XLI. Glacial formations and drainage features of the Erie and Ohio basins, by Frank Leverett. 1902. 802 pp., 26 pls. $1.75.

Treats of an area extending westward from Genesee Valley in New York across northwestern Pennsylvania and Ohio, central and southern Indiana, and southward from Lakes Ontario and Erie to Allegheny and Ohio rivers.

BULLETINS.

An asterisk (*) indicates that the Geological Survey's stock of 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, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin, and detailed records of wells in Onondaga County, N. Y., and Hancock and Wood counties, Ohio. 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, Michigan, Minnesota, New York, Ohio, Pennsylvania, Vermont, and Wisconsin, and detailed records of wells in Cook County, Ill.; Erie County, N. Y.; Ottawa, Sandusky, and Summit counties, Ohio; and Manitowoc County, Wis. The wells of which detailed sections are given were selected because they afford valuable stratigraphic information.

GEOLOGIC FOLIOS.

Under the plan adopted for the preparation of a geologic map of the United States the entire area is divided into small quadrangles, bounded by certain meridians and parallels, and these quadrangles, which number several thousand, are separately surveyed and mapped.[1] The unit of survey is also the unit of publication, and the maps and description of each quadrangle are issued in the form of a folio. When all the folios are completed they will constitute the Geologic Atlas of the United States.

A folio is designated by the name of the principal town or of a prominent natural feature within the quadrangle. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped and several pages of descriptive text. The text explains the maps and describes the topographic and geologic features of the country and its mineral products. The topographic map shows roads, railroads, waterways, and, by contour lines, the shapes of the hills and valleys and the height above sea level of all points in the quadrangle. The areal-geology map shows the distribution of the various rocks at the surface. The structural-geology map shows the 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 of underground-water horizens. 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.

Folios 1 to 163, inclusive, are published in only one form (18 by 22 inches), called the library edition. Some of the folios that bear numbers higher than 163 are published also in an octavo edition (6 by 9 inches). Owing to a fire in the Geological Survey building May 18, 1913, the stock of geologic folios was more or less damaged by fire and water, but 80 or 90 per cent of the folios are usable. They will be sold at the uniform price of 5 cents each, with no reduction for wholesale orders. This rate applies to folios in stock from 1 to 184, inclusive (except reprints), also to the library edition of folio 186. The library edition of Folios 185, 187, and higher numbers sells for 25 cents a copy, except that some folios which contain an unusually large amount of matter sell at higher prices. The octavo edition of Folio 185 and higher numbers sell for 50 cents a copy, except Folio 193, which sells for 75 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 or more at the retail rate.

[1] Index maps showing areas in the St. Lawrence basin covered by topographic maps and by geologic folios will be mailed on receipt of request addressed to the director U. S. Geological Survey, Washington, D. C.

All the folios contain descriptions of the drainage of the quadrangles. The folios in the following list contain also brief discussions 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.

*81. Chicago, Illinois-Indiana.

Describes an area embracing not only the immediate site of the city but adjacent parts of Cook, Dupage, and Will counties, Ill.; gives an account of the water power, discusses the quality of the waters, and gives analyses of waters from artesian wells; gives also a list of papers relating to the geology and paleontology of the area.

*140. Milwaukee special, Wisconsin, 5c.

Gives analyses of spring waters and of artesian water in Milwaukee; also tabulated data concerning wells.

155. Ann Arbor, Mich. 25c.

Discusses the present lakes, the lakes of the glacial period, and under "Economic geology," the water resources, including the use of the rivers for power and of the underground waters, shallow and artesian, for city and village supplies; discusses the quality of the waters, and gives details by townships.

*169. Watkins Glen-Catatonk, New York.

Includes discussion of water supply at Ithaca.

190. Niagara, N. Y. 50c. either edition.

Gives analyses of mineral water from well at Akron; discusses briefly the municipal supplies of Buffalo, Niagara Falls, Tonawanda, La Salle, and Youngstown, and the use of Niagara River for power development.

205. Detroit, Mich. 50c. either edition.

Discusses surface and ground waters; gives mineral analyses of water from Lake Huron, from rivers near Detroit, and from salt wells.

MISCELLANEOUS REPORTS.

Other Federal bureaus and 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 St. Lawrence River basin are the reports of the Chief of Engineers, United States Army, the State Geological Survey of Illinois, the Illinois Water-Supply Commission, the Rivers and Lakes Commission of Illinois, the New York State Conservation Commission and State Water-Supply Commission, and the water-power report of the Tenth Census (vol. 16). The following reports deserve special mention:

The mineral content of Illinois waters, by Edward Bartow, J. A. Udden, S. W. Parr, and George T. Palmer: Illinois State Geol. Survey Bull. 10, 1909.

Chemical and biological survey of waters of Illinois, by Edward Bartow: Univ. Illinois Pubs. 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.

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 *v.* 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.

Reports of the water resources investigation of Minnesota, by the State Drainage Commission, 1909–1912.

Water powers of Wisconsin, by L. S. Smith: Wisconsin Geol. and Nat. Hist. Survey Bull. 20, 1908.

Report of the Railroad Commission of Wisconsin to the legislature on water powers. 1915.

Hydrology of the State of New York, by George W. Rafter: New York State Mus. Bull. 85, 1905.

Many of these reports can be obtained from the various commissions, and probably all can be consulted in the public libraries of the larger cities.

GEOLOGICAL SURVEY HYDROLOGIC REPORTS OF GENERAL INTEREST.

The following list comprises reports that are not readily classifiable by drainage basins and that cover a wide range of hydrologic investigations:

WATER-SUPPLY PAPERS.

*1. Pumping water for irrigation, by H. M. Wilson. 1896. 57 pp., 9 pls.

Describes pumps and motive powers, windmills, water wheels, and various kinds of engines also, storage reservoirs to retain pumped water until needed for irrigation.

*3. Sewage irrigation, by G. W. Rafter. 1897. 100 pp., 4 pls. (See Water-Supply Paper 22.) 10c.

Discusses methods of sewage disposal by intermittent filtration and by irrigation; describes utilization of sewage in Germany, England, and France, and sewage purification in the United States.

*8. Windmills for irrigation, by E. C. Murphy. 1897. 49 pp., 8 pls. 10c.

Gives results of experimental tests of windmills during the summer of 1896 in the vicinity of Garden, Kans.; 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, makes comparisons of wheels of several types, and discusses results.

*22. Sewage irrigation, Part II, by G. W. Rafter. 1899. 100 pp., 7 pls. 15c.

Gives résumé of Water-Supply Paper 3; discusses pollution of certain streams, experiments on purification of factory wastes in Massachusetts, value of commercial fertilizers, and describes; American sewage-disposal plants by States; contains bibliography of publications relating to sewage utilization and disposal.

*41. The windmill, its efficiency and economic use, Part I, by E. C. Murphy. 1901. 72 pp., 14 pls. 5c.

*42. The windmill, its efficiency and economic use, Part II, by E. C. Murphy. 1901. 75 pp., 2 pls. 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.

*57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp. (See No. 149.) 5c.

*61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp. 5c.

Nos. 57 and 61 contain information as to depth, diameter, yield, and head of water in borings more than 400 feet deep; under head "Remarks" gives information concerning temperature, quality of water, purpose of boring, etc. The lists are arranged by States, and the States are arranged alphabetically. A second, revised, edition was published in 1905 as Water-Supply Paper 149 (q. v.). 5c.

*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 underground waters; permeability of rocks and porosity of soils; causes, rates, and laws of motion of underground water; 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 yield of flowing well; 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.

79. Normal and polluted waters in northeastern United States, by M. O. Leighton. 1903. 192 pp. 10c.

Defines essential qualities of water for various uses, the impurities in rain, surface, and underground waters, the meaning and importance of sanitary analyses, and the principal sources of pollution; chiefly, "a review of the more readily available records" of examination of water supplies derived from streams in the Merrimack, Connecticut, Housatonic, Delaware, and Ohio River basins; contains many analyses.

*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 stream flow; gives rainfall, run-off, and evaporation formulas; discusses effect of forests on rainfall and run-off.

87. Irrigation in India (second edition), by H. M. Wilson. 1903. 238 pp., 27 pls. 25c.

First edition was published in Part II of the Twelfth Annual Report.

93. Proceedings of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp. 25c.

Contains, in addition to an account of the organization of the hydrographic [water-resources] branch of the United States Geological Survey and the reports of the conference, 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 the use of the plane table, by J. B. Lippincott.
The use of alkaline waters for irrigation, by Thomas A. 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 instructions 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 waters in the United States, by E. B. Goodell. 1904. 120 pp. (See No. 152.)

Explains the legal principles under which antipollution statutes become operative, quotes court decisions to show authority for various deductions, and classifies according to scope the statutes enacted in the different States.

110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains the following reports of general interest. The scope of each paper is indicated by its title.

Description of underflow 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 vertical well casings, from notes furnished by A. N. Talbot.

Experiment relating to problems of well contamination at Quitman, Ga., by S. W. McCallie.

Notes on the hydrology of Cuba, by M. L. Fuller.

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 streams 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., the contamination of rock wells and of streams by waste oil and brine.

*114. Undergound waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains report 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 underground 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.

Scope indicated by title.

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.

Scope indicated by title.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Defines and classifies underground waters, gives common-law rules relating to their use, and cites State legislative acts affecting them.

140. Field measurements of the rate of movement of underground waters, by C. S. Slichter. 1905. 122 pp., 15 pls. 15c.

Discusses the capacity of sand to transmit water, describes measurements of underflow in Rio Hondo, San Gabriel, and Mohave River valleys, Cal., and on Long Island, N. Y., gives results of tests of wells and pumping plants, and describes stovepipe method of well construction.

143. Experiments on steel-concrete pipes on a working scale, by J. H. Quinton. 1905. 61 pp., 4 pls. 5c.

Scope indicated by title.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains brief reports of general interest as follows:

Drainage of ponds into drilled wells, by Robert E. Horton. Discusses efficiency, cost, and capacity of drainage wells, and gives statistics of such wells 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.

Contains brief account of the organization of the hydrographic [water-resources] branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of technical papers by members of the service. Of the papers read at the conference those listed below (scope indicated by title) are of more or less general interest:

Proposed State code of water laws, by Morris Bien.
Power engineering applied to irrigation problems, by O. H. Ensign.
Estimates on tunneling in irrigation projects, by A. L. Fellows.
Collection of stream-gaging data, by N. C. Grover.
Diamond-drill methods, by 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 irrigating 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 the 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.

*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), location, depth, diameter, yield, height of water, and other available information, concerning wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 to 61; mentions also principal publications relating to deep borings.

*150. Weir experiments, coefficients, and formulas, by R. E. Horton. 1906. 189 pp., 38 pls. (See Water-Supply Paper 200.) 15c.

Scope indicated by title.

151. Field assay of water, by M. O. Leighton. 1905. 77 pp., 4 pls.

Discusses methods, instruments, and reagents used in determining turbidity, color, iron, chlorides, and hardness in connection with the studies of the quality of water in various parts of the United States.

*152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Scope indicated by title.

*160. Underground-water papers, 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.

Gives account of work in 1905; lists of publications relating to underground waters, and contains the following brief reports of general interest:

Significance of the term "artesian," by Myron L. Fuller.
Representation of wells and springs on maps, by Myron L. Fuller.
Total amount of free water in the earth's crust, by Myron L. Fuller.
Use of fluorescein in the study of underground waters, by R. B. Dole.
Problems of water contamination, by Isaiah Bowman.
Instances of improvement of water in wells, by Myron L. Fuller.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

*163. Bibliographic review and index of underground-water literature published in the United States in 1905, by M. L. Fuller, F. G. Clapp, and B. L. Johnson. 1906. 130 pp. 15c.

Scope indicated by title.

*179. Prevention of stream pollution by distillery refuse, based on investigations at Lynchburg, Ohio, by Herman Stabler. 1906. 34 pp., 1 pl. 10c.

Describes grain distillation, treatment of slop, sources, character, and effects of effluents on streams; discusses filtration, precipitation, fermentation, and evaporation methods of disposal of wastes without pollution.

*180. Turbine water wheel tests and power tables, by R. E. Horton. 1906. 134 pp. 2 pls. 20c.

Scope indicated by title.

*185. Investigations on the purification of Boston sewage, by C. E. A. Winslow and E. B. Phelps. 1906. 163 pp. 25c.

Discusses composition, disposal, purification, and treatment of sewages and recent 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 in intermittent sand filtration and coarse material; gives bibliography.

*186. Stream pollution by acid-iron wastes, a report based on investigations made at Shelby, Ohio, by Herman Stabler. 1906. 36 pp., 1 pl.

Gives history of pollution by acid-iron wastes at Shelby, Ohio, and resulting litigation; discusses effect of acid-iron liquors on 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 amount 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., 38 pls. 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 the 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 conservation of water resources. 1909. 96 pp., 2 pls. 15c.

Contains the following papers, whose scope is indicated by their titles: Distribution of rainfall, 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, method 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 and 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 safety of supplies from different materials; springs and their protection; open or dug and deep wells, their location, yield, 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 underground 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 of costs 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 of 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.

259. The underground waters of southwestern Ohio, by M. L. Fuller and F. G. Clapp, with a discussion of the chemical character of the waters, by R. B. Dole. 1912. 228 pp., 9 pls. 35c.

Describes the topography, climate, and geology of the region, the water-bearing formations, the source, mode of occurrence, and head of the waters, and municipal supplies; gives details by counties; discusses in supplement, under chemical character, method of analysis 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. The matter in the supplement was also published in Water-Supply Paper 254 (The underground waters of north-central Indiana).

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; gives results of analyses of waters of the Rio Grande and of Pecos, Gallinas, and Hondo rivers.

*315. The purification of public water supplies, by G. A. Johnson. 1913. 84 pp., 8 pls. 10c.

Discusses ground, lake, and river waters as public supplies, development of waterworks systems in the United States, water consumption, and typhoid fever; describes methods of filtration and sterilization of water and municipal water softening.

334. The Ohio Valley flood of March–April, 1913 (including comparisons with some earlier floods), by A. H. Horton and H. J. Jackson. 1913. 96 pp., 22 pls. 20c.

Although relating specifically to floods in the Ohio Valley, this report discusses also the causes of floods and the prevention of damage by floods.

337. The effects of ice on stream flow, by William Glenn Hoyt. 1913. 77 pp., 7 pls. 15c.

Discusses methods of measuring the winter flow of streams.

*345. Contributions to the hydrology of the United States, 1914. N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c.

*(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.
Scope indicated by title.

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.

(c) The relation of stream gaging to the science of hydraulics, by C. H. Pierce and R. W. Davenport, pp. 77–84.
(e) A method of correcting river discharge for a changing stage, by B. E Jones, pp. 117–130.
(f) Conditions requiring the use of automatic gages in obtaining records of stream flow, by C. H. Pierce, pp. 131–139.
Three papers presented at the conference of engineers of the water-resources branch in December, 1914.

*400. Contributions to the hydrology of the United States, 1916. N. C. Grover, chief hydraulic engineer.

(a) The people's interest in water-power resources, by G. O. Smith, pp. 1–8.
(c) The measurement of silt-laden streams, by Raymond C. Pierce, pp. 39–51.
(d) Accuracy of stream-flow data, by N. C. Grover and J. C. Hoyt, pp. 53–59.

416. The divining rod, a history of water witching, with a bibliography, by Arthur J Ellis. 1917. 59 pp. 10c.

A brief paper published "merely to furnish a reply to the numerous inquiries that are continually being received from all parts of the country" as to the efficacy of the divining rod for locating underground water.

425. Contributions to the hydrology of the United States, 1917; N. C. Grover, chief hydraulic engineer. 1918. Contains:

(c) Hydraulic conversion tables and convenient equivalents, pp. 71–94. 1917.

427. Bibliography and index of the publications of the United States Geological Survey relating to ground water, by O. E. Meinzer. 1918. 169 pp., 1 pl.

Includes publications prepared, in whole or part, by the Geological Survey that treat any phase of the subject of ground water or any subject directly applicable to ground water. Illustrated by map showing reports that cover specific areas more or less thoroughly.

ANNUAL REPORTS.

*Fifth Annual Report of the United States Geological Survey, 1883–84, J. W. Powell, Director. 1885. xxxvi, 469 pp., 58 pls. $2.25. Contains:

*The requisite and qualifying conditions of artesian wells, by T. C. Chamberlin, pp. 125–173. Pl. 21. Scope indicated by title.

Twelfth Annual Report of the United States Geological Survey, 1890–91, J. W. Powell, Director. 1891. 2 parts. Pt. II, Irrigation, xviii, 576 pp., 93 pls. $2. Contains:

*Irrigation in India, by H. M. Wilson, pp. 375–561, pls. 107–146. 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. 111–145. 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:

*The potable waters of eastern United States, by W. J. McGee, pp. 1–47. 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., 127 pls. $2.65. Contains:

*Principles and conditions of the movements of ground water, by F. H. King, pp. 59–294, pls. 6–16. 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 media, and through sand, 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, pls. 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 agriculture, 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."

A highly technical report.

105. Hydraulic mining débris in the Sierra Nevada, by G. K. Gilbert. 154 pp., 34 pls. 1917.

Presents the results of an investigation undertaken by the United States Geological Survey in response to a memorial from the California Miners' Association asking that a particular study be made of portions of the Sacramento and San Joaquin valleys affected by detritus from torrential streams. The report deals largely with geologic and physiographic aspects of the subject, traces the physical effects, past and future, of the hydraulic mining of earlier decades, the similar effects which certain other industries induce through stimulation of the erosion of the soil, and the influence of the restriction of the area of inundation by the construction of levees. Suggests cooperation by several interests for the control of the streams now carrying heavy loads of débris.

BULLETINS.

*32. Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 1886. 235 pp.

Defines mineral waters, lists the springs by States, and gives tables of analyses so far as available.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Bulletins 264 and 298 discuss the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describe the general methods of work; give tabulated records of wells by States, and detailed records selected as affording valuable stratigraphic information.

*319. Summary of the controlling factors of artesian flows, by Myron L. Fuller, 1908. 44 pp. 10c.

Describes underground reservoirs, the sources of underground 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 geologic 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 the 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 Report; M=Monograph; B=Bulletin; P=Professional 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.

ADDITIONAL COPIES

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