A. H. Tuttle

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DEPARTMENT OF THE INTERIOR
NITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

SURFACE WATER SUPPLY

OF

T LAKES AND ST. LAWRENCE RIVER DRAINAGES, 1906

H. K. BARROWS
A. H. HORTON
DISTRICT HYDROGRAPHERS

WASHINGTON
GOVERNMENT PRINTING OFFICE
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CONTENTS.

ILLUSTRATIONS.

SURFACE WATER SUPPLY OF THE GREAT LAKES AND ST. LAWRENCE RIVER DRAINAGES, 1906.[a]

H. K. BARROWS and A. H. HORTON,
District Hydrographers.[b]

INTRODUCTION.

SCOPE OF WORK.

The water supply of the United States is of more importance to the life and pursuits of the people than is any other natural resource. In the arid States the limit of agricultural development is determined by the amount of water available for irrigation; while in all parts of the country the increase in the population of cities and towns makes necessary additional water supplies for domestic and industrial uses, in procuring which both the quantity and the quality of the water that may be obtained must be considered. The location of manufacturing plants may depend largely on the water-power facilities and on the character of the water. The notable advances made in the electric transmission of power have led to the utilization of water powers for the operation of manufacturing establishments, railroads, and municipal lighting plants, many of which are at some distance from the places at which the power is developed.

The intelligent establishment and maintenance of enterprises or industries that depend on the use of water demands a thorough knowledge of the flow of the streams and an understanding of the conditions affecting that flow. This knowledge should be based on data showing both the total flow and the distribution of the flow throughout the year, in order that normal fluctuations may be provided for. As the flow of a stream is variable from year to year, estimates of future flow can be made only from a study of observations

[a] This report contains information similar to that published in previous years under the title "Report on Progress of Stream Measurements."

[b] The data presented in this report were collected as follows:

New York and New England under the direction of H. K. Barrows, assisted by Robert E. Horton and C. C. Covert.

Michigan and Wisconsin, A. H. Horton, district hydrographer, assisted by M. S. Brennan, L. S. Smith, V. H. Reineking, and D. H. Dugan.

The preparation of the data for publication has been under the direction of John C. Hoyt, assisted by R. H. Bolster, Robert Follansbee, F. F. Henshaw, J. E. Stewart, and H. D. Padgett.

covering several years. The rapid increase in the development of the water resources of the United States has caused a great demand by engineers for information in regard to the flow of streams, as it is now generally realized that the failure of many large power, irrigation, and other projects has been due to the fact that the plans were made without sufficient trustworthy information in respect to the water supply.

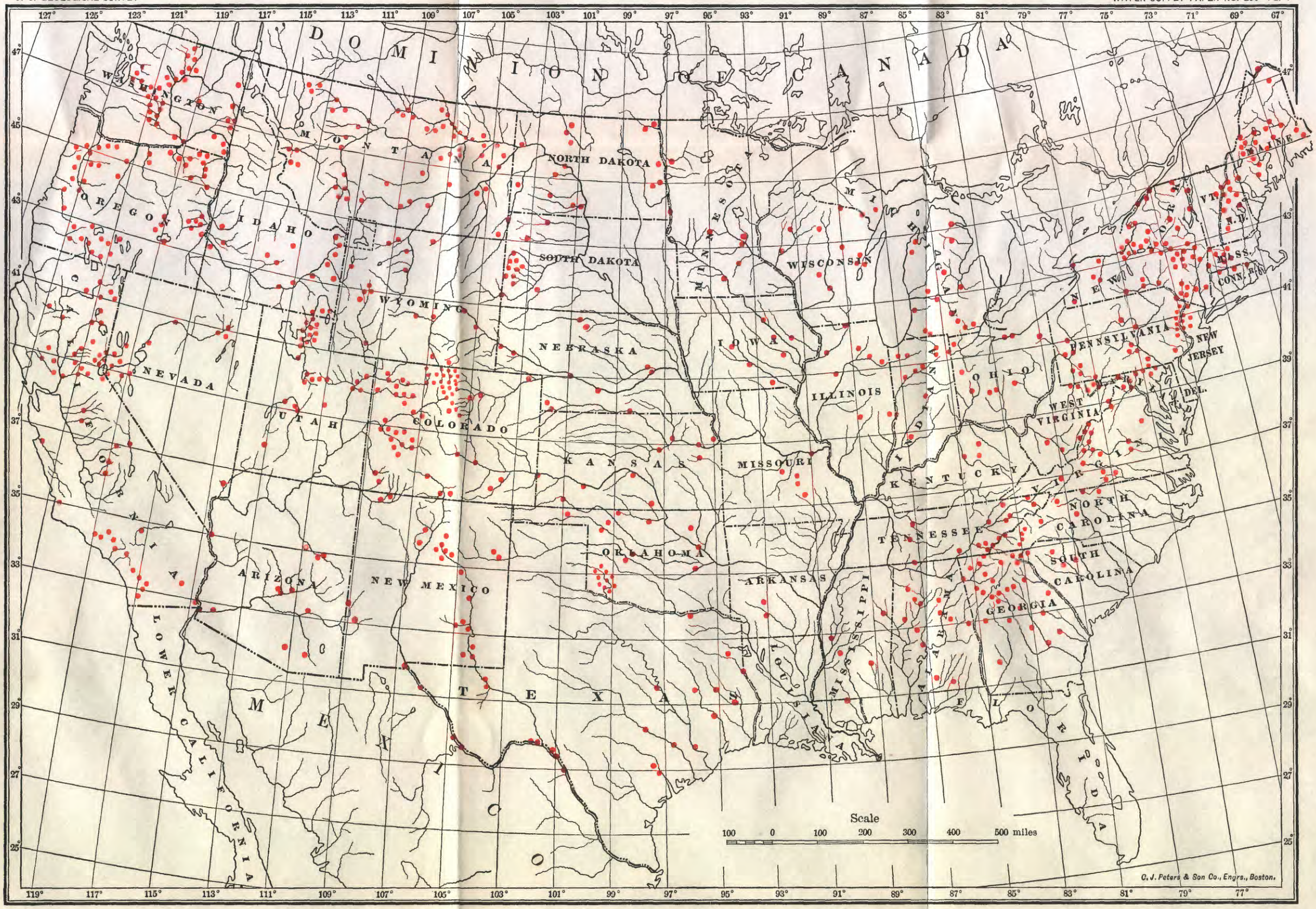
Owing to the broad scope of these hydrographic investigations and the length of time they should cover in order that the records may be of greatest value, it is in general impossible for private individuals to collect the necessary data, and as many of the streams traverse more than one State this work does not properly fall within the province of the State authorities. The United States Geological Survey has therefore, by means of specific appropriations by Congress, for several years systematically made records of stream flow, with the view of ultimately determining all the important features governing the flow of the principal streams of the country. In carrying out this plan stations are established on the streams and maintained for a period long enough to show their regimen or general behavior. When a record that is sufficient for this purpose has been obtained for any stream the work on that stream is discontinued. The order in which the streams are measured is determined by the degree of their importance.

During 1906 the regimen of flow was studied at about 700 stations distributed along the various rivers throughout the United States, as shown on Pl. I. In addition to these records data in regard to precipitation, evaporation, water power, and river profiles were obtained in many sections of the country.

These data have been assembled by drainage areas, and are published in a series of fourteen Water-Supply and Irrigation Papers Nos. 201 to 214, inclusive, each of which pertains to the surface water resources of a group of adjacent areas. In these papers are embodied not only the data collected in the field, but also the results of computations based on these data, and other information that has a direct bearing on the subject, such as descriptions of basins and the streams draining them, utility of the water resources, etc. The list follows:

Water-Supply and Irrigation Papers on Surface Water Supply, 1906.

201. Surface water supply of New England, 1906 (Atlantic Coast of New England drainage).
202. Surface water supply of the Hudson, Passaic, Raritan, and Delaware river drainages, 1906.
203. Surface water supply of the Middle Atlantic States, 1906. (Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.)
204. Surface water supply of the Southern Atlantic and Eastern Gulf States, 1906. (Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.)



MAP OF UNITED STATES SHOWING LOCATION OF PRINCIPAL RIVER STATIONS MAINTAINED DURING 1906.

205. Surface water supply of the Ohio and lower eastern Mississippi river drainages, 1906.
206. Surface water supply of the Great Lakes and St. Lawrence River drainages, 1906.
207. Surface water supply of the upper Mississippi River and Hudson Bay drainage, 1906.
208. Surface water supply of the Missouri River drainage, 1906.
209. Surface water supply of the lower western Mississippi River drainage, 1906.
210. Surface water supply of the western Gulf of Mexico and Rio Grande drainages, 1906.
211. Surface water supply of the Colorado River drainage above Yuma, 1906.
212. Surface water supply of the Great Basin drainage, 1906.
213. Surface water supply of California, 1906. (The Great Basin and Pacific Ocean drainage in California, and Colorado River drainage below Yuma.)
214. Surface water supply of the North Pacific Coast drainages, 1906.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing such records up to and including 1903 has been published in Water-Supply Paper No. 119. The following table gives, by years and primary drainage basins, the numbers of the papers on the surface water supply, published from 1901 to 1906.

Numbers of water-supply papers containing results of stream measurements, 1901–1906.[a]

	1901.	1902.	1903.	1904.	1905.	1906.
	No.	*No.*	*No.*	*No.*	*No.*	*No.*
Atlantic Coast of New England drainage	65 75	82	97	124	165	201
Hudson, Passaic, Raritan, and Delaware river drainages	65 75	82	97	125	166	202
Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages	65 75	82 83	97 98	126	167	203
Santee, Savannah, Ogeechee, and Altamaha river and eastern Gulf of Mexico drainages	65 75	83	98	126	168	204
Ohio and lower eastern Mississippi river drainages	65 75	83	98	128	169	205
Great Lakes and St. Lawrence River drainages	65	83	97	129	170	206
Hudson Bay and upper eastern and western Mississippi River drainages	65 66 75	83 84 85	98 99 100	128 130	171	207
Missouri River drainage	66 75	84	99	130 131	172	208
Meramec, Arkansas, Red, and lower western Mississippi river drainages	66 75	84	99	131	173	209
Western Gulf of Mexico and Rio Grande drainages	66 75	84	99	132	174	210
Colorado River drainage above Yuma	66 75	85	100	133	175	211
The Great Basin drainage	66 75	85	100	133	175	211
The Great Basin and Pacific Ocean drainages in California and Colorado River drainage below Yuma	66 75	85	100	134	177	213
North Pacific Coast drainages	66 75	85	100	135	178	214

DEFINITIONS.

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 which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet

[a] Reports containing data for years prior to 1901 are noted in the series list at the end of this paper.

per square mile, and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the quantity of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used.

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

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot: One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION AND USE OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of monthly and yearly discharges and run-off.
6. Tables showing discharge and horsepower and the number of days during the year when the same are available.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station, and they also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge

measurements made during the year, including the date, the name of the hydrographer, the width and area of cross section, the gage height, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage heights taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The discharge measurements and gage heights are the base data from which the other tables are computed. In cases of extensive development, it is expected that engineers will use these original data in making their calculations, as the computations made by the Survey are based on the data available at the time they are made and should be reviewed and, if necessary, revised when additional data are available.

The rating table gives the discharge in second-feet, corresponding to various stages of the river, as given by the gage heights. It is published to enable engineers to determine the daily discharge in case this information is desired.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise, in the column of "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 for each second during the month. Upon this the computations for the remaining columns, which are defined on page 4, are based.

The values in the table of monthly discharge are intended to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates.

In most work where data in regard to flow are used the regimen of flow is of primary importance. Therefore for the principal stations tables have been prepared showing the horsepower that can be developed at various rates of flow and the length of time that these rates of flow and the corresponding horsepower are available. These tables have been prepared on a basis of 80 per cent efficiency on the turbines, and the horsepower per foot of fall is given in order that the reader can determine the horsepower for any fall.

In the computations sufficient significant figures have been used so that the percentage of error in the tables will not in general exceed 1 per cent. Therefore most of the values in the tables are given to

only three significant figures. In making the various computations Thatcher's slide rule, Crelle's tables, and computation machines have been generally used.

In order to give engineers an idea of the relative value of the various data, notes in regard to accuracy are given as far as possible. This accuracy depends on the general local conditions at the gaging stations and the amount of data collected. Every effort possible is made to so locate the stations that the data collected will give a high degree of accuracy. This is not always possible, but it is considered better to publish rough values with explanatory notes rather than no data.

In the accuracy notes the following terms have been used, indicating the probable accuracy in per cent of the mean monthly flow. As these values are mean values, the error in the value for the flow of any individual day may be much larger.

Excellent indicates that the mean monthly flow is probably accurate to within 5 per cent; good, to within 10 per cent; fair, to within 15 per cent; approximate, to within 25 per cent.

CONVENIENT EQUIVALENTS.

Following is a table of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equal 15.7 United States gallons per second.
100 California miner's inches equal 96.0 Colorado miner's inches.
100 California miner's inches for one day equal 4.96 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 104 California miner's inches.
100 Colorado miner's inches for one day equal 5.17 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.

100 United States gallons per minute for one day equal 0.442 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1⅓ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel, realizing 80 per cent of theoretical power.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geological Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief descriptions are given:

Streams may be divided, with respect to their physical conditions, into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In determining the daily flow special methods are necessary for each class. The data upon which these determinations are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and the area of the cross section. The method chosen for any case depends upon the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to

the coefficients to be used in the Chezy formula, $v = c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are, in general, only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in determining the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir methods.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining the flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable measurements of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests, which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q = c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula are known (see Water-Supply Papers Nos. 180 and 200[a]); (*f*) either no flash boards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, the dam is built for purposes of power or navigation and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such determinations of flow the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions, and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the determinations of flow will not involve, for a critical stage of considerable duration, the use of a head, on a broad-

[a] Water-Supply Paper No. 200 replaces No. 150, the edition of which has been exhausted.

crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends upon the contour of the bed and the fluctuations of the water surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and of dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures usually referred to as equipment are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements, coefficients must be used to reduce the observed velocity to the mean velocity.

The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

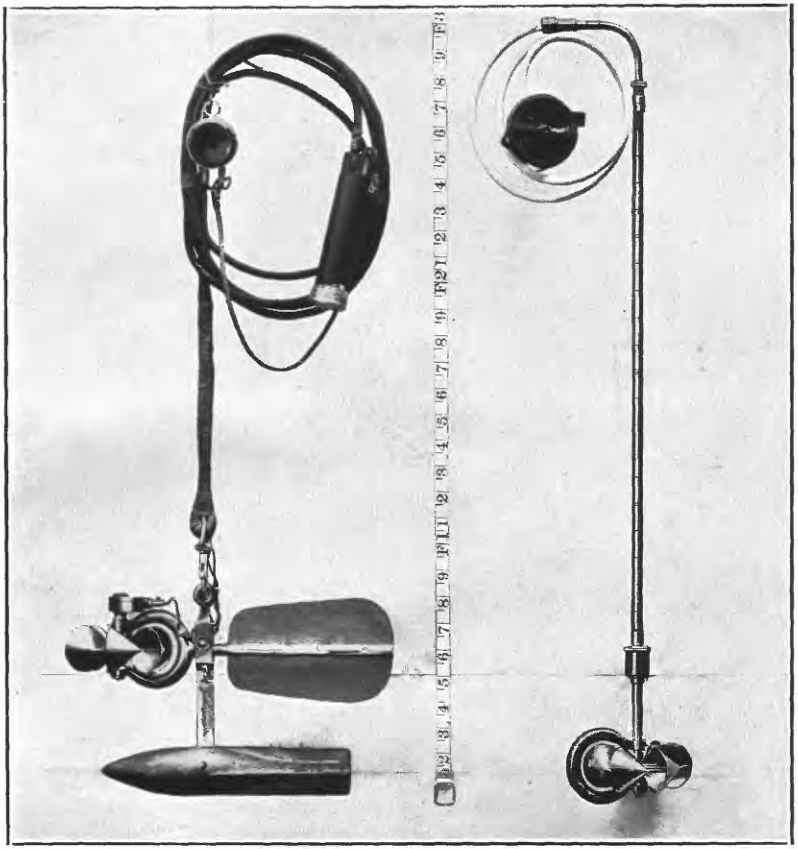
The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types: Those in which the wheel is made up of a series of cups, as the Price, and those having a screw propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, shown in Pl. II, *A*, which has been largely developed and has been extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, a cable, a boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending upon the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity,



A. PRICE CURRENT METERS.

B. CURRENT-METER RATING STATION AT LOS ANGELES, CAL.

area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve; 0.2 and 0.8 depth; and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity-curve and its axis by the depth. On account of the length

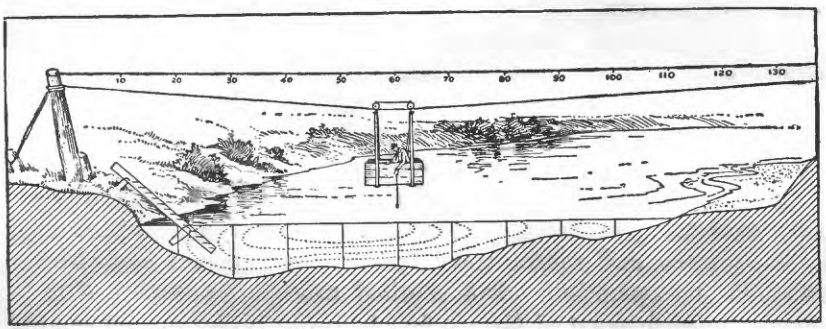


FIG. 1.—Cable station, showing section of river, car, gage, etc.

of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions and, moreover, the indications are that it holds nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top

velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending upon the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in fig. 1, and the

mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8, and vertical velocity-curve methods, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice. For information in regard to flow under ice cover, see Water-Supply Paper No. 187.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of determining run-off, depending upon whether or not the bed of the stream is permanent.

For stations on streams with permanent beds, the first step in computing the run-off is the construction of a rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends upon the method used in measuring flow.

For a station at a weir or dam, the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend upon the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends upon the following laws of flow for open, permanent channels: (1) The discharge will remain constant so long as conditions at or near the gaging station remain constant; (2) the discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall

of the stream be neglected; (3) the discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be therefore a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors—the area and the mean velocity—any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly upon the surface slope, the roughness of the bed, and the cross section of the stream. Of these the slope is the principal factor. In accordance with the relative changes of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, the discharge can be determined by its use. In case of velocity-area stations frequent discharge measurements must be made if the deter-

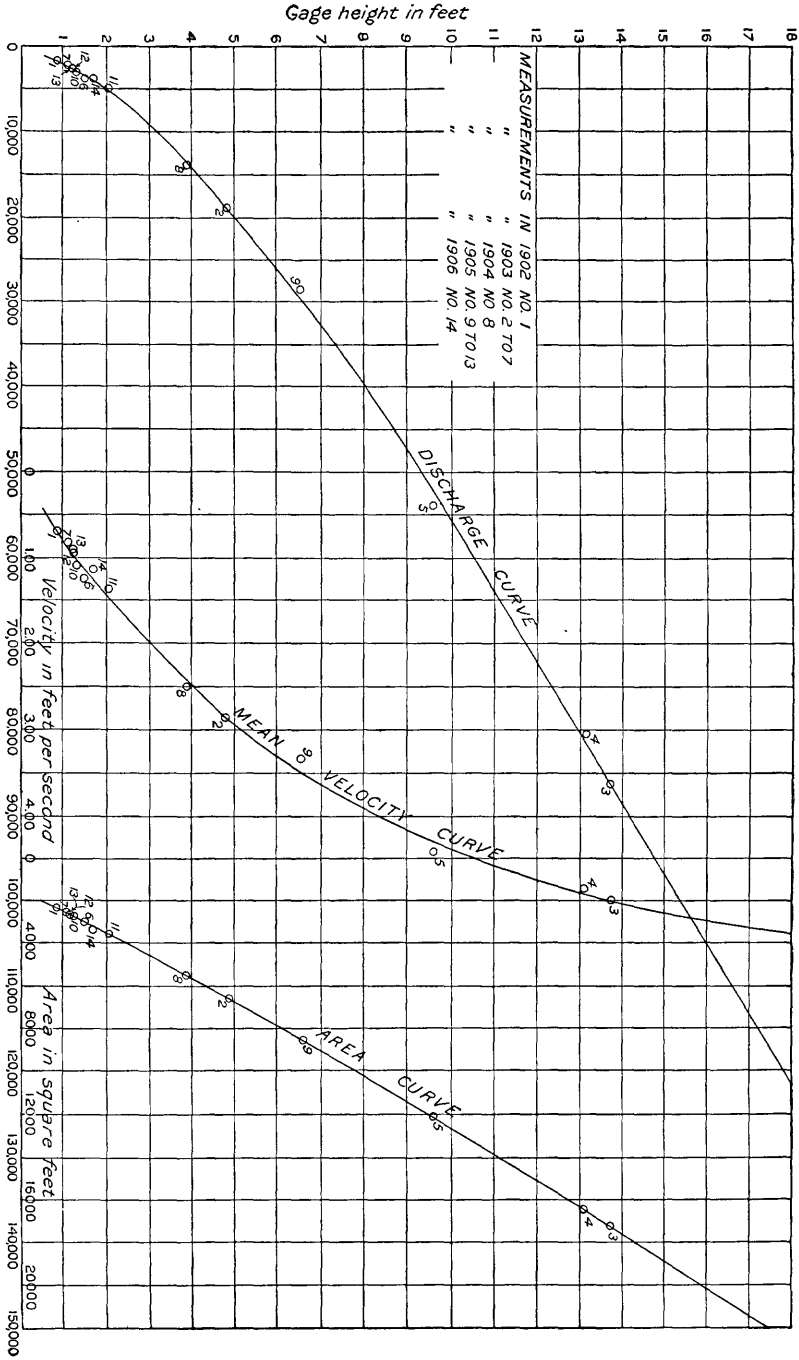


Fig. 2.—Discharge, area, and mean-velocity curves of Potomac River at Point of Rocks, Md.

minations of flow are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharge for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in determining the flow at stations where the bed shifts but slowly.

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LAKE MICHIGAN DRAINAGE.

GENERAL FEATURES.

The Lake Michigan drainage basin comprises a comparatively narrow strip of flat or gently rolling land in eastern Wisconsin, on the west shore of the lake, and a much wider strip of nearly the same character in Michigan, on the east shore. The principal streams entering the lake from the west are Fox and Menominee rivers; from

the east, St. Joseph, Kalamazoo, Grand, Muskegon, and Manistee rivers.

The following pages give the results of data collected during 1906 in the Lake Michigan drainage basin.

ESCANABA RIVER BASIN.

ESCANABA RIVER NEAR ESCANABA, MICH.

The gaging station was established in May, 1903. It is located at a highway bridge 4 miles above the mouth of the river. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 12, where are given also references to publications that contain data for previous years.

Discharge measurements of Escanaba River near Escanaba, Mich., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 19	Horton and Brennan	194	1,270	6.43	7,830
June 9[a]	M. S. Brennan	194	882	4.17	2,880
June 10	do	194	865	4.10	2,580

[a] Heavy run of logs.

Daily gage height, in feet, of Escanaba River near Escanaba, Mich., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.3	3.0	3.3	2.2	2.2	2.2	2.8	3.3
2	.....	4.4	3.1	3.2	2.1	2.2	2.2	2.8	3.1
3	.....	4.5	3.2	3.0	2.1	2.2	2.2	2.7	3.0
4	.....	4.4	3.3	2.9	2.2	2.2	2.3	2.8	2.9
5	.....	4.4	3.4	2.8	2.3	2.1	2.2	2.9	2.9
6	.....	4.2	3.6	2.7	2.3	2.1	2.3	2.9	2.8
7	.....	3.9	3.7	2.6	2.1	2.2	2.3	3.0	2.8
8	.....	3.9	4.0	2.6	2.2	2.3	2.4	3.1	2.9
9	4.0	4.0	4.1	2.5	2.3	2.4	2.4	3.1	2.9
10	4.1	3.8	4.1	2.4	2.5	2.5	2.5	3.1	2.8
11	4.3	3.7	4.0	2.4	2.4	2.6	2.5	3.0	2.8
12	4.6	3.5	3.8	3.4	2.2	2.8	2.5	3.1	2.9
13	5.2	3.4	3.9	3.4	2.1	2.9	2.3	3.0	2.9
14	5.3	3.5	3.9	3.3	2.1	2.9	2.3	2.8	2.9
15	5.3	3.4	3.7	3.4	2.3	2.9	2.4	2.8	2.9
16	5.4	3.5	3.5	3.2	2.2	3.1	2.5	2.9	2.8
17	5.6	3.4	3.5	3.2	2.3	3.1	2.4	2.9	2.9
18	6.2	3.3	3.4	3.1	2.1	3.1	2.4	2.8	2.8
19	6.5	3.2	3.3	3.0	2.1	3.0	2.3	2.7	2.8
20	6.8	3.1	3.3	3.1	2.4	3.0	2.4	2.8	2.9
21	6.9	3.1	3.2	2.9	2.4	2.9	2.3	2.9	2.9
22	6.8	3.2	3.3	2.8	2.3	2.9	2.2	2.9	2.9
23	5.9	3.3	3.4	2.7	2.2	2.8	2.2	2.8	(a)
24	5.8	3.4	3.4	2.5	2.2	2.7	2.3	2.9	.....
25	5.5	3.5	3.6	2.3	2.1	2.7	2.2	3.0	.....
26	5.1	3.4	3.7	2.2	2.3	2.6	2.2	3.1	.....
27	5.1	3.3	3.2	2.1	2.3	2.6	2.3	3.2	.....
28	4.7	3.3	3.7	2.2	2.4	2.5	2.4	3.1	.....
29	4.5	3.4	3.5	2.1	2.2	2.4	2.5	3.1	.....
30	4.3	3.3	3.4	2.1	2.2	2.2	2.5	3.0	.....
31	.....	3.2	.....	2.2	2.3	.....	2.6	.....	.....

[a] Frozen.

Rating table for Escanaba River near Escanaba, Mich., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.10	320	3.10	1,180	4.10	2,530	5.20	4,460
2.20	385	3.20	1,300	4.20	2,690	5.40	4,870
2.30	450	3.30	1,420	4.30	2,850	5.60	5,330
2.40	520	3.40	1,550	4.40	3,010	5.80	5,850
2.50	600	3.50	1,680	4.50	3,180	6.00	6,420
2.60	680	3.60	1,810	4.60	3,350	6.20	7,040
2.70	770	3.70	1,950	4.70	3,520	6.40	7,730
2.80	860	3.80	2,090	4.80	3,700	6.60	8,500
2.90	960	3.90	2,230	4.90	3,880	6.80	9,300
3.00	1,070	4.00	2,380	5.00	4,070	7.00	10,170

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1906, and is well defined between gage heights 2.7 feet and 4.6 feet.

Monthly discharge of Escanaba River near Escanaba, Mich., for 1906.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
April (9–30)	9,720	2,380	5,170	6.46	5.29
May	3,180	1,180	1,870	2.34	2.70
June	2,530	1,070	1,750	2.19	2.44
July	1,550	320	879	1.10	1.27
August	600	320	411	.514	.59
September	1,180	320	714	.892	1.00
October	680	385	485	.606	.70
November	1,300	770	1,000	1.25	1.40
December (1–22)	1,420	860	964	1.20	.98

NOTE.—Values are rated as follows: May and June, excellent; remainder of the period, good.

MENOMINEE RIVER BASIN.

MENOMINEE RIVER NEAR IRON MOUNTAIN, MICH.

This station was established September 4, 1902. It is located at the Homestead highway bridge, 3.5 miles south of Iron Mountain, Mich. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 14, where are given also references to publications that contain data for previous years.

Discharge measurements of Menominee River near Iron Mountain, Mich., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 18	Horton and Brennan	244	3,210	11.51	10,900
April 18	do	244	3,250	11.67	11,200
June 8[a]	M. S. Brennan	238	2,960	10.45	8,750
June 9[a]	do	238	2,820	9.92	8,030

[a] Discharge slightly affected by run of logs.

Daily gage height, in feet, of Menominee River near Iron Mountain, Mich., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	2.48	4.55	3.0	3.8	8.5	8.8	9.2	2.7	2.6	2.9
2	2.42	4.1	3.0	3.9	9.0	6.8	8.3	2.9	3.6	2.25
3	2.4	4.0	2.95	4.3	9.4	7.0	7.5	2.65	3.1	2.3
4	2.5	4.05	2.9	4.75	9.5	5.1	8.6	2.4	2.8	2.4
5	2.5	4.0	2.8	4.9	9.8	7.0	6.4	2.7	2.65	2.5
6	2.6	3.9	2.82	4.92	9.1	6.0	6.2	3.75	2.5	2.45
7	2.58	3.8	2.9	5.0	8.2	8.4	4.1	4.25	2.3	2.4
8	2.5	3.75	2.82	5.05	8.5	10.7	4.0	4.0	2.4	2.5
9	2.4	3.6	2.9	5.35	7.6	11.3	3.6	3.8	2.6	2.6
10	2.4	3.55	2.9	6.1	7.3	10.3	4.75	3.5	2.1	2.55
11	2.3	3.4	3.0	7.15	7.8	8.1	4.4	3.2	2.0	2.75
12	2.4	3.4	3.05	7.9	7.1	7.7	4.3	3.3	2.4	2.65
13	2.85	3.42	3.1	8.25	7.2	6.7	3.9	2.75	4.0	2.7
14	3.45	3.4	3.0	8.9	6.1	4.6	4.1	2.4	3.8	2.75
15	3.6	3.3	3.0	10.6	6.2	3.7	4.6	2.5	3.7	2.4
16	3.6	3.25	3.0	11.05	6.5	4.6	4.3	2.6	3.9	3.25
17	3.5	3.25	2.95	11.4	6.3	2.9	4.1	4.1	3.7	4.05
18	3.35	3.20	2.9	11.7	6.7	2.4	3.8	3.8	3.4	4.15
19	3.0	3.35	3.0	13.1	6.2	2.3	3.6	3.1	3.1	5.0
20	2.7	3.4	2.95	13.7	5.3	3.3	4.2	2.9	2.9	(a)
21	2.7	3.3	2.95	14.3	5.15	4.8	3.9	2.6	2.75	.....
22	2.8	3.3	3.05	14.1	4.35	4.75	3.4	2.85	3.0	.....
23	2.75	3.25	3.05	13.2	2.3	4.3	4.2	3.2	2.9	.....
24	2.8	3.25	2.95	12.15	4.5	4.2	3.9	3.6	2.8	.....
25	3.2	3.20	2.9	11.9	4.7	3.0	3.8	3.9	2.7	.....
26	4.15	3.25	3.05	10.7	5.5	2.6	3.2	4.1	2.65	.....
27	4.85	3.2	3.3	10.1	7.0	8.35	3.8	3.8	2.8	.....
28	5.3	3.05	3.4	9.6	6.7	9.0	3.6	3.6	2.75	.....
29	5.0	.....	3.45	9.4	7.7	8.8	3.4	3.5	2.7	.....
30	4.8	.....	3.55	9.2	8.3	9.1	3.0	3.25	2.8	.....
31	4.8	.....	3.6	.....	8.9	.....	2.8	2.8	.....	.....

(a) Gage reader left.

Rating table for Menominee River near Iron Mountain, Mich., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	1,540	3.30	2,432	4.60	3,396	6.80	5,230
2.10	1,606	3.40	2,503	4.70	3,474	7.00	5,420
2.20	1,672	3.50	2,575	4.80	3,552	7.20	5,615
2.30	1,739	3.60	2,647	4.90	3,630	7.40	5,815
2.40	1,806	3.70	2,719	5.00	3,708	7.60	6,025
2.50	1,874	3.80	2,792	5.20	3,865	7.80	6,235
2.60	1,942	3.90	2,866	5.40	4,023	8.00	6,450
2.70	2,011	4.00	2,940	5.60	4,183	9.00	7,630
2.80	2,080	4.10	3,015	5.80	4,345	10.00	8,930
2.90	2,150	4.20	3,090	6.00	4,510	11.00	10,250
3.00	2,220	4.30	3,166	6.20	4,680	12.00	11,660
3.10	2,290	4.40	3,242	6.40	4,860	13.00	13,100
3.20	2,361	4.50	3,319	6.60	5,040	14.00	14,600

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1906, and is fairly well defined.

Monthly discharge of Menominee River near Iron Mountain, Mich., for 1906.

[Drainage area, 2,420 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	3,940	1,740	2,370	0.979	1.13
February	3,360	2,260	2,590	1.07	1.11
March	2,650	2,080	2,250	.930	1.07
April	15,100	2,790	8,040	3.32	3.70
May	8,670	1,740	5,610	2.32	2.68
June	10,700	1,740	5,040	2.08	2.32
July	7,890	2,080	3,500	1.45	1.67
August	3,130	1,810	2,400	.992	1.14
September	2,940	1,540	2,160	.893	1.00
October (1-19)	3,710	1,710	2,140	.884	.62

NOTE.—Values are rated as follows: January and March to October, fair. It is probable that ice conditions affected the flow during February and that the value given above is considerably in excess of the true value.

PESHTIGO RIVER BASIN.

DESCRIPTION OF BASIN.

Peshtigo River rises in the plateau region of northwestern Wisconsin at an elevation of about 1,600 feet and descends on an average about 10 feet to the mile. But few of its powers have been developed on account of this region being thinly settled. There are falls of 46 feet, 35 feet, and 25 feet at different places on the river that could easily be developed. (See Pl. III.)

PESHTIGO RIVER SURVEY.

In order to point out the power possibilities along Peshtigo River, a survey was made during 1906 from the mouth to Rat River. From the data collected on this survey sheets have been prepared showing a profile of the water surface, a plan of the river, contour along the bank, and prominent natural or artificial features.

The results of this survey have been published on separate sheets and may be had upon application to the Director of the Geological Survey.

PESHTIGO RIVER AT CRIVITZ, WIS.

This station was established April 20 and was discontinued December 12, 1906. It was located on the railroad bridge about one-fourth mile south of Crivitz post-office (or Ellis Junction railroad station).

The channel is straight for about 1,000 feet above and 300 feet below the station. Both banks are of medium height and do not overflow; all the water passes the section, being confined by the railroad embankments. The bed of the stream is gravel and is permanent. There is but one channel at all stages. The current is medium. Log jams and sunken logs affect the discharge at times.

A

B

FALLS ON PESHTIGO RIVER, WISCONSIN.

A, High Falls (40-foot fall); *B*, Caldron Falls (55-foot fall).

Discharge measurements are made from the upstream side of the bridge, to which the gage is attached.

A standard chain gage, attached to the upstream side of the bridge, was read during 1906 by Andrew Johnson; length of chain, 22.85 feet. The bench mark is the top of parapet wall of left abutment, extreme downstream end, near front face, marked with white paint; elevation, 21.52 feet. The reference point is the center of gage pulley; elevation, 22.66 feet. Elevations refer to the datum of the gage.

Discharge measurements of Peshtigo River at Crivitz, Wis., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 20	Horton and Brennan	136	897	9.88	2,520
June 8	M. S. Brennan	135	822	9.70	2,030
June 29	do	127	650	8.26	1,560

Daily gage height, in feet, of Peshtigo River at Crivitz, Wis., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	8.9	7.9	6.2	4.3	5.7	5.7	6.7	6.9
2	.....	8.4	6.8	6.0	5.6	6.1	5.4	6.3	7.0
3	.....	9.5	6.7	6.1	5.0	5.5	5.2	6.7	7.4
4	.....	7.2	6.4	6.0	4.3	6.6	4.0	6.2	6.5
5	.....	7.9	6.7	8.5	5.3	6.6	5.4	5.7	6.2
6	.....	8.4	7.9	7.1	5.8	6.2	5.3	5.9	6.3
7	.....	6.6	8.5	6.8	5.8	6.2	5.4	5.9	6.5
8	.....	7.3	8.4	6.6	6.1	5.6	5.4	5.9	6.2
9	.....	8.2	9.7	6.8	5.9	5.6	5.2	5.8	6.0
10	.....	6.4	9.8	6.5	5.8	4.0	5.7	5.7	6.1
11	.....	7.1	7.4	6.1	5.7	5.5	5.3	5.9	5.8
12	.....	5.9	6.9	6.6	5.9	5.8	5.4	6.0	6.2
13	.....	6.7	7.7	6.2	5.5	5.7	5.6	5.9	.....
14	.....	6.5	7.3	6.0	6.4	5.7	5.4	6.0	.....
15	.....	7.7	8.4	6.6	5.0	5.4	5.6	6.0	.....
16	.....	6.5	8.3	6.5	5.5	5.5	5.3	5.9	.....
17	.....	6.5	6.2	6.8	5.2	5.8	5.4	5.9	.....
18	.....	6.0	6.1	6.4	5.3	5.9	5.3	6.1	.....
19	.....	6.7	6.3	6.5	5.3	6.5	5.4	5.7	.....
20	9.8	6.2	7.5	6.1	5.6	6.0	5.6	5.7	.....
21	10.4	6.5	7.5	6.6	5.3	5.8	6.6	5.8	.....
22	10.7	6.7	8.5	6.5	5.7	5.8	6.5	6.0	.....
23	10.6	6.6	8.4	5.8	5.6	5.7	6.6	5.9	.....
24	10.5	6.5	8.5	5.3	5.4	5.7	6.7	5.8	.....
25	9.9	7.1	8.5	5.4	6.2	5.9	6.8	5.8	.....
26	9.3	6.6	.....	5.7	5.2	5.7	6.9	7.0	.....
27	8.5	8.4	.....	5.7	6.1	5.9	7.5	6.8	.....
28	8.6	8.7	.....	5.7	6.0	6.4	7.3	7.2	.....
29	8.5	7.4	6.9	5.8	6.8	6.0	7.2	6.8	.....
30	8.1	7.7	7.0	5.6	6.1	5.7	6.8	6.9	.....
31	.....	7.9	.....	5.3	6.0	.....	6.7	.....	.....

PESHTIGO RIVER AT HERMAN'S FARM, NEAR CRIVITZ, WIS.

This station was established September 7, 1906, under the direction of D. W. Mead. It is located at Herman's farm, 4½ miles west of Crivitz, Wis., in the northwest quarter of sec. 26, T. 32 N., R. 19 E.

The channel is straight for about 800 feet above the station and for 300 feet below. The banks do not overflow. The bottom of the

river is gravel and permanent. There is one channel at all stages. The current is swift.

Discharge measurements are made from a boat which is held in position by means of a rope stretched across the river.

The gage, which is read daily by Rose Herman, consists of two sections. The bench mark is a copper nail in top of a pine stump 50 feet from the water's edge and about 50 feet southeast of the gage; elevation, 731.70 feet above sea level and 19.82 feet above the datum of the gage.

Discharge measurements of Peshtigo River at Herman's farm, near Crivitz, Wis., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 7	V. H. Reineking	128	436	3.40	657
October 29	do	130	463	4.20	1,020
November 16	do	125	380	3.20	562

Daily gage height, in feet, of Peshtigo River at Herman's farm, near Crivitz, Wis., for 1906.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	3.0	3.7	4.2	17	3.4	3.0	3.4	3.3
2	.....	2.95	3.75	4.0	18	3.45	3.05	3.5	3.3
3	.....	2.3	3.5	3.9	19	3.5	3.3	3.5	3.35
4	.....	3.25	3.4	3.9	20	3.4	3.5	3.45	3.4
5	.....	3.0	3.4	3.8	21	3.4	3.7	3.5	3.2
6	.....	3.0	3.35	3.6	22	3.4	3.8	3.3	3.2
7	3.4	2.95	3.35	3.6	23	3.45	3.8	3.3	3.25
8	3.2	3.0	3.4	3.5	24	3.4	3.9	3.35	3.15
9	3.0	3.0	3.4	3.6	25	3.4	4.0	3.4	3.1
10	3.0	3.05	3.5	3.55	26	3.4	4.1	3.8	3.1
11	3.0	2.8	3.5	3.5	27	3.0	4.2	4.0	3.05
12	3.15	3.2	3.45	3.3	28	3.7	4.15	4.2	3.15
13	3.2	3.05	3.4	3.35	29	3.35	4.2	4.3	3.1
14	3.1	3.0	3.3	3.3	30	3.15	4.0	4.25	3.05
15	3.1	3.0	3.25	3.3	31	.....	3.9	.....	3.1
16	3.3	3.0	3.2	3.3					

Rating table for Peshtigo River at Herman's farm, near Crivitz, Wis., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.30	280	2.90	455	3.40	645	3.90	870
2.40	305	3.00	490	3.50	690	4.00	920
2.50	330	3.10	525	3.60	735	4.10	970
2.60	360	3.20	565	3.70	780	4.20	1,020
2.70	390	3.30	605	3.80	825	4.30	1,070
2.80	420						

NOTE.—The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1906, and is well defined between gage heights 3.2 feet and 4.2 feet.

Monthly discharge of Peshtigo River at Herman's farm, near Crivitz, Wis., for 1906.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
September (7–30)	780	490	601
October	1,020	280	646
November	1,070	565	710
December	1,020	508	653

NOTE.—Values for 1906 are good.

OCONTO RIVER BASIN.

DESCRIPTION OF BASIN.

Oconto River rises in a number of small lakes and swamps in the plateau region at an elevation of about 1,530 feet above sea level and descends 945 feet in its length of 87 miles. About two-thirds of its total fall is in the upper 35 miles of its course. At Undershell it turns abruptly and flows nearly due east, joining Lake Michigan near Oconto. The most important water powers are found in the last 33 miles of its course, in which distance the river descends 190 feet.

OCONTO RIVER AT GILLETT, WIS.

This station was established June 7, 1906. It is located at the highway bridge about 2½ miles south of Gillett, Wis.

The channel is straight for about 200 feet above and 300 feet below the station. Both banks are low but do not overflow. The bed of the stream is gravel and is permanent. The current is swift. Old pier foundations at both banks may affect the flow somewhat.

A standard chain gage, which was read during 1906 by Samuel Gilbertson and Hattie Gilbertson, is fastened to the lower side of the bridge; length of chain, 24.82 feet. The reference point is the top of downstream board guard rail 59 feet from the initial point; elevation, 17.75 feet above gage datum.

Discharge measurements of Oconto River at Gillett, Wis., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 7	M. S. Brennan	81	359	5.95	926
June 29	do	77	339	5.72	727

Daily gage height, in feet, of Oconto River at Gillett, Wis., for 1906.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		5.4	4.75	5.15	5.1	6.05	6.7
2		5.5	4.7	5.15	5.4	6.0	6.7
3		5.7	4.75	5.7	5.2	5.9	6.6
4		6.15	4.75	5.7	5.2	5.8	6.15
5		5.75	4.2	5.5	4.9	5.8	6.95
6		6.0	4.25	5.6	5.1	5.85	5.6
7	5.95	6.0	4.85	5.6	5.4	5.7	6.1
8	6.0	5.8	4.9	5.0	5.4	5.8	7.25
9	6.15	5.75	4.8	5.2	5.1	5.8	7.5
10	6.1	5.6	5.1	5.25	5.2	5.7	7.85
11	5.95	5.6	5.4	5.3	5.0	4.6	8.3
12	5.9	5.6	5.7	5.25	5.3	5.7	9.1
13	6.2	5.5	5.3	5.2	6.15	5.4	7.8
14	6.15	5.1	5.3	5.65	4.3	5.7	7.4
15	5.6	5.2	5.3	4.9	5.35	5.5	7.35

Daily gage height, in feet, of Oconto River at Gillett, Wis., for 1906—Continued.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	5.65	5.2	5.4	6.15	5.3	5.5	6.8
17	5.6	5.8	5.3	5.8	5.3	5.95	7.7
18	5.6	5.0	4.8	5.8	5.3	5.9	8.1
19	5.0	4.95	4.5	5.9	5.8	6.2	9.0
20	5.4	5.0	5.2	6.0	6.0	6.2	9.1
21	5.7	5.0	5.2	6.0	6.1	6.35	(a)
22	6.0	5.5	5.2	5.1	6.0	6.3	.....
23	6.0	5.0	5.9	5.3	6.2	6.25	.....
24	6.2	4.9	5.6	5.5	6.15	6.15	.....
25	5.85	4.85	5.8	5.5	5.9	5.7	.....
26	5.75	4.8	6.0	5.5	6.1	7.05	.....
27	5.65	4.75	6.3	5.5	6.4	7.3	.....
28	5.75	4.75	6.2	5.4	6.4	7.35	.....
29	5.75	4.4	6.1	5.05	6.7	7.3	.....
31	5.65	4.7	5.9	5.0	6.3	7.2	.....
31	.....	4.7	5.6	.....	6.1	.....	.....

(a) Frozen.

OCONTO RIVER AT STILES, WIS.

This station was established April 20, 1906, but was discontinued June 6, 1906, as the dam immediately above the station seriously modified the flow.

Discharge measurements of Oconto River at Stiles, Wis., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 20	Horton and Brennan	119	517	4.74	2,510
June 6	M. S. Brennan	120	250	2.71	988

Daily gage height, in feet, of Oconto River at Stiles, Wis., for 1906.

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1	.....	4.0	3.0	17	.....	3.8	.....
2	.....	3.8	2.4	18	.....	4.0	.....
3	.....	3.6	3.2	19	.....	4.4	.....
4	.....	3.8	2.5	20	4.9	2.6	.....
5	.....	3.3	2.7	21	4.8	4.0	.....
6	.....	4.5	2.8	22	4.7	4.1	.....
7	.....	2.8	.....	23	4.4	4.0	.....
8	.....	4.5	.....	24	4.6	4.1	.....
9	.....	4.2	.....	25	4.6	3.3	.....
10	.....	4.2	.....	26	4.8	3.7	.....
11	.....	4.1	.....	27	4.6	2.8	.....
12	.....	4.4	.....	28	4.3	3.3	.....
13	.....	4.7	.....	29	3.8	2.3	.....
14	.....	3.4	.....	30	3.8	3.1	.....
15	.....	4.4	.....	31	.....	3.3	.....
16	.....	4.2	.....				

WOLF RIVER BASIN.

DESCRIPTION OF BASIN.

Wolf River rises in a number of small lakes 25 miles south of the northern boundary of Wisconsin and flows in a general southerly direction, entering upper Fox River at a point about 10 miles west

of Lake Winnebago. In the upper half of its course the descent of Wolf River is very rapid. At the Chicago and Northwestern Railroad crossing near Lenox it has an elevation of 1,562 feet above sea level, and between this point and Shawano, 80 miles, the river falls practically 10 feet per mile. Shawano is the head of navigation; below this point the river is very sluggish, with no opportunities for water power.

WOLF RIVER AT DARROW'S BRIDGE, NEAR SHAWANO, WIS.

A station was established April 21, 1906, at Darrow's bridge, about 2 miles south of Shawano, and was discontinued June 6, 1906, as the dam above modified the flow.

A measurement was made April 21, 1906, by Horton and Brennan, with the following results:

Width, 188 feet; area, 1,350 square feet; gage height, 5.87 feet; discharge, 3,890 second-feet.

Daily gage height, in feet, of Wolf River at Darrow's bridge, near Shawano, Wis., for 1906.

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1		4.7	4.8	17		4.8	
2		4.7	4.3	18		4.1	
3		4.5		19		4.1	
4		4.0	3.8	20			
5		4.8		21	6.1	4.2	
6				22		3.6	
7		4.6		23	5.4	3.9	
8		4.7		24	5.3	3.8	
9		4.3		25	5.0	4.2	
10		4.6		26	4.7	4.2	
11		3.5		27	4.7		
12		4.2		28	4.6	3.6	
13				29		5.2	
14		4.8		30	4.5	5.0	
15		4.8		31		4.3	
16		4.7					

WOLF RIVER AT WHITE HOUSE BRIDGE, NEAR SHAWANO, WIS.

This station was established June 6, 1906. It is located at the "White House" highway bridge, about 3½ miles north of Shawano, Wis.

The channel is straight for about 200 feet above and 500 feet below the station. Both banks are of medium height and do not overflow. The bed of the stream is gravel and is permanent. There is one channel at all stages. The current is medium swift. This station may be affected by back water from the dam about 4 miles below.

A standard chain gage, which is read daily by Albert Utke, is fastened to the guard rail on the upstream side of the bridge; length of chain, 16.25 feet. The reference point is the center of gage pulley; elevation, 16.07 feet above gage datum.

Discharge measurements of Wolf River near Shawano, Wis., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 6	M. S. Brennan	136	767	6.90	1,970
June 30	do	132	629	5.96	590

Daily gage height, in feet, of Wolf River near Shawano, Wis., for 1906.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	6.5	6.5	5.8	6.8	7.7
2	.....	6.8	6.3	.....	5.8	6.7	(a)
3	.....	8.2	6.4	6.5	5.9	6.6	.....
4	.....	7.6	6.2	6.6	6.0	.....	.....
5	6.9	7.6	.....	6.4	6.1	6.2	.....
6	7.4	7.4	6.2	6.2	6.0	6.4	.....
7	7.7	7.3	6.2	6.1	.....	6.8	.....
8	7.9	.....	6.0	5.9	6.3	6.5	.....
9	7.7	7.1	5.9	.....	6.1	6.1	.....
10	7.7	6.4	6.0	6.0	6.1	6.4	.....
11	7.1	6.5	6.7	6.4	6.4	.....	.....
12	6.9	6.4	.....	6.4	6.4	6.2	.....
13	7.0	6.8	6.2	6.2	6.0	5.9	.....
14	6.5	6.9	6.2	6.1	.....	6.6	.....
15	6.8	.....	6.0	6.3	6.1	6.3	.....
16	6.6	6.5	6.0	.....	6.1	6.3	.....
17	6.6	6.3	6.5	7.0	6.0	6.6	.....
18	6.5	6.0	6.3.	6.6	6.3	.....	.....
19	6.7	6.2	.....	6.6	6.3	6.7	.....
20	6.5	5.8	6.0	6.4	6.9	7.2	.....
21	6.9	6.3	5.9	6.3	.....	7.0	.....
22	7.2	.....	6.0	6.4	6.5	7.3	.....
23	6.8	6.4	6.3	.....	6.3	7.3	.....
24	.....	6.1	6.2	6.1	6.6	7.2	.....
25	6.0	5.7	6.0	6.2	6.9	.....	.....
26	6.7	6.1	.....	6.1	6.7	8.1	.....
27	6.6	6.2	6.7	6.0	6.7	8.1	.....
28	6.5	6.2	6.4	5.9	.....	7.4	.....
29	6.4	.....	7.2	5.8	6.7	7.6	.....
30	5.8	5.8	6.2	.....	6.5	7.1	.....
31	.....	6.0	5.8	.....	6.6	.....	.....

(a) Frozen.

ST. JOSEPH RIVER BASIN.

DESCRIPTION OF BASIN.

St. Joseph River rises at Bunday Hills, in northern Hillsdale County, Mich., flows southwestward into Indiana, turns northward at South Bend, recrosses the State line near Bertrand, and debouches into Lake Michigan at St. Joseph. The total area drained is approximately 4,586 square miles, of which 2,916 square miles are in Michigan and 1,670 square miles are in Indiana. The drainage basin contains more than 400 small lakes, varying in surface area from one-eighth of a square mile to 6 square miles. Of these, approximately 100 are in Indiana and 300 in Michigan. No storage is developed on the stream.

Elkhart River, one of the principal Indiana tributaries of the St. Joseph, drains an area of about 500 square miles, which contains large lakes and extended swamps, the principal fall of the stream occurring in its passage from marsh to marsh.

ST. JOSEPH RIVER AT MENDON, MICH.

This station is located at the Marantette Bridge, near Mendon, Mich.

Daily gage heights were obtained during 1906, but are not published, owing to the following sources of errors in any estimates of flow which might be based on them: (1) Inaccuracy of discharge measurements caused by the poor natural conditions of flow; (2) backwater from dam below the station; (3) the growth of aquatic plants in the channel, which changes the relation of gage height to discharge during the summer; (4) occasional backwater from Portage Creek, which enters the St. Joseph between the gage and the measuring section and complicates the problem somewhat. This creek flows parallel to and about 1 mile distant from the St. Joseph at Mendon and was at one time diverted across the divide, affording water power with a fall of 20 feet, but this diversion has been discontinued.

A measurement was made April 19, 1906, by D. F. Mott, with the following results:

Width, 100 feet; area, 589 square feet; gage height, 228 feet; discharge, 1,590 second-feet.

ST. JOSEPH RIVER NEAR BUCHANAN, MICH.

This station was established April 1, 1901. It is located at the dam of the South Bend Electric Company, 1 mile below the village of Buchanan. The conditions at this station are described in Water-Supply Paper No. 170, page 20, where are given also references to publications that contain data for previous years.

Daily discharge, in second-feet, of St. Joseph River near Buchanan, Mich., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.	3,320	6,042	3,559	4,983	3,416	2,899	1,758	1,644	1,200	684	1,862	6,481
2.	3,303	5,004	3,742	5,288	3,544	2,826	2,407	1,969	1,391	1,053	1,776	3,521
3.	3,377	4,108	4,508	4,798	3,802	2,399	2,326	1,841	2,187	1,327	1,484	3,810
4.	3,394	3,615	5,699	4,505	2,183	2,774	1,895	1,734	1,934	1,558	946	3,202
5.	3,637	3,897	6,069	4,194	2,590	2,214	2,485	1,286	1,904	1,753	1,849	2,460
6.	3,270	3,196	5,581	4,108	3,126	2,745	2,127	1,834	1,807	1,648	1,838	3,887
7.	2,542	2,888	5,300	4,137	3,344	2,756	2,077	1,806	2,145	1,218	1,606	5,811
8.	3,521	3,245	5,145	4,060	3,077	2,574	1,924	1,966	1,787	1,674	1,567	5,978
9.	3,706	4,058	5,073	4,371	2,986	3,791	2,252	2,229	1,056	2,065	1,924	5,023
10.	3,204	3,656	4,841	4,722	3,014	4,542	1,917	2,705	1,464	1,338	1,846	5,558
11.	2,846	3,054	4,321	4,804	2,897	5,909	1,894	4,542	1,520	1,948	839	5,685
12.	2,744	3,710	4,764	4,774	2,762	5,868	2,129	2,794	1,810	1,661	1,482	5,530
13.	2,701	3,823	4,420	4,520	2,271	5,525	2,012	2,835	1,556	1,595	1,773	5,503
14	2,515	3,603	4,191	4,739	2,913	5,535	2,133	2,462	1,868	1,079	1,781	5,044
15.	2,840	3,824	4,036	5,161	2,929	4,826	1,712	3,806	1,868	935	1,708	5,006

Daily discharge, in second-feet, of St. Joseph River near Buchanan, Mich., for 1906— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	3,268	3,403	3,899	6,133	3,095	4,696	2,180	1,437	1,324	1,237	1,671	4,40
17	2,831	2,914	3,773	5,752	3,406	3,621	1,772	1,838	1,014	1,601	1,849	5,22
18	2,929	2,820	3,350	5,635	3,513	4,118	1,537	1,754	1,719	1,537	960	4,23
19	2,941	3,630	4,033	5,182	3,499	3,646	1,539	1,650	2,028	1,373	1,820	4,39
20	3,100	3,387	3,643	4,978	3,572	3,442	1,316	2,125	1,589	1,518	1,821	3,87
21	3,157	3,290	3,481	4,630	3,695	3,202	1,624	1,810	1,638	1,175	2,069	3,51
22	5,473	3,529	3,294	4,101	3,266	3,044	775	1,907	1,398	1,050	2,907	3,64
23	8,461	3,568	3,168	4,798	2,880	2,804	1,722	1,657	573	1,777	2,604	3,05
24	8,648	3,843	3,156	3,915	3,104	2,471	1,511	1,699	1,032	1,729	4,032	2,76
25	7,617	3,261	2,853	3,347	2,753	3,111	1,627	1,521	1,332	1,646	4,157	2,16
26	7,179	4,418	3,781	3,672	2,588	2,821	1,512	1,195	1,122	1,559	4,821	2,64
27	7,501	4,167	4,169	4,074	2,542	2,490	1,323	2,204	1,325	1,391	4,656	2,97
28	6,856	3,773	5,718	3,822	3,145	2,537	1,348	1,929	989	1,100	4,599	3,24
29	6,442	.....	5,528	3,500	3,145	2,303	930	1,933	1,639	1,611	4,516	3,06
30	6,618	.....	5,501	3,911	2,987	2,282	1,906	1,258	756	1,781	4,210	3,42
31	6,382	.....	5,568	.....	2,949	.....	1,631	1,479	.....	1,824	.....	3,98

Monthly discharge of St. Joseph River near Buchanan, Mich., for 1906.

[Drainage area, 3,940 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	8,650	2,520	4,400	1.12	1.2
February	6,040	2,820	3,700	.939	.9
March	6,070	2,850	4,390	1.11	1.2
April	6,130	3,350	4,550	1.15	1.2
May	3,800	2,180	3,060	.777	.9
June	5,910	2,210	3,460	.878	.9
July	2,480	775	1,780	.452	.5
August	4,540	1,200	2,030	.515	.5
September	2,190	573	1,500	.381	.4
October	2,060	684	1,470	.373	.4
November	4,820	839	2,370	.602	.6
December	6,480	2,160	4,170	1.06	1.2
The year	8,650	573	3,070	.780	10.5

KALAMAZOO RIVER BASIN.

DESCRIPTION OF BASIN.

Kalamazoo River rises in southwestern Jackson County, Mich. flows in a general northwesterly direction, and enters Lake Michigan at Saugatuck. Its length is about 100 miles.

Owing to its steady regimen the Kalamazoo is of great value for water power. Within the past five years three dams and power plants have been constructed to generate electricity for electric traction. An additional plant for this purpose is now under construction at Ceresco. Water power is also used for general manufacturing purposes at Allegan, Battle Creek, Albion, and other points.

KALAMAZOO RIVER NEAR ALLEGAN, MICH.

This station was established April 4, 1901. It is located at the dam of the Commonwealth Power Company, in Trowbridge Township, 6 miles upstream by the river from Allegan. The conditions at this station and the bench marks are described in Water-Supply Paper No. 171, page 22, where are given also references to publications that contain data for previous years.

Daily discharge, in second-feet, of Kalamazoo River near Allegan, Mich., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,112	1,685	1,467	2,821	1,268	1,197	003	869	641	349	812	1,251
2	1,279	1,457	1,744	2,242	1,096	1,026	1,027	477	475	306	915	983
3	1,157	1,218	2,612	2,039	1,156	1,011	1,112	852	411	876	1,045	1,274
4	1,185	984	2,381	1,898	1,342	905	903	760	829	513	904	1,129
5	1,185	1,221	2,214	1,676	1,150	1,136	1,091	632	666	446	983	864
6	1,248	1,116	2,382	1,861	1,184	1,021	1,259	1,091	713	535	804	1,431
7	899	1,167	2,195	1,817	1,062	999	964	1,011	925	581	904	1,902
8	1,176	978	2,275	1,597	1,228	1,192	881	1,028	647	705	569	1,819
9	1,034	1,045	2,061	1,562	1,089	2,533	1,154	917	379	1,052	890	1,670
10	999	785	1,810	1,669	1,234	2,767	1,189	806	547	757	818	1,635
11	783	961	1,609	1,177	971	2,638	1,001	877	622	525	407	1,904
12	602	988	1,431	1,755	1,200	2,610	859	783	648	412	1,044	1,729
13	1,105	1,189	1,590	1,805	1,064	2,729	637	1,018	563	768	983	1,525
14	899	1,592	1,400	2,151	2,033	2,924	573	1,198	687	650	1,018	1,571
15	1,125	1,221	1,406	2,283	2,311	2,378	517	993	557	859	807	1,634
16	1,336	1,185	1,551	2,038	1,983	2,111	834	961	243	545	1,097	1,545
17	1,258	1,128	1,371	2,192	1,821	1,915	954	1,061	635	537	1,321	1,351
18	1,339	1,097	1,133	2,263	2,055	1,061	866	977	533	763	.....	1,306
19	1,318	1,221	1,336	2,233	1,827	1,353	875	.....	799	461	.....	1,366
20	1,553	1,218	1,307	1,856	1,691	1,444	765	.....	714	805	732	1,034
21	2,755	1,469	1,312	1,287	1,465	1,296	793	.....	546	242	1,355	961
22	3,454	1,473	1,118	1,755	1,124	1,344	683	496	792	778	1,699	1,061
23	3,528	1,451	1,178	1,160	1,176	1,252	776	496	330	532	1,621	1,224
24	2,931	1,998	1,042	1,350	1,178	1,088	761	581	853	933	1,669	1,269
25	3,473	2,042	851	1,263	1,031	1,098	731	712	619	758	1,521	512
26	3,557	1,653	1,612	1,327	1,101	1,089	683	718	588	467	1,487	707
27	3,395	1,597	2,350	1,240	1,073	1,073	490	802	623	624	1,553	502
28	3,317	1,656	2,070	1,326	1,037	1,143	445	666	697	1,009	1,525	813
29	2,721	.....	2,247	1,073	1,131	1,085	556	616	482	1,110	1,088	988
30	2,167	.....	2,139	1,067	1,173	1,017	1,102	765	105	1,245	1,316	1,061
31	2,139	.....	2,616	.....	1,094	.....	1,112	471	.....	837	.....	1,304

Monthly discharge of Kalamazoo River near Allegan, Mich., for 1906.

[Drainage area, 1,470 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	3,560	602	1,810	1.23	1.42
February	2,040	785	1,310	.890	.93
March	2,620	851	1,740	1.18	1.36
April	2,820	1,070	1,730	1.18	1.32
May	2,310	971	1,330	.905	1.04
June	2,920	905	1,550	1.05	1.17
July	1,240	445	844	.574	.66
August (28 days)	1,200	471	808	.550	.57
September	925	105	596	.405	.45
October	1,240	242	677	.461	.53
November (28 days)	1,700	407	1,100	.748	.78
December	1,900	502	1,270	.864	1.00

REED'S SPRINGS, NEAR ALBION, MICH.

A gaging station was established at this place December 7 and 8, 1904, for the purpose of obtaining information concerning the permanence of the supply furnished to streams by the numerous springs in the moraines. It was discontinued June 30, 1906. The conditions at this station are described in Water-Supply Paper No. 171, page 24.

Gage height, in feet, and discharge, in second-feet, of Reed's springs, near Albion, Mich. for 1906.

Date.	Gage height on weir.	Discharge.	Date.	Gage height on weir.	Discharge.
	Feet.	*Sec.-feet.*		*Feet.*	*Sec.-feet.*
January 7	1.09	2.66	May 13	1.10	2.7
April 1	1.10	2.75	May 20	1.10	2.7
April 8	1.10	2.75	May 27	1.10	2.7
April 15	1.10	2.75	June 3	1.10	2.7
April 22	1.10	2.75	June 11	1.10	2.7
April 29	1.10	2.75	June 17	1.10	2.7

GRAND RIVER BASIN.

DESCRIPTION OF BASIN.

Grand River rises in the southern part of Jackson County, Mich. flows in a general northerly and northwesterly direction, and empties into Lake Michigan at Grand Haven. Its drainage area, which comprises a rich agricultural region in the south-central portion of Michigan, includes extensive swamps and marshes but comparatively few lakes. At Grand Rapids the stream passes over a limestone ledge, making a considerable fall, which has been developed for power purposes, and at Grand Ledge a similar descent occurs over sandstone.

The Grand receives a number of important tributaries, notably Flat, Thornapple, Maple, Lookingglass, and Red Cedar rivers.

GRAND RIVER AT NORTH LANSING, MICH.

This station was established March 2, 1901, and was discontinued August 4, 1906. It was located at the Seymour Street Bridge, a short distance below the North Lansing dam. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 26, where are given also references to publications that contain data for previous years.

Discharge measurements of Grand River at North Lansing, Mich., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 20	D. L. Mott	177	966	4.90	1,780
June 16	Horton and Covert	183	811	[a] 5.20	1,400

[a] Uncertain.

Daily gage height, in feet, of Grand River at North Lansing, Mich., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	3.24	4.69	3.59	5.23	2.95	3.02	2.08	2.30
2	3.13	3.75	3.43	4.57	3.02	2.80	2.33	2.55
3	2.98	3.44	6.08	4.33	3.39	2.27	1.93	2.35
4	3.02	3.22	6.82	4.53	3.27	2.52	1.98	3.05
5	3.08	4.02	6.37	3.68	2.96	2.97	2.68	.....
6	3.09	3.58	6.24	4.07	2.63	2.43	2.70	.....
7	2.55	3.42	5.42	4.17	2.95	2.38	2.52	.....
8	2.47	3.27	4.88	4.02	2.70	5.12	2.63	.....
9	2.54	3.15	4.60	4.74	2.75	9.23	2.48	.....
10	2.52	3.09	3.96	5.27	2.82	9.88	2.35	.....
11	2.56	2.42	4.18	5.43	2.91	8.57	2.08	.....
12	2.66	2.98	3.39	5.05	2.72	7.43	2.05	.....
13	2.42	2.66	3.86	4.98	2.52	6.07	2.15	.....
14	2.14	3.06	3.56	5.18	3.33	5.50	2.07	.....
15	2.96	3.44	3.32	6.58	4.23	4.60	2.10	.....
16	3.48	3.02	3.46	6.78	4.45	4.05	2.35	.....
17	3.88	2.70	3.14	6.35	3.89	3.31	2.30	.....
18	3.48	2.20	2.80	5.52	3.87	3.46	2.03	.....
19	3.54	2.66	3.20	5.52	3.28	3.33	2.08	.....
20	3.76	2.51	2.96	4.73	3.02	2.97	2.00	.....
21	5.89	3.48	2.99	4.00	2.88	3.02	2.05	.....
22	7.56	3.93	2.90	4.27	2.90	2.90	2.03	.....
23	8.92	3.79	2.66	3.42	2.55	2.63	2.33	.....
24	9.14	3.78	2.76	3.37	2.42	2.53	2.10	.....
25	8.5	3.70	2.41	3.48	2.42	2.72	2.18	.....
26	7.26	4.40	3.44	3.45	2.42	2.47	2.08	.....
27	6.42	3.94	5.10	3.20	1.82	2.40	2.15	.....
28	5.77	3.30	6.72	3.10	3.13	2.20	2.17	.....
29	5.34	.....	6.90	3.17	3.38	2.37	1.83	.....
30	5.01	.....	6.36	3.23	2.97	2.17	2.33	.....
31	4.61	.....	5.60	.....	3.07	.....	2.43	.....

Rating table for Grand River at North Lansing, Mich., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	251	3.10	761	4.40	1,420	6.40	2,730
1.90	281	3.20	807	4.50	1,475	6.60	2,900
2.00	313	3.30	854	4.60	1,530	6.80	3,080
2.10	347	3.40	902	4.70	1,585	7.00	3,260
2.20	383	3.50	950	4.80	1,640	7.20	3,445
2.30	421	3.60	999	4.90	1,700	7.40	3,635
2.40	461	3.70	1,049	5.00	1,760	7.60	3,830
2.50	502	3.80	1,099	5.20	1,880	7.80	4,030
2.60	544	3.90	1,149	5.40	2,000	8.00	4,240
2.70	586	4.00	1,200	5.60	2,130	9.00	5,370
2.80	629	4.10	1,255	5.80	2,265	10.00	6,680
2.90	672	4.20	1,310	6.00	2,405		
3.00	716	4.30	1,365	6.20	2,565		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1906, and is well defined below gage heights 5.4 feet and fairly well above gage height 5.4 feet.

Monthly discharge of Grand River at North Lansing, Mich., for 1906.

[Drainage area, 1,230 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	5,540	361	1,610	1.31	1.5
February	1,580	383	887	.721	.7
March	3,170	465	1,450	1.18	1.3
April	3,060	761	1,530	1.24	1.3
May	1,450	257	737	.599	.6
June	6,510	372	1,410	1.15	1.2
July	586	260	392	.319	.3
August (1–4)	738	421	531	.432	.0

NOTE.—Values are rated as follows: January to March and June, good; remainder of the period excellent.

GRAND RIVER AT GRAND RAPIDS, MICH.

This station was established March 12, 1901, by L. W. Anderson city engineer of Grand Rapids. It is located at the Fulton Street Bridge. The gage is read by assistants in city engineer's office.

The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 29, where are given also references to publications that contain data for previous years.

A measurement was made during 1906 at gage height 7.58 feet which indicated a discharge nearly 25 per cent in excess of the rating used for 1905. Owing to lack of data tending either to confirm or discredit this measurement, it was considered inadvisable to make estimates of flow for 1906. It is believed, however that the 1905 rating probably applies correctly for 1906.

Daily gage height, in feet, of Grand River at Grand Rapids, Mich., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.95	5.12	.....	1.85	1.32	.....	−0.08	−0.48	0.50	0.70	1.9
2	1.75	4.60	4.68	4.78	1.88	1.22	0.25	− .38	.....	.35	.55	.....
3	2.12	2.35	5.52	4.25	1.75	.....	.28	− .35	.....	.22	.60	1.4
4	2.30	.....	.....	3.72	1.85	.85	.....	− .35	− .45	.12	.....	1.0
5	1.55	3.35	7.05	3.35	1.80	1.18	− .10	.....	− .48	.05	.32	.6
6	1.38	4.60	7.25	3.25	.....	1.90	− .10	− .45	− .50	− .05	.28	.7
7	.....	4.72	7.15	3.22	1.85	1.28	− .15	− .35	− .58	.....	.25	1.4
8	1.50	4.68	6.68	.....	1.45	1.20	.....	− .05	− .58	− .05	.20	1.3
9	1.80	4.48	5.90	3.55	1.35	1.50	+ .05	+ .40	.....	− .02	.18	.....
10	1.68	4.20	5.15	4.50	1.30	.....	− .02	.60	− .60	.00	.18	.....
11	1.65	.....	.....	5.05	1.20	4.22	− .15	.82	− .58	− .15	.....	2.1
12	1.35	3.20	4.15	5.20	1.15	4.95	− .15	.....	− .50	− .05	.00	2.0
13	1.25	3.00	3.70	5.18	.....	4.75	− .18	.48	− .42	− .20	.00	2.0
14	.....	3.35	3.25	5.35	1.95	4.30	− .18	+ .38	− .38	.....	.00	2.3
15	1.08	3.50	3.0	.....	1.95	3.15	.....	− .02	− .40	− .20	− .10	2.3
16	2.48	3.15	2.65	6.75	2.35	2.65	− .10	− .08	.....	− .28	− .10	.....
17	2.45	3.10	2.32	6.95	2.50	.....	− .05	− .25	− .32	− .28	+ .40	3.0
18	2.20	.....	.....	7.05	2.30	1.65	− .05	− .22	− .38	− .30	.....	2.7
19	2.90	2.55	2.02	6.70	1.80	1.60	− .10	.....	− .35	− .25	.40	2.3
20	3.15	2.45	1.85	5.88	.....	1.30	− .15	− .30	− .30	− .28	.60	1.9
21	5.95	4.25	1.75	4.80	1.44	1.25	− .30	− .28	− .28	.....	.85	1.8
22	8.28	.....	1.35	.....	1.10	1.20	.....	− .32	− .22	− .28	1.70	1.6
23	9.78	4.80	1.25	3.65	.95	1.10	− .35	− .25	.....	− .25	2.55	.....
24	10.65	5.82	1.45	3.30	.80	.....	− .35	− .18	− .05	− .28	2.85	1.4
25	11.50	.....	.....	2.90	.75	.62	− .40	− .30	− .30	− .15	.....	1.3

Daily gage height, in feet, of Grand River at Grand Rapids, Mich., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	11.65	6.82	1.80	2.65	0.60	0.70	−0.40	.....	−0.30	−0.05	2.75	1.05
27	11.18	6.48	3.50	2.38	.....	.70	− .38	+0.08	− .35	+ .30	2.90	.80
28	.....	5.65	4.90	2.25	.75	.62	− .40	− .08	− .35	.....	2.55	.85
29	9.15	.....	5.55	.....	1.05	.45	.....	− .18	+ .18	.65	.....	.45
30	8.10	.....	5.88	1.80	.....	.40	− .02	− .35	.....	.85	2.15	.....
31	6.98	.....	5.80	.....	1.25	.....	− .02	− .38	.....	.80	.....	2.05

MUSKEGON RIVER BASIN.

DESCRIPTION OF BASIN.

Muskegon River drains an area 2,663 square miles in extent, lying directly north of the Grand River basin. Its headwaters rise in the north-central part of the southern peninsula of Michigan, whence it flows in a general southwesterly direction until it enters Lake Michigan near the city of Muskegon.

From the vicinity of Evart to Newaygo the Muskegon flows between high banks and has a rapid fall. Levels run for the purpose show that within a distance of 10 miles—5 miles each way from Big Rapids—there is a total fall of 104 feet, practically all of which could be economically developed, as there are favorable sites for the location of dams.

In connection with power development good opportunities exist for the conservation of flow by artificial storage. The water surface areas of the principal lakes of the watershed and of the tributary drainage which they control are given below:

Drainage and surface areas of lakes in Muskegon River watershed.

Lake.	Drainage area.	Water surface.
	Sq. miles.	*Sq. miles.*
Muskrat Lake and group	57	8.0
Clam Lakes	67	6.7
Higgins Lake	67	15.0
Houghton Lake	185	31.0
Higgins and Houghton lakes	252	46.0

In the upper portion of the watershed there is a total lake area of about 110 square miles. Formerly a lumberman's dam was maintained for the purpose of flooding logs between Higgins and Houghton lakes, but this has been washed out. A lumberman's dam, built of logs and earth, which still remains about 1 mile below the foot of Houghton Lake, raises the water level in that lake 4 feet, providing a storage of 3,350,000,000 cubic feet in round numbers.

MUSKEGON RIVER AT NEWAYGO, MICH.

This station was established in March, 1901. It is located at the dam of the Newaygo Portland Cement Company, which crosses the Muskegon in a deep valley above the village of Newaygo. The conditions at this station are described in Water-Supply Paper No. 170, page 32, where are given also references to publications that contain data for previous years.

Daily discharge, in second-feet, of Muskegon River at Newaygo, Mich., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,970	2,237	1,389	2,244	977	1,050	1,082	881	894	1,408	1,387	3,417
2	2,172	1,748	1,309	2,246	1,085	1,148	1,059	1,073	926	1,113	1,418	2,837
3	2,154	2,128	1,190	2,165	1,607	1,233	1,103	884	878	971	1,469	2,488
4	2,115	2,273	1,302	2,098	1,784	1,143	1,188	910	840	1,137	1,243	2,063
5	1,872	2,314	648	2,917	999	1,204	1,103	814	857	984	1,412	1,951
6	1,899	2,172	777	2,133	1,502	1,191	1,100	926	937	1,038	1,226	1,783
7	2,049	2,139	851	2,051	1,555	1,142	1,074	927	852	1,068	1,257	1,631
8	1,971	2,019	777	2,117	1,624	1,188	1,098	945	913	1,344	1,289	1,102
9	1,793	2,041	1,124	3,240	1,453	1,212	984	1,043	868	1,319	1,223	1,292
10	1,795	1,681	1,567	3,349	1,472	1,066	1,114	1,461	830	1,189	1,262	1,129
11	2,017	1,576	1,552	2,016	1,050	1,067	1,050	849	789	1,158	1,179	1,414
12	1,981	1,767	1,605	1,788	977	949	958	946	982	1,158	1,169	1,315
13	2,202	2,202	1,529	1,912	1,015	1,208	1,162	878	876	1,225	1,181	1,593
14	1,953	1,650	1,277	1,836	1,634	1,020	954	891	734	1,249	1,101	2,233
15	2,323	1,456	1,049	2,360	984	1,066	1,122	910	994	1,105	1,208	.....
16	3,062	2,145	1,606	2,413	1,027	1,270	1,061	1,010	990	1,120	1,204	.....
17	2,584	1,896	2,017	2,349	1,082	1,143	1,027	833	926	1,067	1,240	2,613
18	2,793	1,927	609	2,268	1,388	1,111	1,150	860	990	1,258	1,333	2,344
19	2,662	1,859	1,528	2,080	1,130	947	1,187	926	878	1,233	2,207	1,851
20	2,699	2,598	907	1,291	1,083	1,178	1,181	830	782	1,196	2,256	2,164
21	.....	2,577	1,946	1,284	1,115	1,176	1,102	963	1,365	1,286	2,151	2,172
22	.....	1,317	1,931	1,145	1,090	1,082	989	896	1,209	1,281	2,570	2,098
23	.....	1,294	1,627	1,079	958	1,147	1,062	838	1,322	1,186	3,055	1,688
24	.....	1,381	1,498	1,048	1,136	1,227	829	901	1,207	1,164	2,615	1,722
25	.....	1,652	1,525	912	1,255	1,082	1,014	846	906	1,313	2,628	1,805
26	.....	1,482	1,359	1,145	1,260	1,068	1,064	854	1,144	1,376	3,196	1,511
27	2,614	1,413	1,208	1,248	1,387	1,075	1,167	842	1,015	1,345	4,070	1,959
28	2,218	929	2,427	1,228	1,484	1,098	1,060	881	1,081	1,686	3,891	1,789
29	2,226	.....	2,374	907	1,223	1,002	1,104	812	1,191	1,835	3,648	1,909
30	2,109	.....	2,551	1,149	1,422	1,036	1,082	780	1,728	1,606	3,610	1,795
31	2,243	.....	2,722	.....	1,127	.....	1,159	926	.....	1,418	.....	1,880

NOTE.—Ice conditions January 21 to 26.

Monthly discharge of Muskegon River at Newaygo, Mich., for 1906.

[Drainage area, 2,350 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January (25 days)	3,060	1,790	2,220	0.945	0.88
February	2,600	929	1,850	.787	.82
March	2,720	609	1,480	.630	.73
April	3,550	907	1,870	.796	.89
May	1,780	958	1,250	.532	.61
June	1,270	947	1,120	.477	.53
July	1,190	829	1,080	.460	.53
August	1,460	780	914	.389	.45
September	1,730	734	997	.424	.47
October	1,840	971	1,250	.532	.61
November	4,070	1,100	1,960	.834	.93
December (29 days)	3,420	1,100	1,920	.817	.88

MANISTEE RIVER BASIN.

DESCRIPTION OF BASIN.

Manistee River is the northernmost of the group of three large rivers draining the western part of the southern peninsula of Michigan. It has its source in southeastern Antrim County, flows in a general southwesterly direction, and enters Lake Michigan at the city of Manistee, an important lumber center. The harbor at the mouth of the river is excellent. The fall is gradual and no important utilization of the water power has been made, the principal use of the stream being for rafting logs.

MANISTEE RIVER NEAR SHERMAN, MICH.

This station was established July 10, 1903, at North Bridge, near Sherman. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 34, where are given also references to publications that contain data for previous years.

A measurement was made June 30, 1906, by Horton and Covert, with the following results:

Width, 68 feet; area, 409 square feet; gage height, 2.36 feet; discharge, 988 second-feet.

Daily gage height, in feet, of Manistee River near Sherman, Mich., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.88	3.02	3.55	3.30	2.65	2.75	2.28	1.92	2.18	2.00	3.65
2	.....	2.58	2.92	3.80	3.50	2.65	2.80	2.28	1.98	2.15	2.00	3.32
3	.....	2.28	2.80	4.02	3.60	2.62	2.65	2.35	2.12	2.10	2.00	3.00
4	.....	2.35	2.80	4.35	3.80	2.60	2.45	2.30	2.15	2.02	2.00	2.72
5	.....	2.42	2.72	4.58	3.98	2.62	2.40	2.20	2.10	1.95	2.00	2.70
6	.....	2.45	2.70	4.68	3.78	2.65	2.40	2.12	2.08	1.95	2.00	2.65
7	.....	2.42	2.70	4.62	3.55	2.72	2.35	2.10	2.05	1.95	2.00	2.60
8	.....	2.32	2.68	4.60	3.50	2.72	2.30	2.10	2.00	1.95	2.00	2.60
9	.....	2.45	2.68	4.65	3.40	2.68	2.30	2.12	2.00	2.00	2.00	2.52
10	.....	4.00	2.70	4.85	3.32	2.58	2.30	2.12	1.98	2.02	2.05	2.48
11	.....	5.00	2.70	5.05	3.22	2.50	2.30	2.10	1.95	2.10	2.00	2.42
12	.....	4.68	2.68	5.15	3.18	2.42	2.30	2.10	1.92	2.08	2.00	2.52
13	.....	4.00	2.58	5.05	3.18	2.32	2.30	2.02	1.92	2.05	2.00	2.55
14	.....	3.50	2.50	5.00	3.22	2.30	2.30	2.00	1.95	2.05	2.00	2.48
15	.....	3.15	2.45	4.92	3.25	2.30	2.45	2.00	2.00	2.05	2.08	2.40
16	.....	3.02	2.45	4.90	3.22	2.30	2.80	2.00	2.00	2.05	2.10	2.38
17	.....	3.00	2.38	4.88	3.12	2.35	2.95	1.98	1.98	2.05	2.10	2.35
18	.....	3.05	2.28	4.68	3.08	2.40	3.00	1.92	1.95	2.05	2.18	2.35
19	.....	3.40	2.30	4.35	3.08	2.40	3.00	2.05	1.95	2.10	2.22	2.42
20	2.65	3.35	2.35	4.15	3.10	2.40	2.85	2.18	1.90	2.10	2.35	2.30
21	3.35	2.80	2.32	4.10	2.95	2.45	2.55	2.15	1.92	2.08	2.55	2.30
22	4.15	2.60	2.25	4.10	2.82	2.60	2.35	2.10	1.90	2.10	2.75	2.30
23	4.28	2.95	2.18	4.12	2.72	2.55	2.30	2.10	1.90	2.10	2.95	2.30
24	4.05	3.45	2.08	4.08	2.70	2.50	2.30	2.10	1.90	2.10	3.08	2.30
25	4.78	3.70	2.18	3.98	2.70	2.50	2.25	2.10	1.90	2.10	3.22	2.30
26	4.45	3.58	2.40	3.75	2.70	2.40	2.22	2.10	1.90	2.12	3.35	2.30
27	4.00	3.38	2.78	3.65	2.72	2.40	2.32	2.10	1.90	2.15	3.55	2.30
28	3.42	3.15	3.12	3.45	2.80	2.40	2.35	2.10	1.90	2.15	3.68	2.30
29	3.12	.....	3.18	3.40	2.80	2.40	2.35	2.10	2.20	2.10	3.75	2.25
30	3.02	.....	3.25	3.32	2.80	2.35	2.35	2.10	2.20	2.08	3.78	2.22
31	2.98	.....	3.45	.....	2.65	.....	2.30	2.00	.....	2.00	.....	2.32

NOTE.—On February 1 a jam of logs several miles below the station stopped the flow of slush ice, which backed up several miles above the gage and froze; this ice went out February 17.

LAKE HURON DRAINAGE.

GENERAL FEATURES.

The area tributary to Lake Huron in the United States comprises the eastern part of the southern peninsula of Michigan. South of Saginaw Bay the Lake Huron slope is very narrow and the brooks and runnels by which it is drained are only a few miles in length. The so-called Thumb of the Mitten is drained chiefly by three short, northward-flowing streams known as Willow, Pinnepog, and Pigeon rivers, which lie in a flat, marshy region. The Saginaw River system is tributary to the bay at its head, while northward from the bay are Rifle, Au Sable, and Thunder Bay rivers, streams having considerable fall, excellent ground storage, and well-sustained flow. Cheboygan River also belongs in the Lake Huron drainage.

AU SABLE RIVER BASIN.

DESCRIPTION OF BASIN.

Au Sable River rises in southern Otsego County and follows a tortuous course in a general southeasterly direction to its outlet in Lake Huron at Oscoda, Mich. Numerous small lakes, wet sand areas, and undrained hollows occur. Rock outcrops are very rare, the stream bed being usually clay or sand. The tributaries are unimportant, nearly all the rainfall being absorbed by the porous sand areas. At Bamfield, about 40 miles from the outlet, following the river, the elevation is about 850 feet above sea level, and from this point to the mouth of the stream excellent sites for water-power development occur.

AU SABLE RIVER AT BAMFIELD, MICH.

This station was established August 27, 1902. It is located at the highway bridge at Bamfield. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 38, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of Au Sable River at Bamfield, Mich., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.0	1.6	1.8	2.5	2.0	1.8	2.0	1.5	1.1	1.1	1.1	2.9
2	1.0	1.6	1.7	2.7	2.0	1.8	1.1	1.2	1.1	1.1	1.2	2.95
3	1.1	1.4	1.7	2.95	2.0	1.8	1.1	1.1	1.2	1.1	1.2	3.05
4	1.1	1.4	1.7	3.25	2.0	1.9	1.1	1.05	1.1	1.1	1.3	3.0
5	1.0	1.4	1.6	3.6	2.0	1.8	1.1	1.05	1.1	1.1	1.2	3.2
6	1.0	2.5	1.6	3.65	2.1	1.8	1.1	1.05	1.1	1.2	1.3	3.15
7	1.0	2.2	1.6	2.9	2.0	1.8	1.1	1.05	1.1	1.2	1.2	3.1
8	1.0	2.6	1.5	3.0	2.0	1.8	1.1	1.5	1.1	1.2	1.3	3.1
9	0.9	3.0	1.5	3.1	2.1	1.8	1.1	1.5	1.1	1.1	1.3	3.0
10	0.9	2.4	1.5	3.5	2.0	1.8	2.0	1.5	1.0	1.1	1.3	3.0

Daily gage height, in feet, of Au Sable River at Bamfield, Mich., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	0.9	2.4	1.4	3.9	2.0	1.8	1.9	1.5	1.0	1.1	1.2	3.1
12	0.9	2.4	1.4	3.45	1.95	1.8	1.4	1.4	1.0	1.1	1.3	3.0
13	0.9	2.4	1.3	3.45	2.05	1.7	1.4	1.4	1.0	1.1	1.2	2.9
14	0.9	2.4	1.3	3.65	2.0	1.5	1.4	1.3	1.1	1.1	1.3	2.8
15	1.0	2.3	1.2	3.65	2.0	1.5	1.9	1.3	1.0	1.1	1.3	2.8
16	1.1	2.2	1.2	3.45	2.0	1.5	1.9	1.1	1.0	1.1	1.35	2.8
17	1.1	2.0	1.2	3.0	2.1	2.3	1.9	1.1	1.0	1.2	1.55	2.8
18	1.1	2.2	1.1	3.05	1.9	2.3	2.0	1.1	1.0	1.4	1.85	2.6
19	1.0	2.6	1.1	2.5	1.9	2.1	1.5	1.1	1.0	1.5	2.5	2.5
20	1.1	2.7	1.2	2.5	1.9	2.1	1.5	1.1	1.0	1.4	2.7	2.6
21	1.3	2.7	1.2	2.7	1.9	2.0	1.5	1.3	1.0	1.3	2.75	3.0
22	1.4	2.8	1.2	2.7	1.9	1.9	1.4	1.3	1.0	1.3	2.8	3.5
23	2.4	2.8	1.2	2.65	1.9	1.9	1.2	1.2	1.0	1.3	2.7	4.1
24	2.75	2.8	1.2	2.55	1.9	1.9	1.2	1.1	1.0	1.2	2.7	4.35
25	2.2	3.0	1.4	2.45	2.0	1.95	1.1	1.2	1.0	1.3	2.6	5.0
26	2.3	2.8	1.5	2.45	1.9	2.0	1.1	1.2	1.0	1.2	2.6	5.0
27	2.0	2.0	1.8	2.0	1.9	2.0	1.1	1.4	1.0	1.2	2.55	5.0
28	1.55	1.9	1.9	2.0	1.9	2.2	1.4	1.2	1.0	1.1	2.65	4.8
29	1.6	.....	1.7	2.2	1.9	2.0	1.5	1.1	1.1	1.2	2.65	4.2
30	1.6	.....	2.0	1.9	1.9	2.0	2.2	1.1	1.2	1.0	2.8	4.1
31	1.6	.....	2.5	.....	1.9	.....	1.5	1.1	.....	1.0	.....	2.85

Rating table for Au Sable River at Bamfield, Mich., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	1,050	1.70	1,460	2.50	1,960	3.60	2,810
1.00	1,100	1.80	1,520	2.60	2,040	3.80	2,970
1.10	1,140	1.90	1,570	2.70	2,110	4.00	3,130
1.20	1,200	2.00	1,630	2.80	2,190	4.20	3,300
1.30	1,240	2.10	1,700	2.90	2,260	4.40	3,480
1.40	1,300	2.20	1,760	3.00	2,340	4.60	3,650
1.50	1,340	2.30	1,830	3.20	2,490	4.80	3,840
1.60	1,400	2.40	1,900	3.40	2,650	5.00	4,020

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1905, and is well defined below gage height 3.5 feet.

Monthly discharge of Au Sable River at Bamfield, Mich., for 1906.

[Drainage area, 1,420 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	2,150	1,050	1,270	0.894	1.03
February	2,340	1,300	1,850	1.30	1.35
March	1,960	1,140	1,350	.951	1.10
April	3,050	1,570	2,280	1.61	1.80
May	1,700	1,570	1,610	1.13	1.30
June	1,830	1,340	1,570	1.11	1.24
July	1,760	1,140	1,320	.930	1.07
August	1,340	1,120	1,210	.852	.98
September	1,200	1,100	1,120	.789	.88
October	1,340	1,100	1,180	.831	.96
November	2,190	1,140	1,580	1.11	1.24
December	4,020	1,960	2,660	1.87	2.16
The year	4,020	1,050	1,580	1.11	15.11

NOTE.—Values are rated as excellent except in February, the figures for which are probably considerably in excess of the true flow on account of ice conditions.

RIFLE RIVER BASIN.

DESCRIPTION OF BASIN.

Rifle River rises in the vicinity of Rose City, in northern Ogemaw County, flows southward and southeastward, and empties into Saginaw Bay about 5 miles below Omer, Arenac County. Its basin, covering about 385 square miles, is long and narrow, having a width of about 3 miles at the mouth of the stream. The basin contains numerous small glacial lakes, but there is no controlled storage and a very small percentage of natural water surface. Ramifying tributaries at the headwaters give the stream a relatively large volume at the entrance of West Branch, in T. 21 N., R. 3 E. The region is wild and the stream is undeveloped, but it is being exploited with a view to the transmission of electric power to Saginaw and Bay City.

RIFLE RIVER NEAR STERLING, MICH.

This station was established November 14, 1905. It is located near Sterling, at Meeker's bridge, in sec. 5, T. 19 N., R. 5 E., and is about 4 miles upstream from Omer, where a gaging station was formerly maintained. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 40.

A measurement was made June 18, 1906, by Horton and Covert, with the following results:

Width, 51 feet; area, 140 square feet; gage height, 1.70 feet; discharge, 262 second-feet.

Daily gage height, in feet, of Rifle River near Sterling, Mich., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.40	3.35	5.10	5.50	2.38	1.87	2.80	1.39	1.38	1.80	1.85	2.85
2	2.28	2.85	4.70	5.38	2.32	1.82	2.52	1.38	1.38	1.72	1.77	2.58
3	2.46	3.65	4.71	5.48	2.29	1.78	2.29	1.36	1.48	1.52	1.70	2.32
4	2.65	3.70	5.11	5.65	2.22	1.78	2.10	1.30	1.42	1.47	1.66	1.98
5	2.56	3.82	4.95	5.40	2.11	2.00	2.00	1.28	1.40	1.48	1.70	2.08
6	2.49	4.05	4.72	4.68	2.08	1.94	1.70	1.28	1.36	1.45	1.79	2.14
7	2.50	3.65	4.65	4.43	2.04	2.02	1.70	1.40	1.28	1.51	1.64	2.41
8	2.50	3.69	4.48	4.30	2.00	2.28	1.61	1.41	1.32	1.50	1.64	3.35
9	2.60	3.58	4.65	5.25	2.26	2.12	1.60	1.38	1.25	1.55	1.54	3.60
10	2.80	3.35	4.70	6.12	2.25	1.95	1.62	1.36	1.24	1.51	1.60	3.70
11	2.72	3.22	4.55	6.65	2.20	2.32	1.57	1.31	1.26	1.44	1.70	3.25
12	2.75	3.31	4.40	4.99	2.35	1.71	1.58	1.29	1.23	1.46	1.58	3.35
13	2.58	3.48	4.21	4.50	3.35	1.66	1.53	1.26	1.32	1.40	1.50	3.45
14	2.74	3.35	4.05	5.10	3.25	1.65	1.42	1.24	1.26	1.40	1.51	3.15
15	2.72	3.34	3.78	6.65	2.84	1.60	1.42	1.22	1.24	1.33	1.58	3.10
16	3.09	3.38	3.88	6.20	2.65	1.62	1.80	1.25	1.33	1.38	1.50	2.85
17	3.10	3.42	3.45	4.65	3.10	1.72	1.70	1.22	1.31	1.40	1.61	2.50
18	2.96	3.50	3.52	4.18	3.12	1.72	1.59	1.21	1.24	1.40	2.01	2.50
19	3.01	3.55	3.65	3.85	2.72	1.72	1.55	1.26	1.23	1.75	2.36	2.34
20	2.95	3.60	3.65	3.50	2.40	1.69	1.50	1.45	1.24	1.80	2.26	2.32
21	3.50	4.50	3.46	3.18	2.30	1.70	1.60	1.76	1.31	1.76	2.18	2.58
22	5.25	4.54	3.45	3.03	2.14	1.72	1.55	1.65	1.45	1.64	3.75	2.54
23	6.20	4.48	3.50	3.20	2.09	1.70	1.51	1.86	1.49	1.54	3.65	2.32
24	5.20	5.35	3.45	3.03	2.01	1.61	1.48	2.15	1.47	1.65	3.00	2.18
25	4.60	6.64	3.34	2.93	1.94	1.54	1.39	1.76	1.32	2.01	2.55	2.25

Daily gage height, in feet, of Rifle River near Sterling, Mich., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	4.32	6.65	3.90	2.74	2.08	1.56	1.30	1.78	1.27	2.05	3.48	2.42
27	4.12	5.90	5.92	2.53	2.18	2.15	1.37	2.04	1.32	2.22	5.14	2.47
28	4.08	5.44	5.84	2.44	2.15	2.65	1.50	1.80	1.27	2.40	4.14	2.36
29	3.78	.....	6.40	2.62	1.96	2.75	1.52	1.64	1.90	2.29	3.55	2.41
30	3.68	.....	6.79	2.52	1.91	2.50	1.58	1.48	2.30	2.15	3.10	2.45
31	3.58	.....	7.20	.....	1.90	.....	1.51	1.41	.....	2.00	.....	4.08

NOTE.—The following ice conditions prevailed during 1906: January 15, ice along both shores, open channel in midstream above and below gage; January 31, ice along both shores from 4 to 10 inches thick, channel open; February 15, river frozen at gage, open above and below, ice 12 inches thick; February 28, river frozen at gage, open above and below, ice 10 inches thick; March 15, river frozen at gage, small hole open above and below the section, ice 12 inches thick; March 31, ice all gone.

SAGINAW RIVER BASIN.

DESCRIPTION OF BASIN.

Three streams—Tittabawassee, Shiawassee, and Cass rivers—unite near Saginaw to form Saginaw River, the combined catchment areas receiving the drainage from a crescent-shaped region of about 6,000 square miles surrounding Saginaw Bay.

Tittabawassee River, the northernmost of the three, drains a relatively flat region. From railroad profiles it is estimated that the fall of the stream from Highwood to its mouth, a distance of about 50 miles along the river, is 140 feet.

TITTABAWASSEE RIVER AT FREELAND, MICH.

This station was established August 22, 1903, discontinued August 3, 1906, and reestablished October 28, 1906. It is located at the Freeland highway bridge, 10 miles northwest of Saginaw, in sec. 21, T. 13 N., R. 3 E., one-half mile from Freeland. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 42, where are given also references to publications that contain data for previous years.

Discharge measurements of Tittabawassee River at Freeland, Mich., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 21	D. L. Mott	238	2,030	5.58	4,420
June 19	Covert and Horton	213	927	2.08	764

Daily gage height, in feet, of Tittabawassee River at Freeland, Mich., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Oct.	Nov.	Dec.
1	3.62	7.98	13.22	8.58	3.60	3.18	2.38	1.74	.....	3.0	6.5
2	3.62	7.38	12.32	7.80	3.52	2.90	2.00	1.78	.....	2.8	6.25
3	3.58	6.68	11.50	7.45	3.52	2.72	1.98	2.00	.....	2.75	6.0
4	3.52	6.05	11.85	7.60	3.45	2.58	1.90	.....	.....	2.6	5.9
5	3.49	5.95	12.45	7.65	3.28	2.50	1.85	.....	.....	2.6	5.15

Daily gage height, in feet, of Tittabawassee River at Freeland, Mich., in 1906—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Oct.	Nov.	Dec.
6	3.42	5.82	12.20	7.48	3.12	2.52	1.90	.....	.....	2.55	4.85
7	3.32	5.78	11.68	6.02	3.00	2.52	1.95	.....	.....	2.5	5.2
8	3.29	5.65	11.22	6.52	2.88	2.62	1.82	.....	.....	2.45	5.6
9	3.25	5.60	11.00	7.55	3.30	2.75	1.72	.....	.....	2.4	6.0
10	3.22	5.48	10.95	10.43	3.22	2.88	1.68	.....	.....	2.3	6.2
11	3.19	5.18	10.52	10.60	3.35	2.75	1.72	.....	.....	2.2	6.45
12	3.15	4.92	10.05	9.70	3.48	2.48	1.62	.....	.....	2.2	6.8
13	3.12	4.60	9.38	8.85	3.80	2.28	1.50	.....	.....	2.15	6.95
14	3.10	4.48	8.92	8.75	5.20	2.18	1.55	.....	.....	2.1	7.2
15	3.18	4.40	8.62	10.50	5.60	2.08	1.68	.....	.....	2.1	7.55
16	3.40	4.22	8.22	11.30	5.15	2.00	1.75	.....	.....	2.0	7.8
17	3.92	4.00	7.92	10.00	4.65	2.00	1.82	.....	.....	2.0	7.75
18	4.58	4.08	7.62	8.42	4.32	2.00	1.92	.....	.....	2.2	7.0
19	4.08	4.18	7.42	7.30	3.80	1.75	1.78	.....	.....	3.8	6.4
20	4.22	4.30	7.30	6.18	3.10	2.00	1.68	.....	.....	4.05	5.3
21	5.70	6.40	7.45	5.62	2.85	2.00	1.70	.....	.....	5.3	4.95
22	10.08	8.90	7.12	5.28	2.70	2.00	1.65	.....	.....	6.8	4.5
23	13.70	9.95	6.72	5.02	2.60	2.00	1.62	.....	.....	7.1	4.1
24	14.62	10.20	6.38	4.88	2.78	2.05	1.58	.....	.....	6.45	3.9
25	14.20	11.05	6.62	4.65	2.95	2.00	1.50	.....	.....	5.2	3.75
26	13.65	14.90	7.30	4.40	3.38	2.00	1.51	.....	.....	5.85	3.5
27	13.18	14.95	10.65	4.32	3.65	2.08	1.50	.....	.....	6.9	3.45
28	12.30	13.90	13.48	3.85	3.88	2.12	1.58	.....	2.6	7.0	3.35
29	10.98	.....	12.20	3.82	4.05	2.18	1.75	.....	3.0	6.95	3.3
30	9.90	.....	9.90	3.72	3.82	2.10	1.74	.....	3.2	6.9	3.25
31	8.82	.....	9.18	.....	3.45	.....	1.70	.....	3.6	.....	6.0

NOTE.—Ice conditions probably affected the flow to some extent from January 21 to March 29. The high stages during this period were caused by ice jams. The ice passed out at noon, March 29.

LAKE ERIE DRAINAGE.

GENERAL FEATURES.

That portion of the Lake Erie drainage basin that lies within the United States, exclusive of Lakes Superior, Michigan, and Huron, covers the northern third of Ohio, a small corner of northeastern Indiana, and a similar area in southeastern Michigan. South of the lake the drainage area is narrow, the divide lying in places scarcely 50 miles back from the lake shore. To the west the width of the area is greater, and the Maumee, which enters the lake near Toledo, is the largest stream of northern Ohio. The average altitude of the watershed above Lake Erie is 500 feet, but the head of the Maumee at Fort Wayne, Ind., is only 170 feet above the lake. The surface is level or gently rolling.

The principal streams are Huron and Raisin rivers, which enter the lake from the Michigan corner, and Maumee, Black, and Cuyahoga rivers, which enter from Ohio. Of these, the Maumee, formed by the junction of St. Marys and St. Joseph rivers at Fort Wayne, Ind., is the most important.

HURON RIVER BASIN.

DESCRIPTION OF BASIN.

Huron River rises near the central part of Oakland County, Mich., flows southwestward, then southeastward, and is tributary to the west end of Lake Erie near the mouth of Detroit River. The Huron receives the drainage from an irregularly shaped basin having its greatest length parallel to and lying at a distance of 25 to 30 miles from Detroit River. This basin is connected with Lake Erie by a long, narrow valley, averaging 5 miles in width, extending from a point near Ypsilanti southeastward to Lake Erie, a distance of 28 miles. In this portion of its course a large part of the total fall of the river occurs. The conditions are thus nearly ideal for the development of water power, in that nearly the entire catchment area, all the large tributaries, and an extensive area affording lake and ground storage lie above the head of this narrow valley.

The northern portion of the main catchment area is rolling and its topography is complex. The stream flows through a series of lakes, and north of Dover the entire basin is largely composed of lakes and surrounding marshes. In the vicinity of Ann Arbor the topography is very rolling. The stream has here a broad, flat valley, bordered by abrupt hills ranging in height from 100 to 200 feet. The channel is tortuous and changeable. Numerous abandoned sections remain as bayous. Large springs issue from the morainal hills.

Below Ypsilanti the drainage basin is flat, the soil, comparatively heavy and impervious, is mostly under cultivation, and the ground-water level is controlled by numerous drain trenches.

HURON RIVER AT DEXTER, MICH.

This station was established September 1, 1904. It is located just above the highway bridge in the village of Dexter. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 44, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of Huron River at Dexter, Mich., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.40	2.52	1.60	2.08	1.40	1.42	0.90	1.25	0.85	0.90	1.20	1.40
2	1.40	2.42	1.60	2.40	1.45	1.32	.90	1.15	.85	.85	1.20	1.35
3	1.45	2.30	2.05	2.00	1.42	1.22	.90	1.10	.80	.85	1.15	1.35
4	1.60	2.12	2.15	1.95	1.40	1.20	.90	1.10	.80	.85	1.15	1.3
5	1.52	2.00	1.98	1.90	1.35	1.15	1.00	1.08	.80	.95	1.15	1.35
6	1.45	1.92	1.90	1.90	1.35	1.15	.95	1.08	.75	.95	1.15	1.80
7	1.35	1.82	1.85	1.85	1.30	1.25	.95	1.00	.75	.95	1.15	2.00
8	1.40	1.68	1.80	1.80	1.25	1.52	.95	1.00	.70	.95	1.15	1.98
9	1.40	1.58	1.78	2.10	1.40	1.75	.95	1.00	.70	1.00	1.12	1.88
10	1.40	1.48	1.75	2.20	1.35	1.80	.95	1.05	.70	1.00	1.10	1.82

Daily gage height, in feet, of Huron River at Dexter, Mich., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	1.35	1.38	1.72	2.18	1.30	1.72	0.95	1.08	0.70	1.00	1.10	1.80
12	1.35	1.35	1.70	2.10	1.30	1.62	.95	1.00	.70	1.00	1.05	1.75
13	1.30	1.35	1.70	2.08	1.30	1.52	.95	.95	.70	1.00	1.05	1.75
14	1.30	1.35	1.65	2.30	1.80	1.42	.95	.90	.65	1.00	1.05	1.78
15	1.35	1.35	1.60	2.60	2.20	1.35	.92	.90	.65	1.00	1.05	1.85
16	1.65	1.32	1.55	2.55	1.90	1.30	.90	.90	.65	.95	1.05	1.80
17	1.58	1.30	1.52	2.48	1.70	1.30	.90	.85	.65	.95	1.08	1.70
18	1.50	1.28	1.42	2.32	1.52	1.30	.85	.82	.65	.95	1.10	1.55
19	1.50	1.20	1.42	2.22	1.50	1.30	.85	.80	.65	.95	1.10	1.50
20	1.70	1.20	1.38	2.12	1.42	1.30	.80	.80	.65	.95	1.15	1.50
21	2.50	1.40	1.32	1.98	1.32	1.25	.80	.80	.65	.90	1.35	1.45
22	3.30	1.40	1.30	1.88	1.30	1.20	.80	.80	.68	.90	1.50	1.45
23	3.40	1.40	1.30	1.80	1.35	1.20	.90	.80	.70	.90	1.50	1.45
24	3.35	1.45	1.28	1.75	1.50	1.15	.88	.80	.70	.92	1.50	1.68
25	3.25	1.80	1.25	1.70	1.42	1.15	.82	.80	.68	1.00	1.50	1.58
26	3.05	1.80	1.32	1.68	1.35	1.10	.80	.85	.65	1.02	1.50	1.48
27	2.98	1.72	2.10	1.62	1.40	1.10	.75	.85	.65	1.10	1.50	1.38
28	2.92	1.65	2.48	1.58	1.85	1.05	.75	.85	.65	1.15	1.48	1.35
29	2.82	.....	2.40	1.55	1.88	1.00	1.15	.85	.75	1.15	1.45	1.35
30	2.72	.....	2.28	1.45	1.75	.95	1.48	.85	.88	1.15	1.42	1.42
31	2.62	.....	2.18	.....	1.55	.....	1.38	.80	.....	1.20	.....	2.05

HURON RIVER AT GEDDES, MICH.

A record of the depth of overflow at the dam and of the run of the water wheels in the adjacent electric plant has been maintained at Geddes by the Washtenaw Electric Company since February 1, 1904. The conditions at this station are described in Water-Supply Paper No. 170, page 45, where are given also references to publications that contain data for previous years.

Monthly discharge of Huron River at Geddes, Mich., for 1906.

[Drainage area, 757 square miles.]

Month.	Mean discharge in second-feet.	Run-off.	
		Sec.-ft. per sq. mile.	Depth in inches.
January	686	0.906	1.04
February	426	.563	.59
March	515	.680	.78
April	620	.819	.91
May	454	.600	.69
June	322	.425	.47
July	148	.196	.23
August	156	.206	.24
September	83.6	.110	.12
October	139	.184	.21
November	272	.359	.40
December	447	.591	.68
The year	356	.470	6.36

HURON RIVER AT FLATROCK, MICH.

This station was established August 6, 1904. It is located at the highway bridge below Metler's dam at Flatrock, Mich., about 8 miles above the mouth of the stream. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page

47, where are given also references to publications that contain data for previous years.

Discharge measurements of Huron River at Flatrock, Mich., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 23	D. L. Mott	100	430	3.68	944
June 15	Horton and Covert	100	270	2.22	509

Daily gage height, in feet, of Huron River at Flatrock, Mich., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.85	2.8	4.1	2.8	2.6	1.25	1.9	1.0	1.05	1.7	2.3
2		4.35	3.0	4.0	2.65	2.25	1.15	1.65	.7		1.8	2.1
3		5.65	3.0	4.1	2.7	2.05	1.0	1.35	1.05	1.1	1.85	2.05
4		6.0	4.4	3.9	2.65	1.75	1.6	1.35	.85	1.3	1.65	2.1
5		5.7	4.5	3.85	2.7	1.9	1.45	1.35	1.15	1.0	1.6	1.9
6		5.3	4.0	3.9	2.4	1.75	2.25	1.1	1.1	1.1	1.85	3.45
7		5.1	3.8	3.8	2.1	1.75	2.05	1.55	1.0	1.2	1.75	4.9
8		5.0	3.6	3.65	2.35	1.6	1.5	1.4	.85	1.3	1.65	4.8
9		4.85	3.65	3.8	2.2	3.15	1.0	1.35	.85	1.4	1.55	4.2
10		4.65	3.55	4.6	2.35	3.85	1.5	1.35	.85	1.3	1.45	3.85
11		4.05	3.5	4.55	2.45	3.35	1.4	1.4	.7	1.25	1.5	3.5
12		3.6	3.35	4.5	2.25	3.25	1.4	1.3	1.0	1.35	1.5	3.25
13		3.95	3.4	4.25	2.15	2.95	1.25	1.25	.75	1.35	1.6	3.15
14		3.6	3.15	4.2	3.25	2.65	1.25	1.5	.7	1.15	1.5	3.4
15		3.45	3.05	4.9	4.5	2.35	1.05	1.4	.8	1.15	1.5	3.75
16		3.0	2.85	5.3	4.5	2.2	1.1	1.0	.7	1.25	1.45	3.75
17		3.05	2.7	5.15	4.35	2.25	1.15	1.05	.65	1.2	1.35	3.45
18		3.0	2.65	4.65	3.6	2.05	1.25	.95	.6	1.2	1.4	3.2
19		2.8	2.45	4.25	3.0	2.35	1.15	1.0	.85	1.25	1.6	2.65
20	3.1	3.3	2.65	4.05	2.55	2.0	1.0	.95	.75	1.15	1.75	3.7
21	3.75	3.3	2.4	3.95	2.35	2.0	1.1	1.0	.8	1.1	2.35	5.15
22	5.85	3.6	2.4	3.8	2.5	1.85	.95	1.15	.65	1.05	3.0	5.65
23	6.85	3.5	2.25	3.6	2.1	1.65	1.0	1.1	.6	1.2	3.2	4.1
24	7.05	3.2	1.85	3.6	2.15	1.7	1.25	1.2	.85	1.3	3.0	4.1
25	6.45	3.0	2,15	3.3	2.3	1.3	1.2	1.4	.7	1.35	2.6	4.3
26	5.9	3.4	2.05	3.25	2.4	1.8	1.05	1.1	.65	1.35	2.7	4.2
27	5.55	3.75	3.45	3.2	2.25	1.65	1.1	1.05	.8	1.3	2.65	4.25
28	5.4	3.4	5.1	2.9	2.3	1.45	1.15	1.1	.75	1.35	2.5	4.15
29	5.3		5.0	2.85	3.3	1.25	1.35	1.3	.85	1.5	2.35	3.7
30	5.3		4.85	2.7	3.6	1.35	1.8	1.15	1.05	1.9	2.35	3.5
31	5.05		4.35		3.05		2.05	1.1		1.75		4.65

NOTE.—The flow is somewhat affected by ice during the winter months; slush ice is noted on February 3 and anchor ice on March 21.

Rating table for Huron River at Flatrock, Mich., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	141	1.90	401	3.20	722	5.00	1,261
0.70	158	2.00	424	3.30	748	5.20	1,331
0.80	176	2.10	447	3.40	774	5.40	1,403
0.90	194	2.20	471	3.50	801	5.60	1,476
1.00	213	2.30	495	3.60	828	5.80	1,550
1.10	232	2.40	519	3.70	856	6.00	1,624
1.20	252	2.50	543	3.80	884	6.20	1,699
1.30	272	2.60	568	3.90	913	6.40	1,775
1.40	293	2.70	593	4.00	942	6.60	1,852
1.50	314	2.80	618	4.20	1,002	6.80	1,930
1.60	335	2.90	644	4.40	1,064	7.00	2,010
1.70	357	3.00	670	4.60	1,128	8.00	2,416
1.80	379	3.10	696	4.80	1,194		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1906, and is well defined between gage heights 0.3 foot and 2.6 feet.

Monthly discharge of Huron River at Flatrock, Mich., for 1906.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
January (20–31)	2,030	696	1,450
February	1,620	618	967
March	1,300	390	758
April	1,370	593	938
May	1,100	447	617
June	898	262	462
July	483	204	277
August	401	204	263
September	242	141	180
October	401	213	259
November	722	282	419
December	1,490	401	859

NOTE.—Values are good.

MAUMEE RIVER BASIN.

DESCRIPTION OF BASIN.

Maumee River is formed at Fort Wayne, Ind., by the junction of St. Joseph and St. Marys rivers and flows northeastward into Lake Erie at Toledo. The chief tributaries are Auglaize and Tiffin rivers. The total drainage area is 6,723 square miles.

MAUMEE RIVER NEAR SHERWOOD, OHIO.

This station was established May 19, 1903, and was discontinued July 21, 1906. It is located at the highway bridge 2.5 miles south of Sherwood, Ohio, and 200 feet upstream from the Cincinnati Northern Railroad bridge. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 50, where are given also references to publications that contain data for previous years.

Discharge measurements of Maumee River near Sherwood, Ohio, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec. ft.*
February 11 [a]	Brennan and Kriegsman	236	597	3.34	458
March 8	E. F. Kriegsman	248	1,060	4.57	1,920
April 5	do	266	1,540	6.51	3,360
May 12	do	242	470	2.30	482

[a] River entirely frozen over; average thickness of ice, 0.6 foot; gage height to top of ice, 3.39 feet.

Daily gage height, in feet, of Maumee River at Sherwood, Ohio, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	4.4	5.3	5.0	10.5	3.0	2.6	2.45
2	4.0	5.2	3.8	10.1	2.9	2.5	2.45
3	3.72	5.2	3.9	9.5	2.7	2.4	2.5
4	3.7	5.3	5.3	7.2	2.7	2.35	2.6
5	4.2	.....	5.8	6.5	2.6	2.3	2.6
6	4.4	.....	5.6	6.0	2.6	2.25	2.5
7	4.6	.....	5.1	5.6	2.6	2.2	2.5
8	5.0	.....	4.6	5.2	2.5	2.25	2.5
9	5.4	.....	4.2	5.2	2.4	2.4	2.5
10	5.6	.....	4.1	8.5	2.4	2.55	2.7

Daily gage height, in feet, of Maumee River at Sherwood, Ohio, for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
11	5.6	.....	4.0	7.6	2.35	2.6	3.55
12	5.6	.....	3.9	6.4	2.3	4.2	3.5
13	5.6	.....	3.8	5.8	2.25	5.2	3.3
14	5.6	.....	3.6	6.3	2.2	4.8	3.2
15	5.5	4.6	3.3	7.8	2.2	4.6	3.1
16	5.4	.....	3.2	7.2	2.15	4.4	3.0
17	5.2	.....	3.1	6.9	2.1	4.0	3.0
18	5.1	.....	3.1	6.4	2.1	3.6	3.0
19	5.3	3.5	3.0	5.9	2.5	3.35	2.95
20	6.2	.....	3.0	5.0	2.5	3.1	2.9
21	8.1	.....	2.9	4.4	2.45	3.0	2.8
22	9.0	.....	2.9	4.0	2.3	2.8	.....
23	10.7	.....	2.9	3.6	2.2	3.2	.....
24	10.1	3.2	2.8	3.3	2.15	3.0	.....
25	9.6	3.3	2.8	3.4	2.15	2.85	.....
26	9.0	3.3	2.8	4.3	2.15	2.7	.....
27	8.1	4.4	6.32	3.8	2.15	2.6	.....
28	7.3	5.3	12.8	3.4	2.15	2.55	.....
29	5.9	.....	13.0	3.3	2.2	2.5	.....
30	5.5	.....	11.6	3.2	2.3	2.5	.....
31	5.3	.....	11.2	.....	2.65	.....	.....

NOTE.—The river was frozen January 9 to 19 and February 5 to 24; ice was about 0.5 foot thick February 15 to 19.

Rating table for Maumee River near Sherwood, Ohio, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.10	370	3.40	1,120	4.70	2,000	7.00	3,770
2.20	425	3.50	1,180	4.80	2,070	7.20	3,930
2.30	480	3.60	1,240	4.90	2,140	7.40	4,090
2.40	535	3.70	1,300	5.00	2,210	7.60	4,270
2.50	590	3.80	1,370	5.20	2,350	7.80	4,450
2.60	645	3.90	1,440	5.40	2,490	8.00	4,630
2.70	700	4.00	1,510	5.60	2,650	9.00	5,530
2.80	760	4.10	1,580	5.80	2,810	10.00	6,470
2.90	820	4.20	1,650	6.00	2,970	11.00	7,470
3.00	880	4.30	1,720	6.20	3,130	12.00	8,570
3.10	940	4.40	1,790	6.40	3,290	13.00	9,680
3.20	1,000	4.50	1,860	6.60	3,450		
3.30	1,060	4.60	1,930	6.80	3,610		

NOTE.—The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1906, and the form of the 1905 curve. It is well defined below gage height 6.5 feet.

Monthly discharge of Maumee River near Sherwood, Ohio, for 1906.

[Drainage area, 2,190 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January[a]	7,170	.....	2,730	1.25	1.44
February[a]	2,420	.....	1,030	.470	.49
March	9,680	760	2,400	1.10	1.27
April	6,970	1,000	2,980	1.36	1.52
May	880	370	527	.241	.28
June	2,350	425	930	.425	.47
July (1-21)	1,210	562	787	.359	.28

[a] January and February corrected for effect of ice conditions.

NOTE.—Values are rated as follows: January and February, fair; March to July, good.

ST. JOSEPH RIVER AT FORT WAYNE, IND.

This station was established March 20, 1905, and was discontinued July 20, 1906. It was located on the first highway bridge, about 1 mile above the junction with St. Marys River. The gage was read during 1906 by S. F. Mills. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 52.

Discharge measurements of St. Joseph River at Fort Wayne, Ind., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 11 [a]	Brennan and Kriegsman	70	270	2.59	122
March 9	E. F. Kriegsman	163	448	3.40	814
April 4	do	165	549	3.84	1,020
May 10	do	154	269	2.24	222
June 29	do	152	233	2.04	145

[a] Ice along edges. The flow was diminished by about 65 per cent of the open-channel rating.

Daily gage height, in feet, of St. Joseph River at Fort Wayne, Ind., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	3.0	3.55	3.05	8.05	2.45	2.2	2.0
2	2.9	3.25	3.0	6.9	2.4	2.1	2.0
3	2.75	2.85	3.5	5.2	2.35	2.05	2.05
4	3.3	2.7	4.9	4.85	2.35	2.0	2.0
5	3.6	2.7	4.75	3.4	2.5	2.0	1.95
6	3.25	3.1	4.35	3.45	2.55	2.0	1.95
7	3.3	2.9	4.05	3.55	2.4	1.95	1.8
8	3.25	2.8	3.75	3.15	2.3	1.95	1.8
9	3.05	2.7	3.4	4.5	2.25	3.05	1.8
10	2.9	2.6	3.3	5.05	2.25	4.55	1.75
11	2.85	2.4	3.35	4.55	2.2	4.45	2.4
12	2.65	2.35	3.25	4.05	2.15	4.15	2.3
13	2.55	2.15	3.05	3.75	2.15	4.0	2.1
14	2.35	2.2	2.9	3.9	2.1	3.95	1.9
15	2.3	2.5	2.85	5.95	2.1	3.7	1.9
16	2.55	2.55	2.75	5.7	2.1	3.25	2.3
17	2.75	2.55	2.75	5.0	2.35	3.0	2.3
18	2.75	2.1	2.45	4.55	2.65	2.8	2.3
19	2.95	2.05	2.45	4.1	2.55	2.55	2.2
20	2.75	2.0	2.3	3.65	2.3	2.45	2.2
21	4.1	2.05	2.6	3.3	2.25	2.75	.....
22	7.3	2.2	2.25	3.0	2.1	2.8	.....
23	8.0	2.2	2.45	2.9	2.05	2.6	.....
24	7.95	2.3	2.4	2.75	2.05	2.35	.....
25	7.1	2.85	2.4	2.65	2.0	2.25	.....
26	6.45	3.55	3.4	3.6	2.0	2.2	.....
27	6.1	3.7	7.7	3.0	2.35	2.1	.....
28	5.2	3.25	9.15	2.9	2.75	2.05	.....
29	4.55	.....	8.55	2.75	2.5	2.05	.....
30	4.0	.....	7.9	2.55	2.35	2.1	.....
31	3.7	.....	8.65	.....	2.3	.....	.....

NOTE.—Flow affected by ice conditions during part of February.

Rating table for St. Joseph River at Fort Wayne, Ind., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	80	3.10	635	4.40	1,515	6.20	3,190
1.90	105	3.20	695	4.50	1,590	6.40	3,420
2.00	135	3.30	755	4.60	1,670	6.60	3,660
2.10	165	3.40	815	4.70	1,750	6.80	3,900
2.20	200	3.50	880	4.80	1,830	7.00	4,150
2.30	240	3.60	945	4.90	1,910	7.20	4,410
2.40	280	3.70	1,010	5.00	2,000	7.40	4,670
2.50	325	3.80	1,080	5.20	2,180	7.60	4,940
2.60	370	3.90	1,150	5.40	2,365	7.80	5,220
2.70	420	4.00	1,220	6.60	2,560	8.00	5,500
2.80	470	4.10	1,290	5.80	2,760	9.00	7.000
2.90	525	4.20	1,365	6.00	2,970	10.00	8,600
3.00	580	4.30	1,440				

NOTE.—The above table is applicable only for open-channel condition. It is based on discharge measurements made during 1905–6, and is well defined between gage heights 2 feet and 6 feet.

Monthly discharge of St. Joseph River at Fort Wayne, Ind., for 1906.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
January	5,500	240	1,430
February[a]	1,010	.....	330
March	7,240	220	1,570
April	5,580	348	1,420
May	445	135	243
June	1,630	120	490
July (1–20)	280	68	156

[a] Discharge corrected for effect of ice conditions.

NOTE.—Values are rated as follows: February, fair; remainder of period, excellent.

ST. MARYS RIVER AT FORT WAYNE, IND.

This station was established March 20, 1905, and was discontinued July 21, 1906. It was located on the Taylor Street Bridge, in Fort Wayne, about 2.5 miles above the junction of the stream with the St. Joseph. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 55.

Discharge measurements of St. Marys River at Fort Wayne, Ind., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 20	Hanna and Clapp	120	600	5.59	1,360
May 26	M. S Brennan	104	199	2.17	208
July 13	S. K. Clapp	105	254	2.51	246
August 22	M. S. Brennan	104	173	1.87	122
October 4	.....do	105	182	1.92	133
December 7	.....do	113	516	5.00	451
1906.					
March 9	E. F. Kriegsman	104	226	2.60	306
April 4	.....do	138	745	6.42	1,870
April 5	.....do	120	609	5.60	1,610
May 11	.....do	65	56	1.40	58
May 11	.....do	85	117	1.40	55
June 29	.....do	46	22	1.07	31

Daily gage height, in feet, of St. Marys River at Fort Wayne, Ind., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	3.25	2.38	2.20	11.25	1.54	1.26	1.02
2	3.50	2.53	2.25	9.95	1.50	1.28	1.02
3	3.85	2.15	2.68	8.12	1.48	1.29	1.02
4	4.10	2.05	2.67	6.42	1.45	1.30	1.20
5	4.35	1.95	2.60	5.40	1.43	1.40	1.35
6	4.05	1.94	2.57	5 08	1.40	1.45	1.49
7	3.85	1.93	2.51	4.45	1.37	1.50	1.60
8	3.40	1.90	2.45	4.49	1.35	1.80	1.63
9	3.05	1.87	2.55	7.98	1.33	1.89	1.65
10	3.00	1.85	2.53	6.05	1.32	1.90	1.72
11	2.95	1.82	2.51	4.77	1.32	1.80	1.95
12	2.80	1.80	2.48	3.96	1.32	1.72	2.90
13	2.79	1.74	2.45	3.50	1.29	1.65	2.65
14	.....	1.70	2.43	6.38	1.25	1.56	2.39
15	.....	1.68	2.35	6.28	1.22	1.40	1.90
16	.....	1.65	2.15	4.95	1.20	1.35	1.50
17	2.85	1.63	2.15	4.06	1.18	1.40	1.35
18	.....	1.60	2.45	3.55	1.17	1.45	1.32
19	.....	1.57	2.30	3.11	1.16	1.45	1.29
20	.....	1.68	2.20	2.80	1.15	1.40	1.26
21	5.37	1.75	2.10	2.52	1.15	1.35	1.24
22	7.00	1.80	2.05	2.27	1.14	1.33	.....
23	6.15	1.89	2.00	2.14	1.13	1.30	.....
24	5.40	2.02	1.82	2.01	1.12	1.24	.....
25	4.33	2.86	1.85	1.90	1.12	1.18	.....
26	3.51	2.83	2.05	1.85	1.11	1.15	.....
27	3.10	2.90	10.42	1.83	1.10	1.12	.....
28	2.70	3.22	10.92	1.80	1.10	1.10	.....
29	2.51	.....	10.20	1.72	1.09	1.06	.....
30	2.42	.....	10.20	1.57	1.09	1.02	.....
31	2.33	.....	11.60	.....	1.22	.....	.....

NOTE.—The river was frozen January 14 to 20, the ice reaching a thickness of 4 inches. The river was clear of ice on January 21, and was probably not obstructed after that date, except on February 28 and March 18 to 20, on which dates there was backwater caused by an ice gorge below.

Rating table for St. Marys River at Fort Wayne, Ind., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	23	2.30	210	3.60	586	5.80	1,530
1.10	30	2.40	234	3.70	620	6.00	1,630
1.20	38	2.50	260	3.80	655	6.20	1,730
1.30	47	2.60	286	3.90	690	6.40	1,850
1.40	57	2.70	314	4.00	725	6.60	1,970
1.50	69	2.80	342	4.20	800	6.80	2,090
1.60	82	2.90	370	4.40	880	7.00	2,210
1.70	96	3.00	400	4.60	960	8.00	2,810
1.80	111	3.10	430	4.80	1,040	9.00	3,510
1.90	127	3.20	460	5.00	1,130	10.00	4,210
2.00	145	3.30	490	5.20	1,230	11.00	5,010
2.10	165	3.40	522	5.40	1,330	12.00	5,810
2.20	187	3.50	554	5.60	1,430		

NOTE.—The above table is applicable only for open-channel conditions. It is based on twelve discharge measurements made during 1905–6. It is well defined between gage heights 1.0 foot and 2.7 feet, and is fairly well defined above 2.7 feet.

Monthly discharge of St. Marys River at Fort Wayne, Ind., for 1905–6.

[Drainage area, 740 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
May 26–31 [a]	234	117	174	0.235	0.05
June	2,660	69	309	.418	.47
July	325	27	90.9	.123	.14
August	300	26	98.1	.133	.15
September	880	26	270	.365	.41
October	165	50	81.9	.111	.13
November	992	47	145	.196	.22
December [b]	760	90	386	.522	.60
1906.					
January [c]	2,210		586	.792	.91
February [c]	370	78	157	.212	.22
March [c]	5,490	114	945	1.28	1.48
April	5,210	78	1,120	1.51	1.68
May	74	29	43.6	.059	.07
June	127	24	61.1	.083	.09
July 1–21	370	24	97.7	.132	.10

[a] Owing to errors in chain length, no reliable estimates of discharge can be made prior to May 26, 1905.
[b] Backwater caused by ice gorge below gage December 4 to 8 and 13 to 16, 1905; discharge estimated.
[c] During ice periods discharge estimated.
NOTE.—Values for 1905 and 1906 are good.

TIFFIN RIVER NEAR DEFIANCE, OHIO.

This station was established May 19, 1903, and was discontinued March 31, 1906. It was located at the highway bridge on the new road to Evansport, one-half mile above the settlement of Brunnesburg and 3 miles by river above the center of the city of Defiance. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 56, where are given also references to publications that contain data for previous years.

A measurement was made March 8, 1906, by E. F. Kriegsman, with the following results:

Width, 107 feet; area, 434 square feet; gage height, 4.69 feet; discharge, 507 second-feet.

Daily gage height, in feet, of Tiffin River near Defiance, Ohio, for 1906.

Day.	Feb.	Mar.	Day.	Feb.	Mar.	Day.	Feb.	Mar.
1		4.4	12		4.4	23		3.3
2		3.9	13		4.2	24		3.4
3		4.65	14		3.9	25		[a] 3.4
4		[a] 4.9	15		3.8	26	4.4	3.4
5		5.1	16		3.7	27	4.5	8.2
6		5.7	17		3.6	28	4.7	10.6
7		5.2	18		[a] 3.4	29		10.4
8		4.8	19		3.2	30		9.7
9		4.6	20		3.1	31		9.1
10		4.75	21		3.6			
11		[a] 4.6	22		3.4			

[a] Gage heights interpolated.

Rating table for Tiffin River near Defiance, Ohio, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.10	159	3.80	309	4.50	499	7.00	1,320
3.20	178	3.90	334	4.60	528	8.00	1,690
3.30	198	4.00	360	4.70	558	9.00	2,090
3.40	219	4.10	387	4.80	588	10.00	2,500
3.50	240	4.20	414	4.90	619	11.00	2,930
3.60	262	4.30	442	5.00	650		
3.70	285	4.40	470	6.00	970		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1906, and is well defined below gage height 5.7 feet.

Monthly discharge of Tiffin River near Defiance, Ohio, for 1906.

[Drainage area, 748 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
February (26–28)	558	470	509	0.680	0.08
March	2,760	159	714	.955	1.10

NOTE.—Values for 1906 are excellent.

BLACK RIVER BASIN.

BLACK RIVER NEAR ELYRIA, OHIO.

This station was established May 23, 1903, the object being to furnish data for the water supply of nearby towns, and was discontinued July 21, 1906. It was located at the North Ridge Road Bridge, about 5 miles from the center of the city of Elyria. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 59, where are given also references to publications that contain data for previous years.

Discharge measurements of Black River near Elyria, Ohio, in 1904–1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 9	R. W. Pratt	79	188	3.55	691
May 17	do	63	66	1.70	68
June 22	do	35	20	1.15	12
Do	do	35	19	1.15	11.4
July 6	do	80	246	4.11	894
July 28	do	41	24	1.28	25
August 11	do	34	14	1.05	8.2
October 4	do	35	17	1.14	10.5
November 4	do	33	13	0.96	2.8
1905.					
January 17 [a]	R. W. Pratt	75	119	2.80	114
February 1 [a]	do	39	41	1.75	24
May 24	M. S. Brennan	69	52	1.44	56
October 20	R. W. Pratt	55	.....	1.08	10.3
November 4	do	55	30	1.15	12
1906.					
March 7	E. F. Kriegsman	68	66	1.62	103
May 14	do	66	42	1.33	48

[a] River frozen over; measurements indicate that flow is about 25 per cent of the open-channel discharge for the same gage heights.

Daily gage height, in feet, of Black River near Elyria, Ohio, for 1905–6.

1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.4	1.1	6.0	1.7	1.8	1.45	1.1	0.9	1.1	1.0	1.2	4.3
2	2.35	1.1	4.0	1.5	1.8	1.4	1.0	.9	1.1	1.1	1.2	4.0
3	2.3	1.2	4.0	1.4	1.6	1.4	1.0	.9	1.0	1.1	1.1	3.7
4	2.15	1.2	4.0	1.4	1.5	1.35	1.1	1.0	1.0	1.0	1.1	3.4
5	2.1	1.1	4.0	1.3	1.5	1.2	1.4	1.4	1.0	1.0	1.1	3.1
6	2.4	1.1	4.0	1.3	1.4	2.5	1.4	1.5	1.05	1.1	1.1	2.8
7	2.4	1.0	4.1	1.2	1.5	2.5	1.3	1.4	1.05	1.1	1.9	2.4
8	2.2	1.0	5.0	1.2	1.4	3.5	1.35	.9	1.0	1.1	2.2	2.4
9	2.1	1.1	6.0	1.2	1.3	3.5	1.3	.9	1.0	1.05	2.1	2.3
10	1.7	1.1	5.0	1.4	1.4	3.0	1.4	1.1	1.05	.9	2.0	2.2
11	2.1	1.05	5.1	1.5	1.9	2.0	1.35	1.1	1.1	1.1	1.8	2.2
12	2.2	1.05	5.0	5.0	11.1	3.0	1.3	1.1	1.2	1.1	1.6	2.1
13	2.0	.9	5.0	4.0	8.0	2.1	1.2	1.0	1.4	1.2	1.5	2.1
14	1.9	.9	4.1	3.5	4.1	2.05	1.2	1.5	1.4	1.2	1.5	2.1
15	1.7	.9	4.0	2.2	3.0	1.1	1.1	2.5	1.3	1.1	1.4	2.0
16	2.1	.9	2.1	2.5	3.5	2.0	1.1	2.5	1.2	1.1	1.4	1.9
17	2.8	.9	2.1	2.5	3.5	3.5	1.1	2.5	1.1	1.2	1.3	1.7
18	3.3	1.0	3.0	3.0	3.5	3.0	1.0	2.0	2.5	1.2	1.3	1.6
19	2.1	1.0	5.1	2.1	3.0	2.5	1.0	2.0	2.0	1.3	1.2	1.5
20	2.0	1.05	6.0	2.1	2.1	2.0	1.05	2.0	1.8	1.2	1.2	1.3
21	1.7	1.3	5.0	6.1	2.0	2.0	1.0	2.0	2.0	1.5	1,2	1.3
22	1.6	1.35	4.1	6.0	2.0	1.7	1.15	1.8	1.8	1.9	1.1	3.3
23	1.5	3.0	3.0	4.1	1.9	1.5	1.1	2.5	1.7	1.8	1.1	3.0
24	1.5	3.0	3.0	3.0	1.5	1.4	1.1	2.0	1.5	1.7	1.0	2.6
25	1.6	4.0	2.5	2.1	1.4	1.3	1.05	2.0	1.5	1.5	1.0	2.4
26	1.55	4.0	2.5	2.0	1.6	1.2	1.0	1.8	1.4	1.5	1.0	2.0
27	1.5	6.0	2.5	3.1	3.0	1.1	1.0	1.5	1.3	1.4	1.1	1.6
28	1.4	7.0	2.5	2.1	2.8	1.1	1.1	1.4	1.2	1.2	1.4	1.5
29	1.2	.....	2.0	2.0	2.7	1.05	1.1	1.4	1.1	1.1	1.9	1.8
30	1.2	.....	1.8	1.8	2.6	1.0	1.0	1.3	1.0	1.1	4.5	2.1
31	1.1	.....	1.7	.....	2.5	.....	1.0	1.2	.....	1.2	.....	2.0

1906.

1	2.1	1.6	2.5	7.5	1.3	2.0	0.9	.....	.....	.....	.....	.....
2	2.2	1.5	2.1	7.1	1.25	1.7	.9	.....	.....	.....	.....	.....
3	2.3	1.4	1.8	5.2	1.2	1.4	.95	.....	.....	.....	.....	.....
4	2.3	1.6	1.7	4.0	1.2	1.35	1.1	.....	.....	.....	.....	.....
5	2.2	1.6	1.7	3.9	1.3	1.3	1.15	.....	.....	.....	.....	.....
6	2.1	1.5	1.6	3.5	1.25	1.2	1.1	.....	.....	.....	.....	.....
7	2.0	1.4	1.6	3.1	1.2	1.3	1.05	.....	.....	.....	.....	.....
8	2.0	1.4	1.7	3.0	1.2	1.1	1.0	.....	.....	.....	.....	.....
9	2.2	1.4	1.8	2.8	1.4	1.1	1.0	.....	.....	.....	.....	.....
10	2.2	1.5	1.8	2.9	1.5	1.15	.95	.....	.....	.....	.....	.....
11	1.9	1.8	1.9	2.8	1.45	1.1	.95	.....	.....	.....	.....	.....
12	1.8	1.9	2.1	2.7	1.3	1.05	.9	.....	.....	.....	.....	.....
13	1.9	1.9	2.2	2.5	1.25	1.0	.9	.....	.....	.....	.....	.....
14	2.5	2.0	2.2	2.1	1.4	1.0	1.2	.....	.....	.....	.....	.....
15	3.8	2.5	2.3	1.8	1.3	1.0	1.8	.....	.....	.....	.....	.....
16	3.9	2.9	2.2	1.9	1.3	.95	1.9	.....	.....	.....	.....	.....
17	4.1	3.4	1.9	2.1	1.3	.95	1.6	.....	.....	.....	.....	.....
18	3.4	3.5	1.7	1.8	1.25	.9	1.4	.....	.....	.....	.....	.....
19	3.2	3.4	2.1	1.7	1.2	1.0	1.2	.....	.....	.....	.....	.....
20	3.1	3.5	2.2	1.5	1.2	1.0	1.2	.....	.....	.....	.....	.....
21	3.0	4.1	2.3	1.4	1.3	.95	1.1	.....	.....	.....	.....	.....
22	2.8	4.3	2.0	1.3	1.25	1.05	.....	.....	.....	.....	.....	.....
23	2.5	3.9	1.8	1.3	1.2	1.0	.....	.....	.....	.....	.....	.....
24	2.4	3.5	1.7	1.2	1.2	1.0	.....	.....	.....	.....	.....	.....
25	2.4	3.3	1.7	1.3	1.15	.9	.....	.....	.....	.....	.....	.....
26	2.3	3.2	1.8	1.4	1.15	.9	.....	.....	.....	.....	.....	.....
27	2.1	3.1	12.2	1.4	1.25	.95	.....	.....	.....	.....	.....	.....
28	2.0	2.8	12.4	1.3	1.2	.95	.....	.....	.....	.....	.....	.....
29	1.9	.....	7.7	1.2	1.2	.9	.....	.....	.....	.....	.....	.....
30	1.7	.....	7.9	1.2	2.15	.9	.....	.....	.....	.....	.....	.....
31	1.6	.....	8.2	.....	2.05	.....	.....	.....	.....	.....	.....	.....

NOTE.—The above gage heights for 1905–6 were recorded erroneously in some cases, but have been corrected as far as possible. They are still liable to some error. Ice conditions January 1 to February 28 1905. River frozen February 1 to 18, 1906; thickness of ice, 0.2 to 0.8 foot.

Rating table for Black River near Elyria, Ohio, for 1904–1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	2	2.30	294	3.70	748	6.00	1,550
1.00	5	2.40	324	3.80	782	7.00	1,900
1.10	10	2.50	355	3.90	816	8.00	2,250
1.20	18	2.60	386	4.00	850	9.00	2,600
1.30	31	2.70	417	4.20	920	10.00	2,950
1.40	48	2.80	448	4.40	990	11.00	3,300
1.50	70	2.90	479	4.60	1,060	12.00	3,650
1.60	94	3.00	510	4.80	1,130	13.00	4,000
1.70	120	3.10	544	5.00	1,200	14.00	4,350
1.80	148	3.20	578	5.20	1,270	15.00	4,700
1.90	177	3.30	612	5.40	1,340	16.00	5,050
2.00	206	3.40	646	5.60	1,410	17.00	5,400
2.10	235	3.50	680	5.80	1,480	18.00	5,750
2.20	264	3.60	714				

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1906, and is not well defined.

Monthly discharge of Black River near Elyria, Ohio, for 1904–1906.

[Drainage area, 417 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1904.					
January	5,920	31	808	1.94	2.24
February	3,720	235	869	2.09	2.25
March	4,210	70	1,210	2.90	3.34
April	4,140	18	676	1.62	1.81
May	1,480	5	227	.544	.63
June	2,500	5	300	.719	.80
July	2,500	5	255	.612	.71
August	177	2	68.8	.165	.19
September	31	2	11.0	.026	.03
October	31	2	[a] 12.1	.029	.03
November	177	2	75.1	.180	.20
December (1–18)	94	5	48.0	.115	.08
1905.					
March	1,550	120	799	1.92	2.21
April	1,580	18	371	.890	.99
May	3,340	31	440	1.06	1.22
June	680	5	215	.516	.58
July	48	5	16.5	.040	.05
August	355	2	112	.269	.31
September	355	5	56.2	.135	.15
October	177	2	32.1	.077	.09
November	1,020	5	94.7	.227	.25
December	955	31	319	.765	.88
1906.					
January	885	94	346	.830	.96
February 19–28	955	448	684	1.64	.61
March	3,790	94	616	1.48	1.71
April	2,080	18	410	.983	1.10
May	250	14	40.8	.098	.11
June	206	2	20.6	.049	.05
July 1–21	177	2	28.7	.069	.05

[a] Gage heights published as 1.01, 1.02, and 1.03 in Water-Supply Paper No. 129 should be 1.1, 1.2, and 1.3.

NOTE.—The above values are rated as fair with the exception of January to March, 1904. No data concerning ice conditions during these months were available and hence the open-channel rating was applied for this period. The procedure may involve large errors.

CUYAHOGA RIVER BASIN.

DESCRIPTION OF BASIN.

Cuyahoga River rises in eastern Geauga County, flows south-southwestward to a point within about 2 miles of Akron, then turns sharply and flows northwestward to Lake Erie. Its course is extremely tortuous. In one place a straight line 5 miles long would connect two points 12 miles apart by the channel. The valley consists largely of a series of basins, the hills reaching 200 feet or more in height. Many lakes and swamps occur in the headwater region.

CUYAHOGA RIVER AT INDEPENDENCE, OHIO.

This station was established September 21, 1903, and was discontinued July 21, 1906. It was located at the highway bridge at the town of Independence, 10 miles south of Cleveland and 4 miles south of the gaging station formerly located on the highway bridge between Brooklyn and Newberg, Ohio. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 60, where are given also references to publications that contain data for previous years.

Discharge measurements of Cuyahoga River at Independence, Ohio, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 7	E. F. Kriegsman	78	335	6.26	803
May 14	do	62	264	5.39	419

Daily gage height, in feet, of Cuyahoga River at Independence, Ohio, for 1906.

Day.	Jan.	Feb.[a]	Mar.	Apr.	May.	June.	July.
1	5.75	5.25	5.4	9.1	5.1	4.8	4.5
2	5.4	4.75	5.25	8.8	5.05	5.5	4.5
3	5.35	4.9	5.45	7.75	5.0	5.0	4.55
4	7.2	5.0	5.9	6.65	5.05	4.9	5.0
5	6.85	5.25	6.4	6.4	5.65	4.8	4.85
6	6.55	5.25	6.2	7.0	5.9	4.95	5.0
7	6.4	5.5	6.25	6.7	6.4	5.05	5.2
8	6.25	5.5	6.2	6.0	6.05	5.1	5.1
9	5.75	5.5	6.05	6.35	5.8	5.0	4.85
10	5.45	5.5	6.3	7.5	6.0	4.95	5.0
11	5.6	5.48	6.5	7.1	6.75	4.65	4.8
12	5.4	5.45	6.4	7.0	5.6	4.8	4.7
13	5.4	5.45	5.5	7.0	5.6	4.65	4.7
14	5.35	5.4	5.4	6.85	5.55	4.6	4.5
15	5.3	5.4	5.3	6.6	5.3	4.7	4.5
16	6.25	5.4	5.25	6.35	5.2	4.6	4.5
17	5.95	5.4	5.2	6.15	5.2	4.55	5.05
18	6.0	5.4	5.2	5.8	5.2	4.45	4.85
19	6.95	5.4	5.2	5.65	5.05	5.0	4.75
20	6.7	5.4	5.2	5.4	5.0	5.0	4.7

[a] Ice conditions during month.

Daily gage height, in feet, of Cuyahoga River at Independence, Ohio, for 1906—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
21	7.0	5.4	5.1	5.3	4.8	4.9	4.75
22	7.55	8.0	5.1	5.15	4.9	4.85	.....
23	8.25	7.35	5.1	5.5	4.95	4.75	.....
24	7.6	6.75	5.5	5.5	4.9	4.6	.....
25	6.9	6.6	5.45	5.4	4.85	4.4	.....
26	6.3	6.3	5.3	5.5	4.9	4.8	.....
27	5.85	5.9	15.9	5.5	4.8	4.75	.....
28	5.6	5.65	14.4	5.4	4.5	4.55	.....
29	5.45	.....	11.5	5.2	4.85	4.55	.....
30	5.3	.....	11.9	5.15	4.8	4.6	.....
31	5.25	.....	12.15	.....	4.55	.....	.....

NOTE.—The rating table published for 1905 will give approximate results if applied to the above gage heights.

LAKE ONTARIO DRAINAGE.

GENERAL FEATURES.

In the northwestern part of the State of New York, between Niagara and St. Lawrence rivers, is an area aggregating 12,400 square miles drained by streams which flow into Lake Ontario. The divide which controls this drainage is very irregular. Extending to the south and southeast from Fort Niagara, it passes around the headwaters of the Genesee a short distance into Pennsylvania; thence reentering New York it runs southward and eastward from the interior group of lakes, turns to the north, encircles the sources of Black River, turns again to the west, and descends to the lake. The country thus included is level or gently undulating in the counties bordering the lake, but farther south it becomes more rolling, and a series of ridges, gradually increasing in height, stretch down between Cayuga and Seneca and their companion lakes, finally becoming merged with the elevated, broken country forming the principal divide, the abrupt slopes of which attain altitudes of from 2,000 to 2,500 feet about the headwaters of the Genesee.

The easterly or Black River lobe of the drainage basin receives the run-off from the southwestern slope of the Adirondack Mountains—largely a rugged and forest-covered area receiving heavy precipitation, especially in the winter.

The principal streams of the area are the Oswego, formed by the union of Seneca and Oneida rivers, which drain the chain of lakes in central New York, and Genesee, Salmon, and Black rivers.

GENESEE RIVER BASIN.

DESCRIPTION OF BASIN.

Genesee River rises in Potter County, Pa., 8 or 10 miles south of the New York-Pennsylvania boundary, flows northwestward for about 32 miles by general course, then turns to the northeast, and empties into

Lake Ontario 7 miles north of Rochester. The entire length of the stream, following bends, is about 135 miles, and the drainage area is 2,496 square miles.

In the 39 miles between Belmont, in central Allegany County, and Portage, in southwestern Livingston County, the fall of the water surface is 253 feet, an average of 6.4 feet per mile. At Portage the river plunges down in three magnificent falls, and thence nearly to Mount Morris flows at the bottom of a deep gorge. From Mount Morris to Rochester the valley is broad and open and the stream is bordered by meadows subject to occasional overflow. At Rochester there is another abrupt descent over three heavy falls, amounting to about 260 feet within the city.

The series of remarkable lakes tributary to the Oswego basin is continued westward into the basin of the Genesee and includes Conesus, Hemlock, Canadice, and Honeoye lakes. These lakes serve as natural reservoirs and have inlets draining considerable areas at their upper ends. The slopes adjacent to the lakes themselves are narrow and steep and are drained by gulleys and torrential brooks. The area below the lakes is rolling and the soil is rich and extensively cultivated. The areas and elevations of these lakes are shown in the following table:

Areas and elevations of lakes in Genesee River basin.[a]

Lake.	Elevation.	Water-surface area.	Drainage area.	Per cent water surface.
	Feet.	*Sq. miles.*	*Sq. miles.*	
Hemlock Lake	896	2.8	46.8	6.12
Canadice Lake	1,092	.7	12.6	5.57
Honeoye Lake	800	2.5	39.6	6.41

[a] These lake basins are shown on the Honeoye, Canandaigua, Naples, and Wayland topographic atlas sheets of the United States Geological Survey, from which the areas have been taken, with the exception of those for Hemlock and Canadice lakes, which are from surveys for the Rochester waterworks.

Above all the private dams at Rochester the State has a dam for diverting water to the Erie Canal, and in the basin of Black Creek, one of the upper tributaries of the Genesee from the west, are two reservoirs, owned by the State, also used for the benefit of the Erie Canal.

Cuba reservoir, on the Genesee-Allegheny divide, receives the drainage from a tributary area of 26.6 square miles. The storage volume is 454,000,000 cubic feet. The overflow from this reservoir enters Allegheny River. The storage water may be turned into the summit level of the abandoned Genesee Valley Canal and thence into Genesee River.

GENESEE RIVER AND CANASERAGA CREEK NEAR MOUNT MORRIS, N. Y.

This station was established May 22, 1903, and was discontinued April 30, 1906. It was located at the highway bridge near Mount Morris, a short distance below the inflow of Canaseraga Creek. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 65, where are given also references to publications that contain data for previous years.

Discharge measurements of Genesee River near Mount Morris, N. Y., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 12[a]	C. C. Covert	118	298	5.75	452
February 13[a]	do	118	290	5.78	479
February 16[a]	do	127	373	6.00	525
March 29	do	171	1,640	13.90	5,420
March 30	do	166	1,500	13.10	5,780
March 31	do	193	2,660	19.05	10,800
March 31	do	193	2,630	18.85	10,200
April 1	do	185	1,750	14.33	5,920
April 2	do	163	1,210	11.60	4,360
April 3	do	161	1,050	10.50	3,930
April 4	do	161	1,120	10.85	4,460
April 14	do	153	864	9.38	3,080
April 21	do	129	502	6.89	1,660
April 22	do	127	460	6.60	1,520
April 23	do	127	504	6.90	1,740
September 15	do	70	191	4.15	238

[a] Measurements made under ice cover, average thickness of ice, 0.49 foot, 0.41 foot, and 0.68 foot, respectively. Gage height to bottom of ice, 5.36 feet, 5.47 feet, and 5.42 feet, respectively.

Daily gage height, in feet, of Genesee River near Mount Morris, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	Day.	Jan.	Feb.	Mar.	Apr.
1	8.2	6.4	6.65	13.85	17	8.95	5.75	4.95	9.45
2	7.3	5.8	6.85	11.2	18	7.95	5.8	4.8	8.4
3	6.8	7.7	6.3	10.3	19	7.2	5.6	4.8	7.65
4	7.2	7.5	8.25	10.5	20	6.55	5.5	5.9	7.2
5	9.7	7.35	8.0	13.4	21	12.05	5.6	5.15	6.8
6	7.7	7.1	6.1	12.35	22	16.25	6.5	5.0	6.6
7	6.3	6.65	5.9	11.45	23	15.45	6.55	5.0	6.8
8	6.1	6.5	5.7	9.95	24	15.3	6.1	4.7	6.5
9	7.2	6.4	5.5	9.55	25	10.5	5.85	4.85	6.25
10	9.0	6.3	5.5	13.2	26	8.35	6.05	5.05	5.95
11	8.8	6.05	5.25	14.1	27	7.45	5.65	9.1	5.75
12	8.9	5.75	5.25	11.7	28	7.0	7.05	21.43	5.5
13	8.3	5.55	5.25	10.35	29	6.7	.....	14.7	5.5
14	7.7	5.95	5.05	9.35	30	6.3	.....	13.5	5.65
15	7.55	6.0	5.0	10.55	31	6.15	.....	18.45	.....
16	7.05	5.8	5.1	11.1					

NOTE.—River frozen over from February 1 to March 20, approximately. During frozen period gage readings were taken to water surface through a hole cut in ice. Ice averaged from 0.2 to 0.6 foot thick at gage and from 0.3 to 0.8 foot thick 200 feet below.

This station has backwater conditions during the spring floods; also considerable water flows around the left-hand end of the bridge above gage height 18.0 feet.

Rating table for Genesee River near Mount Morris, N. Y., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.70	490	6.10	1,215	7.50	2,030	9.80	3,560
4.80	535	6.20	1,270	7.60	2,090	10.00	3,700
4.90	580	6.30	1,325	7.70	2,155	10.20	3,840
5.00	625	6.40	1,380	7.80	2,220	10.40	3,980
5.10	675	6.50	1,435	7.90	2,285	10.60	4,120
5.20	725	6.60	1,490	8.00	2,350	10.80	4,270
5.30	775	6.70	1,550	8.20	2,480	11.00	4,420
5.40	830	6.80	1,610	8.40	2,610	12.00	5,170
5.50	885	6.90	1,670	8.60	2,740	13.00	5,960
5.60	940	7.00	1,730	8.80	2,870	14.00	6,760
5.70	995	7.10	1,790	9.00	3,000	15.00	7,560
5.80	1,050	7.20	1,850	9.20	3,140	16.00	8,360
5.90	1,105	7.30	1,910	9.40	3,280	17.00	9,160
6.00	1,160	7.40	1,970	9.60	3,420	18.00	9,960

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1906 and is fairly well defined.

Monthly discharge of Genesee River near Mount Morris, N. Y., for 1906.

[Drainage area, 1,070 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	8,560	1,220	2,830	2.64	3.04
February	1,080	442	650	.607	.63
March	11,000	268	1,690	1.58	1.82
April	6,840	885	3,290	3.07	3.42

NOTE.—Discharges February 1 to March 20 have been taken as 50 per cent of the open-water flow: backwater assumed March 28, discharge corrected.
Values are rated as follows: January and April, good; March, fair; February, approximate.

Discharge measurements of Canaseraga Creek near Mount Morris, N. Y., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 29	C. C. Covert	84	500	9.22	1,880
March 30	do	84	456	8.90	1,620
March 31 [a]	do	94	900	13.55	1,670
April 2	do	81	368	7.85	1,430
April 3	do	75	310	7.00	1,150
April 21	do	66	142	4.45	478

[a] Backwater from Genesec River.

GENESEE RIVER AT HIGH DAM NEAR MOUNT MORRIS, N. Y.

A gaging station has been established at the dam of the Mount Morris Water Power Company, in the village of Mount Morris, N. Y., and readings have been taken regularly twice each day, by John McAstocker, since September 1, 1905.

The dam is of masonry construction, having a horizontal crest of open cross section 255 feet long. There are two waste ways, having crests each 12 inches wide and 18.0 feet and 17.9 feet long, respectively, closed by stop planks to about 2 feet above the main crest; also one short spillway with crest 6 inches wide and 17 feet long and about 1 foot higher than the wasteways. The dam and the spillways

are separated by masonry piers 6 feet, 8 feet, and 6 feet in width, respectively.

A portion of the flow is diverted through a section of the old Genesee Valley Canal, which is utilized as a headrace, the power being used to drive a number of mills and factories. In order to determine the amount of this diversion, a gage has been placed in the tailrace below the mills. It is read twice each day by F. M. Goff, electrical engineer in the employ of the power company. A number of meter measurements have been made, and a rating curve to determine the daily flow through the canal is partly developed. When the complete curve is developed, the data will be published.

GENESEE RIVER AT ROCHESTER, N. Y.

This station was established February 9, 1904. It is located at the Elmwood Avenue Bridge, in Rochester, N. Y. The conditions at this station[a] and the bench marks are described in Water-Supply Paper No. 170, page 69, where are given also references to publications that contain data for previous years.

Discharge measurements of Genesee River at Rochester, N. Y., in 1904–1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 20	C. C. Covert		1,010	1.30	592
August 9	E. H. Fisher		976	1.18	614
August 10	do		957	1.10	589
August 11	do		944	1.15	594
August 12	do		963	1.20	667
August 15	do		973	1.10	587
August 27	do		972	1.22	703
August 30	do		916	1.07	554
September 17	do		923	1.05	511
November 11	C. C. Covert		994	1.20	534
1905.					
March 22	Covert and Weeks	382	4,220	10.00	24,700
March 22	do	382	4,200	9.95	24,900
March 25	do	382	4,300	10.20	25,500
March 27	do	382	4,200	9.92	25,200
March 27	do	382	4,160	9.82	24,800
March 28	do	382	4,050	9.50	23,600
March 29	do	382	3,960	9.08	22,500
April 2	do	373	2,140	4.18	6,530
April 3	do	372	1,890	3.50	5,200
April 4	do	372	1,820	3.28	4,580
May 28	C. C. Covert	352	974	1.11	441
1906.					
February 14[b]	Covert and Weeks	306	1,710	1.40	728
February 15[c]	do	360	1,020	1.53	894
March 28	Weeks and Casey	383	3,160	6.85	14,100
March 29	do	383	3,320	7.32	15,100
March 30	do	383	2,680	5.64	9,580
March 31	do	383	2,860	6.06	12,400
March 31	do	383	2,940	6.31	13,300
April 1	do	384	3,040	6.60	14,200
April 1	do	383	3,050	6.36	13,000
April 2	do	376	2,480	5.08	8,830
April 2	do	375	2,330	4.70	7,160
April 3	do	374	2,100	4.10	5,860

[a] The gage datum is 245.59 feet above the city topographic datum, to which gage heights published for 1904 refer.

[b] Measured under ice cover, about one-fourth mile above regular section; gage height to top of ice, 1.50 feet; average thickness of ice, 0.50 foot.

[c] Measured under ice cover at regular section; gage height to top of ice, 1.63 feet; average thickness of ice, 0.46 foot; some needle ice.

Daily gage height, in feet, of Genesee River at Rochester, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.0	2.0	1.7	6.5	1.8	2.4	1.5	1.1	1.3	1.2	3.0	2.06
2	2.9	2.0	2.0	5.6	1.9	2.0	1.4	1.2	1.2	1.3	3.0	2.05
3	2.9	2.0	1.5	4.2	2.2	1.9	1.4	1.3	1.1	1.6	3.0	2.04
4	2.5	2.0	1.9	3.8	3.5	1.8	2.2	1.2	1.1	1.4	2.9	2.03
5	2.3	2.0	2.7	4.0	3.0	1.7	2.6	1.6	1.1	1.4	2.8	2.02
6	3.3	1.9	3.1	4.9	3.1	1.5	2.0	1.7	1.1	1.5	2.6	2.01
7	2.9	1.9	2.1	4.6	2.9	2.7	1.8	1.6	1.0	2.5	2.4	6.02
8	2.4	1.8	2.0	4.0	2.5	2.5	1.6	1.6	1.0	3.5	2.3	6.08
9	2.4	1.8	1.9	3.6	2.2	2.7	1.4	1.7	1.0	2.8	2.1	5.0
10	2.3	1.8	1.8	5.0	2.1	1.9	1.4	1.7	1.0	2.4	2.0	3.06
11	2.1	1.7	1.6	5.9	2.4	1.8	1.4	1.5	1.0	2.5	2.0	3.01
12	1.9	1.7	1.3	5.5	2.3	1.8	1.3	1.6	1.0	2.8	2.3	4.04
13	2.2	1.4	1.6	4.5	2.1	1.8	1.3	1.8	1.0	2.6	2.06	3.03
14	1.9	1.4	1.5	3.8	2.0	1.7	1.2	1.6	1.0	2.2	3.01	3.0
15	1.7	1.5	1.6	3.5	2.2	1.5	1.1	1.5	1.0	2.1	2.09	3.02
16	1.9	2.0	1.5	4.0	2.2	1.5	1.1	1.5	1.0	2.0	2.08	6.0
17	2.2	2.0	1.4	3.8	2.1	1.5	1.1	1.4	1.0	1.9	2.06	5.06
18	2.3	1.8	1.4	3.3	2.1	1.8	1.2	1.3	1.0	1.8	2.08	4.0
19	2.2	1.6	1.4	3.0	2.5	1.9	1.4	1.2	1.0	1.7	4.07	3.05
20	2.1	1.4	1.3	2.8	2.3	1.9	1.3	1.1	1.0	1.9	5.0	3.0
21	2.7	1.5	1.5	2.5	2.0	1.7	1.2	1.1	1.0	3.4	4.04	2.06
22	4.9	1.8	1.6	2.3	1.8	1.6	1.2	1.4	1.0	3.1	6.04	2.01
23	5.6	2.0	1.4	2.2	1.7	1.5	1.2	1.4	1.3	2.6	5.08	2.1
24	5.3	2.0	1.6	2.3	1.6	1.5	1.2	1.8	1.3	2.5	4.06	2.0
25	4.9	2.1	1.6	2.2	1.9	1.5	1.1	2.0	1.4	2.3	3.07	3.0
26	3.5	2.1	1.5	2.1	2.2	1.5	1.0	1.8	1.3	3.6	3.04	3.2
27	2.7	1.8	2.4	2.0	1.9	1.5	1.0	1.5	1.3	3.3	3.02	3.0
28	2.4	1.6	6.0	1.9	1.9	1.4	1.0	1.4	1.1	2.6	3.00	2.8
29	2.1	.....	7.3	1.8	3.2	1.3	1.1	1.4	1.1	2.4	3.01	2.7
30	2.4	.....	5.8	1.8	2.6	1.5	1.2	1.5	1.1	2.5	2.08	2.3
31	2.1	.....	6.0	.....	2.2	.....	1.2	1.3	.....	2.5	.....	2.3

Rating table for Genesee River at Rochester, N. Y., for 1904–1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	400	2.30	2,140	3.60	4,840	5.80	10,800
1.10	490	2.40	2,320	3.70	5,080	6.00	11,400
1.20	580	2.50	2,500	3.80	5,320	6.20	12,000
1.30	670	2.60	2,700	3.90	5,560	6.40	12,600
1.40	760	2.70	2,900	4.00	5,800	6.60	13,220
1.50	850	2.80	3,100	4.20	6,320	6.80	13,860
1.60	1,000	2.90	3,300	4.40	6,840	7.00	14,500
1.70	1,150	3.00	3,500	4.60	7,380	8.00	17,800
1.80	1,300	3.10	3,720	4.80	7,940	9.00	21,400
1.90	1,450	3.20	3,940	5.00	8,500	10.00	25,100
2.00	1,600	3.30	4,160	5.20	9,060	11.00	29,000
2.10	1,780	3.40	4,380	5.40	9,620		
2.20	1,960	3.50	4,600	5.60	10,200		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1906 and is well defined.

Monthly discharge of Genesee River at Rochester, N. Y., for 1904–1906.

[Drainage area, 2,360 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1904.[a]					
February (9–12)	31,800	14,500	24,000	10.17	1.51
March 2–31[b]	27,000	2,500	12,900	5.47	6.10
April[b]	13,200	4,160	7,460	3.16	3.53
May	7,660	1,450	3,160	1.34	1.54
June	8,500	670	2,230	.945	1.05
July	3,100	670	1,310	.555	.64
August	1,150	400	634	.269	.31
September	850	400	523	.222	.25
October	2,500	490	986	.418	.48
November	760	490	562	.238	.27
December	13,200	490	1,570	.665	.77
1905.[c]					
January (1–27)	5,560	1,600	2,800	1.19	1.20
March (18–31)	25,900	1,960	20,200	8.56	4.46
April	13,200	2,320	4,150	1.76	1.96
May	2,140	1,300	1,460	.619	.71
June	7,660	850	2,670	1.13	1.26
July	4,380	715	1,340	.568	.65
August	3,720	535	1,230	.521	.60
September	850	400	580	.246	.27
October	1,000	400	589	.250	.29
November	7,940	580	1,400	.593	.66
December	7,380	580	2,690	1.14	1.31
1906.[d]					
January	10,200	1,150	3,250	1.38	1.59
February	1,780	760	1,320	.559	.58
March	15,500	670	2,680	1.14	1.31
April	12,900	1,300	5,110	2.17	2.42
May	4,600	1,000	2,130	.902	1.04
June	2,900	670	1,300	.551	.61
July	2,700	400	783	.332	.38
August	1,600	490	878	.371	.43
September	760	400	484	.205	.23
October	4,840	580	2,280	.966	1.11
November	11,600	1,600	3,650	1.55	1.72
December	11,600	1,600	4,070	1.72	1.98
The year	15,500	400	2,330	.987	13.4

[a] Values for 1904 are rated as follows: February to May, good; June, July, October, and December, fair; August, September, and November, approximate.
[b] Discharge interpolated for missing days.
[c] Values for 1905 are rated as follows: January, May to August, November, and December, fair; March and April, good; September and October, approximate.
[d] Values for 1906 are rated as follows: January, April, November, and December, good; February, March, May to August, and October, fair; September, approximate.

CANADICE LAKE OUTLET NEAR HEMLOCK, N. Y.

This station is located at a weir constructed at the outlet at the foot of the lake by the city engineer's department of Rochester, N. Y., in February, 1903. The entire yield of the drainage basin passes this weir. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 71, where are given also references to publications that contain data for previous years.

Monthly discharge of Canadice Lake outlet near Hemlock, N. Y., for 1906.

[Drainage area, 12.6 square miles.]

Month.	Mean discharge in second-feet.	Run-off.	
		Sec.-ft. per sq. mile.	Depth in inches.
January	9.52	0.755	0.87
February	9.33	.740	.77
March	11.1	.880	1.01
April	27.7	2.20	2.45
May	13.1	1.04	1.20
June	10.9	.864	.95
July	8.74	.693	.79
August	8.14	.646	.75
September	6.54	.519	.58
October	6.97	.552	.63
November	27.1	2.15	2.40
December	33.0	2.62	3.02
The year	14.3	1.13	15.02

HONEOYE CREEK AT EAST RUSH, N. Y.

This station was established February 13, 1903, and was discontinued April 30, 1906. It was located at the gristmill dam in the village of East Rush. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 72, where are given also references to publications that contain data for previous years.

Daily discharge, in second-feet, of Honeoye Creek at East Rush, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	Day.	Jan.	Feb.	Mar.	Apr.
1	84	84	60	527	17	60	70	60	305
2	60	42	60	445	18	60	77	77	301
3	52	42	148	329	19	84	70	44	305
4	123	43	194	282	20	104	70	53	229
5	141	42	172	553	21	169	172	74	231
6	111	37	123	542	22	246	196	94	219
7	77	33	84	505	23	321	104	70	214
8	44	42	99	444	24	132	148	60	179
9	44	40	70	541	25	84	169	25	149
10	31	43	70	1,176	26	70	172	70	149
11	29	25	77	764	27	70	84	1,107	125
12	61	38	52	574	28	77	60	1,073	131
13	88	39	52	497	29	60	.....	512	121
14	43	70	52	411	30	70	.....	510	131
15	54	70	52	366	31	84	.....	1,023	.....
16	60	70	52	345					

NOTE.—From January 1 to March 26 the discharge is approximate; the flow over crest of dam was obstructed by ice.

Monthly discharge of Honeoye Creek at East Rush, N. Y., for 1906.

[Drainage area, 238 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	321	29	90.0	0.378	0.44
February	196	25	76.8	.323	.34
March	1,110	25	202	.848	.98
April	1,180	121	370	1.55	1.73

NOTE.—Above values are rated as approximate.

OSWEGO RIVER BASIN.

DESCRIPTION OF BASIN.

Oswego River is formed by the union of Seneca and Oneida rivers about 12 miles northwest of Syracuse, N. Y., whence its course is northwestward to Oswego, where it enters Lake Ontario. The length of the river from the junction to the mouth is about 20.5 miles, and the drainage basin along this distance is a narrow strip of country, moderately rolling. Above the junction of Seneca and Oneida rivers the basin spreads out, attaining an extreme width east and west of about 100 miles and north and south of from 70 to 80 miles.

The most remarkable feature of the drainage basin is the chain of lakes stretching across its southern border. From west to east the principal lakes are, in order, Canandaigua, Keuka, Seneca, Cayuga, Owasco, Skaneateles, and Oneida. These seven lakes include a water surface of approximately 280 square miles, increased by four smaller lakes—Cross, Onondaga, Otisco, and Cazenovia—to about 295 square miles. The larger of the lakes, Oneida, Cayuga, and Seneca, are used for steam-towing navigation, having connection with the Erie and Oswego canals. Cayuga and Seneca lakes are noted for their depth and for the abrupt slopes of their beds The influence of the lakes on Oswego River is of the utmost importance in contributing to the steadiness of its flow.

A fall of 100 feet in the course of the main river is largely utilized by seven dams, which also partly canalize the stream. The intervening stretches are covered by the Oswego Canal, which draws its water supply from the river.

OSWEGO RIVER AT BATTLE ISLAND, N. Y.

This station was established September 14, 1900, and was discontinued April 30, 1906. It was located 3 miles above the mouth of the river and 0.6 mile below the State dam at Battle Island. The conditions at this station and the bench marks are described in Water-

Supply Paper No. 170, page 74, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of Oswego River at Battle Island, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	Day.	Jan.	Feb.	Mar.	Apr.
1	5.9	6.05	5.15	7.4	17	5.8	4.88	5.05	8.05
2	6.35	5.85	5.2	7.65	18	5.75	4.68	.....	8.0
3	6.65	5.0	5.05	7.5	19	5.8	4.82	5.05	8.0
4	6.55	5.15	5.45	7.5	20	5.55	4.82	.....	7.85
5	6.4	5.15	5.92	7.5	21	5.45	4.88	.....	7.78
6	6.25	5.1	5.8	7.5	22	6.2	4.88	.....	6.55
7	5.75	5.25	5.8	7.4	23	6.7	4.9	.....	6.95
8	6.5	5.15	5.7	7.3	24	6.95	4.85	.....	6.8
9	6.6	5.0	5.65	7.8	25	6.9	4.75	.....	6.65
10	6.4	5.0	5.65	8.4	26	6.85	5.5	.....	6.5
11	5.8	4.7	5.0	8.3	27	6.6	5.3	6.2	6.45
12	5.75	5.0	5.65	8.3	28	6.1	5.1	6.8	6.4
13	5.5	4.92	5.5	8.2	29	6.4	.....	7.05	6.15
14	5.25	4.9	5.15	8.05	30	6.3	.....	7.2	6.55
15	5.7	4.82	5.0	7.95	31	6.15	.....	7.3	.....
16	5.75	4.82	5.0	8.25					

NOTE.—Gage height below 5.0 feet on March 18 and March 20 to 26. River does not freeze over entirely at gage; shore ice extends from 10 to 50 feet out, leaving an open channel in center of stream. The frozen period is affected by needle ice at times. Ice period for 1906, from January 31 to February 26, ice 0.5 to 0.8 foot thick at gage. Backwater from ice jam below gage on February 26 to 28. During frozen period readings were taken to water surface through a hole cut in ice.

Rating table for Oswego River at Battle Island, N. Y., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.00	7,300	5.70	8,690	6.40	10,120	7.20	11,820
5.10	7,490	5.80	8,890	6.50	10,330	7.40	12,260
5.20	7,690	5.90	9,090	6.60	10,540	7.60	12,700
5.30	7,890	6.00	9,300	6.70	10,750	7.80	13,130
5.40	8,090	6.10	9,500	6.80	10,950	8.00	13,580
5.50	8,290	6.20	9,710	6.90	11,170	8.20	14,020
5.60	8,490	6.30	9,920	7.00	11,390	8.40	14,470

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1900–1904, and is fairly well defined.

Monthly discharge of Oswego River at Battle Island, N. Y., for 1906.

[Drainage area, 4,990 square miles.]

Month.	Discharge in second-feet.			Run-off	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile	Depth in inches.
January	11,300	7,790	9,610	1.93	2.22
March [a]	12,000	7,200	8,670	1.74	1.55
April	14,500	9,610	12,400	2.48	2.77

[a] March 1–19, 27–31; discharge for March 18 estimated.

NOTE.—Values for 1906 are excellent.

CANANDAIGUA OUTLET AT ALLOWAY, N. Y.

A temporary gage was erected by F. P. Williams, at the highway bridge across the Canandaigua Outlet at Alloway September 18, 1906. The gage consists of a board divided to feet and tenths, secured vertically to the northwest wing wall of the bridge. The zero mark is at

elevation 408.0 and is referred to a bench mark consisting of a chisel draft on the northwest abutment of the bridge having an approximate elevation of 420.25 feet. The gage was read each day from September 18 to October 30, 1906, inclusive, by George Tuscher; observations were taken at 7 a. m., at noon, and at 6 p. m. The mean daily elevation has been obtained by adding together twice the morning reading, plus the noon reading, plus twice the afternoon reading, and dividing the sum by 5. Measurements by means of surface floats were made at a point about 500 feet below the bridge. Current-meter measurements are made on the downstream side of the Alloway Bridge. Owing to regulation by storage in Canandaigua Lake, the flow in the outlet ordinarily fluctuates but little during the day. There are, however, a number of dams in the outlet by which the flow may be temporarily held back as pondage.

Daily gage height, in feet, of Canandaigua Outlet at Alloway, N. Y., for 1906.

Day.	Sept.	Oct.	Day.	Sept.	Oct.
1		0.76	16		0.82
2		.86	17		.90
3		.86	18	0.52	.78
4		.80	19	.56	.90
5		.80	20	.66	1.90
6		.78	21	.78	1.56
7		1.52	22	.78	1.32
8		1.00	23	.96	1.16
9		.86	24	.90	1.16
10		.94	25	.80	1.22
11		1.04	26	.82	1.20
12		1.10	27	.62	1.20
13		1.10	28	.62	1.26
14		.82	29	.80	1.26
15		.76	30	1.08	1.16

SENECA LAKE AT GENEVA, N. Y.

A gaging station was established at the foot of Seneca Lake, October 18, 1905. The record is furnished by the department of public works, Geneva, N. Y., C. T. Church, superintendent. Readings are taken Wednesday night of each week by the engineer, Reynolds Hill, after the pumps are stopped.

The station is at the pump house of the city water supply, about 2 miles south of Geneva, along the west shore of the lake. Two 5-foot sections of galvanized iron gage, divided into feet and tenths, are fastened to a center post in the intake well; elevation of zero referred to United States Geological Survey tablet at Geneva, 440.78.

Drainage areas tributary to Seneca Lake.

Keuka Lake:	Square miles.
Above outlet	161
Water surface	17.5
Between Keuka Outlet and Seneca Lake	24.80
Total	203.3

	Square miles.
Catherine Creek:	
Above Montaur Falls	66.5
Montaur Falls to Seneca Lake	29.9
Total	96.4
Glen Creek	23.5
All other drainage	317.8
Total	641
Water surface of Seneca Lake	67.2
Grand total	708.2

Gage heights of Seneca Lake at Geneva, N. Y., 1905–6.

1905.	Feet.
October 25	5.0
October 31	4.8
November 8	4.6
November 15	5.0
November 22	4.3
November 29	4.3
December 6	4.5
December 13	4.4
December 21	4.5
December 30	4.7
1906.	
January 3	4.7
January 10	4.8
January 17	4.6
January 24	4.7
January 31	4.7
February 7	4.5
February 14	4.4
February 21	4.4
February 28	4.3
March 7	4.4
March 14	4.4
March 21	3.9
March 28	4.3
April 4	4.7
April 11	4.9
April 18	5.1
April 25	5.3
May 2	5.1
May 9	5.1
May 16	5.1
May 23	5.1

1906.	Feet.
May 30	5.2
June 6	5.2
June 13	5.2
June 20	5.3
June 27	5.3
July 4	5.4
July 11	5.5
July 18	5.4
July 26	5.4
August 1	5.3
August 8	(a)
August 15	(a)
August 22	(a)
August 29	5.5
September 5	5.4
September 12	5.2
September 19	5.0
September 26	4.9
October 3	4.8
October 10	4.8
October 17	4.7
October 24	4.8
October 30	4.5
November 7	4.4
November 14	4.4
November 21	4.6
November 28	4.5
December 5	4.3
December 12	4.4
December 19	4.5
December 26	4.5

[a] Water over gage.

CAYUGA LAKE AT ITHACA, N. Y.

A gaging station was established at the head of Cayuga Lake August 6, 1905. A staff gage is used, attached to the wall of the breakwater about 150 feet from the light-house. Gage readings are taken once each day during the open season and once a week during the winter by Fred Thomas.

Gage height of Cayuga Lake at Ithaca, N. Y., for 1906.

	Feet.		Feet.
January 6	1.35	July 7	2.1
January 13	1.25	July 14	2.2
January 20	.85	July 21	2.3
January 27	1.10	August 4	2.15
February 3	.65	August 11	2.35
February 10	.55	August 18	2.2
February 17	.40	August 25	2.1
February 24	.35	September 1	2.15
March 3	.50	September 8	2.0
March 10	.70	September 15	1.95
March 17	.65	September 22	1.9
March 24	.35	September 29	1.85
March 31	1.60	October 1	1.85
April 7	1.85	October 6	1.7
April 14	2.30	October 13	1.4
April 21	2.15	October 20	1.65
April 28	1.65	October 27	1.7
May 1	1.65	October 31	1.75
May 5	1.70	November 3	1.3
May 12	1.50	November 10	1.25
May 19	1.35	November 17	.95
May 26	1.10	November 24	1.35
June 2	1.40	November 30	1.2
June 9	1.35	December 1	1.25
June 16	1.50	December 8	1.3
June 23	1.75	December 15	1.4
June 30	1.90	December 29	1.35
July 1	2.1		

SENECA RIVER AT BALDWINSVILLE, N. Y.

This station was established November 12, 1898. It is located at the State dam in Baldwinsville, 12 miles along the river from the junction of Seneca and Oneida rivers. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 76, where are given also references to publications that contain data for previous years.

ONEIDA RIVER NEAR EUCLID, N. Y.

This station was established August 30, 1902. It is located 7 miles upstream from Three River Point. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 80, where are given also references to publications that contain data for previous years.

Discharge measurements of Oneida River near Euclid, N. Y., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 17	C. C. Covert	245	1,400	3.30	3,490
August 10	do	240	1,010	4.71	1,280
September 21	E. F. Weeks	238	867	[a] 5.30	705
October 18	do	234	860	[a] 5.30	906

[a] Gage heights uncertain.

Daily discharge, in second-feet, of Oneida River near Euclid, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3,720	5,240	3,270	4,900	4,180	2,380	2,070	1,570	866	845	1,090	1,980
2	4,030	5,240	3,100	5,240	4,070	2,380	2,070	1,380	783	783	1,120	1,980
3	4,030	5,130	3,370	5,240	3,920	2,340	2,070	1,350	742	762	1,190	1,870
4	4,130	4,900	3,420	5,350	4,130	2,290	2,210	1,140	742	804	1,090	1,970
5	4,230	4,680	3,570	5,350	4,180	2,250	2,340	907	742	824	1,090	2,260
6	4,180	4,280	3,720	5,600	4,240	2,110	2,210	907	742	907	1,090	2,370
7	3,980	4,180	3,720	5,470	4,070	2,250	2,180	907	742	845	1,090	2,370
8	3,830	3,980	3,570	5,470	3,920	2,420	2,180	990	742	949	1,090	2,540
9	4,030	3,620	3,470	6,580	3,770	2,590	2,040	990	742	1,070	1,090	2,580
10	4,230	3,620	3,420	6,970	3,560	2,630	2,000	990	824	907	1,090	2,750
11	4,030	3,420	3,420	6,330	3,560	2,630	1,920	907	742	990	1,120	2,880
12	4,030	3,370	3,220	6,330	3,560	2,510	1,920	845	658	990	1,190	2,880
13	3,830	3,220	3,220	6,520	3,460	2,630	1,780	990	742	990	1,170	2,710
14	3,620	3,050	3,220	6,710	3,510	2,630	1,780	1,300	658	969	1,090	2,630
15	3,620	2,880	3,100	6,710	3,670	2,630	1,780	1,240	658	907	1,020	2,630
16	3,620	2,880	2,880	6,710	3,460	2,550	1,740	1,170	658	928	1,120	2,670
17	3,570	2,790	2,880	6,970	3,460	2,800	1,640	1,090	658	1,020	1,190	2,710
18	3,620	2,710	2,880	6,840	3,260	2,800	1,640	1,090	637	1,090	1,270	2,710
19	3,520	2,540	2,790	6,840	3,210	2,760	1,600	1,140	495	1,120	1,300	2,710
20	3,570	2,540	2,710	6,580	3,110	2,590	1,500	1,300	679	1,140	1,330	2,830
21	3,880	2,580	2,630	6,330	2,980	2,420	1,500	1,270	742	990	1,500	2,880
22	4,230	2,540	2,630	6,330	2,940	2,250	1,500	1,190	742	969	1,570	2,880
23	4,740	2,790	2,540	6,210	2,800	2,210	1,500	1,090	762	949	1,300	2,880
24	4,840	2,880	2,370	6,025	2,630	2,180	1,450	1,070	824	949	1,300	3,050
25	5,180	3,000	2,370	5,840	2,590	2,070	1,400	990	824	949	1,450	2,960
26	5,350	3,140	2,410	5,545	2,470	2,070	1,380	990	824	949	1,640	2,670
27	5,350	2,920	2,790	5,295	2,510	2,070	1,300	949	824	949	1,640	2,500
28	5,240	3,100	3,570	5,130	2,680	2,070	1,300	907	824	1,020	1,680	2,370
29	5,240	.....	3,930	4,955	2,760	2,070	1,400	949	824	1,090	1,780	2,230
30	5,130	.....	4,450	4,680	2,590	2,070	1,710	907	886	1,090	1,780	2,580
31	4,900	.....	4,790	.....	2,470	.....	1,920	866	.....	1,090	.....	2,710

NOTE.—During January, February, and a part of March the river was partly frozen above dam, but not enough to modify flow.

Monthly discharge of Oneida River near Euclid, N. Y., for 1906.

[Drainage area, 1,310 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	5,350	3,570	4,240	3.24	3.74
February	5,240	2,540	3,470	2.65	2.76
March	4,790	2,370	3,200	2.44	2.81
April	6,970	4,680	5,970	4.56	5.09
May	4,240	2,470	3,350	2.56	2.95
June	2,800	2,070	2,390	1.83	2.04
July	2,340	1,300	1,780	1.36	1.57
August	1,570	866	1,080	.824	.950
September	886	495	744	.568	.634
October	1,140	762	962	.734	.846
November	1,780	1,020	1,280	.977	1.09
December	5,050	1,870	2,570	1.96	2.26
The year	6,970	495	2,570	1.98	26.74

NOTE.—Above values are good.

ONEIDA CREEK AT KENWOOD, N. Y.

A report of the flow of this stream during the latter portion of the low-water season of 1906 has been furnished by the Oneida Community. The record includes the flow through a 24-inch Hercules wheel and a 24-inch Camden water wheel, as well as the flow over the dam when any occur. The Camden water wheel was little used during this period. The water was drawn below crest level of Sunset Lake storage pond and nearly the entire twenty-four hour flow of the stream passed through the wheels during the ten and one-fourth hours daily run. No adequate records were kept during the first three weeks of September. The run of the mill, however, indicates that the flow was considerably less than during the period covered by the record. A gaging record of this stream in 1900 showed a minimum flow for several days of 13 to 15 second-feet, or an average of 0.222 second-foot per square mile from a tributary drainage area of 63 square miles.

Discharge of Oneida Creek at Kenwood, N. Y., for 1906.

	Second-feet.		Second-feet.
September 22	22.5	October 10	19.6
September 24	19.0	October 11	23.5
September 25	17.9	October 12	23.2
September 26	17.3	October 13	24.5
September 27	15.0	October 14	19.2
September 28	13.8	October 15	32.3
September 29	16.2	October 16	17.9
October 1	19.3	October 17	16.1
October 2	13.8	October 18	16.1
October 3	13.8	October 19	17.3
October 5	21.0	October 20	16.9
October 6	26.2	October 21	136.0
October 7	61.5	October 22	61.7
October 8	46.0	October 23	39.4
October 9	24.7	October 24	24.2

CHITTENANGO CREEK AT CHITTENANGO, N. Y.

This station was established May 22, 1901. It is located at the Main Street Bridge in the village of Chittenango and is one-half mile above the State dam diverting water for the supply of the summit level of Erie Canal. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 82, where are given also references to publications that contain data for previous years.

Discharge measurements of Chittenango Creek at Chittenango, N. Y., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 16	E. F. Weeks	58	170	2.60	329
April 21	do	57	132	2.11	201
November 7	do	.....	101	1.52	75

Daily gage height, in feet, of Chittenango Creek at Chittenango, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.05	1.75	1.55	2.05	1.55	1.85	2.2	1.4	1.0	1.6	1.6	1.4
2	1.95	1.55	1.55	1.95	1.85	1.75	2.0	1.5	1.0	1.6	1.5	1.6
3	1.95	1.45	2.35	2.05	2.4	1.65	1.8	1.5	1.1	1.4	1.4	1.6
4	2.3	1.5	2.65	2.2	2.25	1.45	2.0	1.4	1.0	1.5	1.6	1.6
5	2.2	1.4	2.0	2.5	2.35	1.35	1.8	1.4	1.1	1.4	1.6	1.6
6	2.15	1.35	1.75	2.45	2.15	1.25	1.6	1.4	1.2	1.6	1.5	2.5
7	1.95	1.45	1.55	2.35	1.95	1.45	1.6	1.5	1.1	1.6	1.6	1.8
8	2.0	1.35	1.55	2.3	1.75	2.00	1.5	1.6	1.2	1.5	1.5	1.7
9	1.95	1.45	1.45	2.35	1.75	1.95	1.4	1.4	1.2	1.5	1.6	1.6
10	1.95	1.45	1.55	2.95	1.75	1.75	1.6	1.4	1.2	1.6	1.6	1.6
11	2.0	1.35	1.6	2.8	1.85	1.35	1.4	1.4	1.2	1.6	1.7	1.6
12	2.0	1.45	1.55	2.45	1.8	1.75	1.5	1.4	1.2	1.5	1.8	1.6
13	1.95	1.35	1.45	2.25	1.95	1.65	1.4	1.4	1.0	1.4	1.7	1.6
14	1.9	1.45	1.5	2.4	2.15	1.55	1.4	1.4	1.0	1.6	1.6	1.8
15	1.9	1.45	1.4	2.85	1.85	1.55	1.4	1.2	1.2	1.6	1.6	3.2
16	2.0	1.35	1.35	2.65	1.65	1.8	1.2	1.2	1.2	1.6	1.6	2.4
17	1.95	1.45	1.4	2.35	1.6	2.1	1.4	1.2	1.2	1.6	1.6	1.8
18	2.05	1.45	1.45	2.25	1.55	2.75	1.4	1.2	1.3	1.8	2.4	1.6
19	1.95	1.25	1.5	2.2	2.05	2.8	1.2	1.2	1.2	1.6	2.2	1.4
20	2.05	1.3	1.4	2.1	1.85	2.5	1.2	1.4	1.3	1.6	1.8	1.2
21	2.3	2.1	1.35	1.95	1.65	2.2	1.2	1.6	1.6	1.6	1.6	1.0
22	2.55	2.3	1.45	1.85	1.45	2.05	1.2	1.5	1.7	1.6	1.6	1.8
23	2.7	1.85	1.5	1.75	1.45	2.5	1.2	1.4	1.6	1.6	1.6	1.8
24	2.55	1.85	1.45	1.7	1.25	2.45	1.2	1.2	1.5	1.8	1.4	1.6
25	2.1	2.1	1.55	1.6	1.35	2.25	1.2	1.2	1.4	1.9	1.2	1.6
26	1.95	2.0	1.9	1.7	1.45	2.05	1.2	1.2	1.5	2.0	1.5	1.5
27	2.05	1.75	3.7	1.6	3.05	1.95	1.2	1.0	1.6	1.8	1.8	1.4
28	1.85	1.55	3.15	1.55	2.85	2.15	1.2	1.0	1.5	1.8	1.6	1.4
29	1.75	.....	2.25	1.6	2.65	2.05	1.3	.8	1.6	2.0	1.4	1.5
30	1.95	.....	3.15	1.65	2.45	2.15	1.2	1.0	1.6	1.8	1.4	.....
31	1.85	.....	2.75	.....	2.15	.....	1.2	1.0	.....	1.6	.....	.....

NOTE.—There was no ice obstruction previous to January 23. After this date there was some shore ice and some ice at gage, varying from 0.25 to 0.6 foot thick; but the stream was not entirely closed during the winter. During the frozen period gage heights were taken to water surface through a hole in the ice.

Rating table for Chittenango Creek at Chittenango, N. Y., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	20	1.60	85	2.40	275	3.20	630
0.90	25	1.70	100	2.50	315	3.30	680
1.00	30	1.80	115	2.60	355	3.40	735
1.10	35	1.90	135	2.70	395	3.50	790
1.20	40	2.00	155	2.80	440	3.60	850
1.30	50	2.10	180	2.90	485	3.70	910
1.40	60	2.20	210	3.00	530		
1.50	70	2.30	240	3.10	580		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1906, and is well defined.

Monthly discharge of Chittenango Creek at Chittenango, N. Y., for 1906.

[Drainage area, 79 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	395	108	177	2.24	2.58
February	240	45	87.8	1.11	1.16
March	910	55	169	2.14	2.47
April	508	78	217	2.75	3.07
May	555	45	166	2.10	2.42
June	440	45	164	2.08	2.32
July	210	40	68.9	.872	1.01
August	85	20	52.6	.666	.77
September	100	30	51.7	.654	.73
October	155	60	91.6	1.16	1.34
November	275	40	92.7	1.17	1.30
December	630	30	113	1.43	1.65
The year	910	20	121	1.53	20.82

NOTE.—Values are rated as follows: January, March to July, and October to December, good; February, August, and September, fair.

SALMON RIVER BASIN.

DESCRIPTION OF BASIN.

Salmon River rises in the southwestern part of Lewis County, N. Y., flows first southward then northwestward, and enters Lake Ontario near Port Ontario. The basin above the gaging station is rolling and very sandy, rock lying near the surface in the upper part of the watershed, where there are also extensive tracts of original forest. The region is subject to heavy falls of snow, which sometimes accumulates in the forest areas to a depth of several feet and melts gradually during March and April, feeding the stream.

Drainage areas tributary to Salmon River.[a]

	Area.	Total area.
	Sq. miles.	*Sq. miles.*
Salmon River above Osceola	44.04	44.04
Salmon River from Osceola to junction of North Branch	26.03	70.07
North Branch Salmon River:		
Above Mill Creek	83.05	.....
Mill Creek	14.25	.....
From Mill Creek to mouth	2.35	.....
Total	99.65	169.72
Salmon River from North Branch to Salmon Falls	23.70	193.42
Salmon River from Salmon Falls to Beaver Dam Brook	6.05	199.47
Beaver Dam Brook	15.44	214.91
Salmon River from Beaver Dam Brook to Sandbank	1.03	215.94
Salmon River from Sandbank to Orwell Brook	1.28	217.22
Orwell Brook	23.13	240.35
Salmon River from Orwell Brook to Trout Brook	2.10	242.45
Trout Brook	14.40	256.85
Salmon River from Trout Brook to Fox Bridge	1.92	258.77
Salmon River from Fox Bridge to Pulaski	7.49	266.26
Salmon River from Pulaski to mouth	5.90	272.16

[a] From U. S. Geological Survey topographic maps.

SALMON RIVER NEAR PULASKI, N. Y.

This station was established September 5, 1900. It is located at Fox Bridge, near Pulaski, N. Y. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 84, where are given also references to publications that contain data for previous years.

Discharge measurements of Salmon River near Pulaski, N. Y., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 18	E. F. Weeks	182	787	5.60	3,980
August 18	C. C. Covert	170	198	2.40	94
September 20	do	158	176	2.25	54
October 25	Barrows and Covert	175	312	3.20	450

Daily gage height, in feet, of Salmon River near Pulaski, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.18	3.65	3.42	4.42	4.02	2.92	4.45	2.62	2.30	3.30	3.22	3.50
2	3.78	3.25	3.30	4.15	3.90	2.88	3.80	2.52	2.30	2.95	3.10	3.15
3	3.68	3.18	3.60	4.00	4.38	2.82	3.30	2.55	2.38	2.78	3.05	2.92
4	3.90	3.20	4.25	4.25	4.65	2.80	3.75	2.65	2.65	2.50	3.00	3.10
5	4.00	3.25	4.12	4.85	4.82	2.78	4.18	2.70	2.55	2.58	3.00	3.10
6	3.90	3.12	3.72	4.45	4.32	2.95	3.45	2.70	2.40	2.68	2.98	3.18
7	3.50	3.15	3.65	4.12	3.90	2.92	3.15	2.75	2.38	3.82	2.92	3.40
8	3.50	3.20	3.50	4.00	3.60	3.65	2.95	2.65	2.40	3.50	2.88	3.25
9	3.50	3.20	3.42	4.08	3.55	4.35	2.88	2.55	2.32	3.10	2.85	3.22
10	3.40	3.20	3.42	4.08	3.80	3.65	2.90	2.5	2.30	3.55	2.92	3.15
11	3.42	3.18	3.20	4.20	3.78	3.45	3.32	2.62	2.30	3.48	3.18	3.10
12	3.50	3.15	3.25	4.22	3.55	3.18	3.15	2.68	2.25	3.22	3.40	3.00
13	3.40	3.15	3.10	4.50	3.70	2.98	2.90	2.58	2.25	3.05	3.25	3.00
14	3.35	3.20	3.08	4.72	5.10	2.95	2.75	2.50	2.30	2.98	3.12	3.05
15	3.35	3.18	3.08	6.90	4.48	2.82	2.70	2.50	2.25	2.90	2.98	3.25
16	3.38	3.12	3.05	6.35	3.88	2.80	2.65	2.45	2.25	2.80	2.98	4.50
17	3.35	3.15	3.02	5.75	3.58	2.80	2.68	2.42	2.28	2.75	2.95	4.30
18	3.35	3.12	2.95	5.58	3.48	2.80	2.70	2.38	2.25	2.70	3.02	3.70
19	3.32	3.08	3.00	5.52	3.32	2.88	2.65	2.35	2.20	2.62	4.08	3.32
20	3.28	3.08	3.00	5.60	3.20	2.82	2.65	2.35	2.25	4.15	3.88	3.25

Daily gage height, in feet, of Salmon River near Pulaski, N. Y., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	3.68	3.38	2.98	5.15	3.12	2.72	2.70	2.38	2.25	3.95	3.52	3.28
22	4.40	3.95	2.98	5.10	3.10	2.70	2.72	2.45	2.32	3.45	3.58	3.18
23	5.75	3.92	2.92	5.02	3.02	2.78	2.68	2.45	2.58	3.18	3.52	3.00
24	6.80	3.85	2.98	4.45	3.00	2.80	2.65	2.38	2.72	3.02	3.40	2.95
25	5.40	4.05	2.95	4.20	2.98	2.78	2.60	2.35	2.48	3.12	3.25	3.02
26	4.75	4.30	2.98	4.02	3.00	2.70	2.52	2.35	2.40	3.42	3.22	3.18
27	4.40	3.80	4.45	4.02	3.28	2.62	2.50	2.35	2.40	3.30	3.92	3.10
28	4.12	3.55	5.28	4.08	3.75	2.60	2.50	2.35	2.48	3.48	4.60	3.00
29	3.68	.....	5.2	4.00	3.30	2.68	2.50	2.35	2.45	3.75	4.05	3.00
30	3.70	.....	4.95	4.05	3.12	3.30	2.52	2.35	3.32	3.55	3.50	3.00
31	3.78	.....	4.78	.....	3.00	.....	2.65	2.30	.....	3.40	.....	3.70

NOTE.—Stream not entirely closed by ice during winter period, but channel obstructed at times by needle and anchor ice.

Rating table for Salmon River near Pulaski, N. Y., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.20	46	3.40	620	4.60	1,980	5.80	4,490
2.30	67	3.50	697	4.70	2,140	5.90	4,780
2.40	93	3.60	781	4.80	2,300	6.00	5,100
2.50	124	3.70	865	4.90	2,470	6.20	5,770
2.60	161	3.80	965	5.00	2,640	6.40	6,530
2.70	204	3.90	1,060	5.10	2,840	6.60	7,340
2.80	253	4.00	1,170	5.20	3,020	6.80	8,190
2.90	307	4.10	1,300	5.30	3,240	7.00	9,070
3.00	364	4.20	1,420	5.40	3,460	7.20	10,000
3.10	422	4.30	1,550	5.50	3,700	7.40	11,000
3.20	480	4.40	1,680	5.60	3,950	7.60	12,060
3.30	550	4.50	1,830	5.70	4,200		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902 to 1906, and is fairly well defined.

Monthly discharge of Salmon River near Pulaski, N. Y., for 1906.

[Drainage area, 259 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	.....	.....	1,340	5.17	5.96
February	.....	.....	640	2.47	2.57
March	.....	.....	880	3.40	3.92
April	8,620	1,180	2,350	9.07	10.12
May	2,840	349	943	3.64	4.20
June	1,620	161	370	1.43	1.60
July	1,750	124	390	1.51	1.74
August	228	67	125	.483	.56
September	567	46	104	.402	.45
October	1,360	124	519	2.00	2.31
November	1,980	280	606	2.34	2.61
December	1,830	323	554	2.14	2.47
The year	8,620	46	735	2.84	38.51

NOTE.—Values are rated as follows: January to March, fair, on account of ice obstruction; remainder of 1906, good.

BLACK RIVER BASIN.

DESCRIPTION OF BASIN.

Black River rises in the western part of Hamilton County, N. Y., flows southwestward across Herkimer County into Oneida County, turns near Forestport and runs somewhat west of north through Lewis County to eastern Jefferson County, and then flows westward to Black River Bay, at the eastern extremity of Lake Ontario. The upper part of the basin is very rugged and mountainous and contains a large number of lakes.

The flow of the river is controlled by storage on its upper tributaries, including Beaver River at Beaver, a series of reservoirs at the headwaters of Moose River, and additional reservoirs at Forestport and on the headwaters of the main river.

Water is diverted from Black River through Forestport feeder to supply the Black River Canal at Boonville. A portion of this diverted water flows northward from Boonville and enters Black River again at Lyons Falls; the remainder flows southward through the Black River Canal and enters the Erie Canal at Rome. The amount of this diversion, which takes place during the season of canal navigation, is not recorded.

BLACK RIVER NEAR FELTS MILLS, N. Y.

This station was established August 29, 1902. It is located at the dam of the Black River Traction Company, near the village of Felts Mills. The dam is 9 miles upstream from Watertown and 7 miles upstream from the old Huntingtonville gaging station on this stream. The conditions [a] at this station and the bench marks are described in Water-Supply Paper No. 170, page 87, where are given also references to publications that contain data for previous years.

Daily discharge, in second-feet, of Black River at Felts Mills, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7,630	5,390	2,970	7,320	4,790	3,220	3,520	1,530	880	2,360	2,240	3,070
2	7,810	4,490	2,740	6,720	4,360	1,920	6,170	1,710	1,420	2,340	2,020	2,040
3	4,640	3,190	2,440	5,230	4,790	1,920	5,280	1,430	1,350	2,010	1,540	2,700
4	4,790	3,080	4,440	4,790	5,550	1,810	5,280	1,450	1,440	1,290	1,470	2,000
5	5,080	2,740	5,390	5,080	6,030	1,920	5,990	300	1,530	1,320	2,400	1,820
6	6,030	2,540	5,080	5,230	6,540	2,040	2,760	1,620	1,560	1,370	1,530	1,610
7	4,600	2,540	4,220	5,080	6,720	2,170	2,810	1,590	1,060	1,720	1,450	2,200
8	5,550	2,350	3,560	4,440	5,550	1,920	2,290	1,790	1,260	2,380	1,440	2,020
9	5,080	2,350	3,190	5,080	4,940	2,290	2,540	1,680	890	2,190	1,500	1,750
10	3,690	2,350	2,540	4,490	4,360	2,290	2,420	1,500	980	2,190	1,350	2,260
11	3,440	2,950	2,540	4,350	4,360	2,950	2,810	1,470	980	2,600	1,470	1,780
12	3,310	2,740	3,690	4,790	4,360	3,520	3,080	1,080	700	2,500	2,410	1,860
13	3,190	2,160	2,540	5,390	3,960	3,220	2,540	1,410	1,410	2,690	2,320	1,780
14	2,680	2,160	2,540	5,870	8,010	3,220	2,040	1,440	1,380	2,120	2,230	2,390
15	2,630	2,740	2,540	6,930	8,400	2,170	1,170	1,830	1,240	1,790	2,150	1,890

[a] Owing to high water it was impossible to obtain a profile of the crest of this dam until August, 1906. Previous estimates for this station have been made from elevations taken at the ends of the crest, and the dam assumed to be level. The 1906 profile shows more or less settlement near the center; hence an increase in discharge of about 10 per cent for the same gage height over previous estimates. The dam was constructed in 1900, and the recomputations are based on the assumption that the settlement has been proportionate each year.

Daily discharge, in second-feet, of Black River at Felts Mills, N. Y., for 1906—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Dec.	Dec.
16	2,630	2,350	2,350	9,830	9,210	1,920	1,360	1,220	890	1,560	2,030	2,810
17	2,540	2,160	1,990	13,400	8,790	2,290	1,470	1,110	1,220	1,470	2,110	3,340
18	4,490	1,920	1,360	14,200	8,010	3,370	1,470	840	1,280	1,440	2,120	2,890
19	3,690	2,970	2,440	12,900	6,030	2,950	1,470	80	960	1,440	5,230	2,940
20	3,690	1,990	1,910	11,900	4,870	2,040	1,080	1,700	1,480	2,380	5,210	2,740
21	3,220	1,990	1,630	11,600	3,220	1,920	1,080	1,300	1,180	3,570	4,730	2,480
22	7,710	4,790	2,250	11,300	3,220	1,990	1,080	1,440	970	3,640	4,590	2,270
23	13,400	4,490	1,750	11,600	3,220	1,700	1,850	1,680	590	3,120	4,140	1,700
24	18,100	4,490	2,070	10,500	2,680	1,700	1,380	1,910	1,700	2,560	3,580	1,280
25	18,800	4,440	1,360	10,000	2,540	1,920	1,840	1,540	1,660	2,180	3,160	1,080
26	19,000	5,710	2,250	8,590	2,420	1,810	1,230	1,310	1,550	2,280	3,130	1,970
27	19,000	4,490	2,630	7,260	3,220	1,470	1,070	1,840	1,180	2,370	2,990	1,710
28	11,600	4,490	6,370	6,370	4,120	1,410	870	1,300	1,040	2,420	5,030	1,650
29	9,000	.....	7,630	5,450	5,100	1,430	800	1,280	860	3,740	4,500	1,620
30	6,200	.....	7,260	5,710	5,100	723	1,650	1,350	1,150	2,940	3,750	1,470
31	6,030	.....	7,440	.....	3,960	.....	1,330	1,390	.....	2,670	.....	2,390

NOTE.—The Harmon Paper Company began operations January 2, using a part of the flow; and no records were kept of run of wheels or tailrace gage until after May 1; hence the discharges for this period are considerably in error. On October 26 and 27 and November 17 and 18, the crest of dam was obstructed by logs. The following ice conditions prevailed during December, 1906: December 1 to 3, anchor ice in wheel racks, river partly frozen over; December 7, pond frozen over, ice within 75 feet of crest of dam; December 8, ice up to crest; December 21, ice frozen on crest and holding water back; December 31, ice gone from crest.

Monthly discharge of Black River at Felts Mills, N. Y., for 1906.

[Drainage area, 1,850 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	19,000	2,540	7,070	3.82	4.40
February	5,710	1,920	3,220	1.74	1.81
March	7,630	1,360	3,330	1.80	2.08
April	14,200	4,350	7,710	4.17	4.65
May	3,210	2,420	5,110	2.76	3.18
June	3,520	723	2,170	1.17	1.30
July	6,170	800	2,310	1.25	1.44
August	1,910	80	1,390	.750	.86
September	1,700	590	1,190	.643	.72
October	3,740	1,290	2,280	1.23	1.42
November	5,230	1,350	2,790	1.51	1.68
December	3,340	1,080	2,110	1.14	1.31
The year	19,000	80	3,380	1.83	24.85

NOTE.—Values May to December are rated as good; prior to May the probable error is greater than 10 per cent.

MOOSE RIVER AT MOOSE RIVER, N. Y.

This station was established June 5, 1900. It is located at Moose River village. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 89, where are given also references to publications that contain data for previous years.

Discharge measurements of Moose River at Moose River, N. Y., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 7	Covert and Weeks	217	730	2.52	791
September 22	C. C. Covert	212	440	.97	238
September 23	do	215	630	1.72	582
September 24	do	213	596	1.68	545

Daily gage height, in feet, of Moose River at Moose River, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.92	2.78	2.53	2.58	3.38	2.03	2.83	1.73	0.90	1.95	1.10	2.25
2	2.67	2.68	2.43	2.58	3.33	1.88	3.43	1.68	.80	1.20	1.50	2.00
3	2.72	2.53	2.33	2.48	4.28	1.73	2.93	1.73	.95	1.20	1.50	1.70
4	2.72	2.38	2.58	2.38	4.38	1.63	3.18	1.73	1.60	1.00	1.40	1.60
5	2.72	2.23	2.68	2.63	4.43	1.53	2.93	1.63	1.20	.90	1.40	1.40
6	2.62	2.03	2.48	2.73	4.93	1.43	2.43	1.63	.75	1.05	1.40	1.55
7	2.52	1.93	2.28	2.53	4.53	1.53	3.13	1.53	.60	1.25	1.50	1.60
8	2.52	2.03	2.13	2.33	4.23	2.38	1.78	1.28	.50	1.40	1.40	1.70
9	2.62	2.03	2.03	2.23	3.33	3.63	1.88	1.03	.50	1.30	1.50	1.55
10	2.72	2.03	2.03	2.23	3.33	3.18	1.83	1.03	.55	1.25	1.50	1.35
11	2.62	2.13	1.93	2.43	3.13	2.73	1.73	.93	.85	1.70	1.60	1.15
12	2.57	2.13	1.83	2.38	3.03	2.53	1.63	1.03	1.00	1.65	1.60	1.20
13	2.42	2.03	1.73	2.23	4.28	2.38	1.73	1.13	1.00	1.65	1.70	1.35
14	2.27	1.93	1.68	2.43	6.13	1.98	1.73	1.03	1.30	1.65	1.65	1.60
15	2.22	1.93	1.63	5.73	5.13	1.83	1.63	.93	1.00	1.45	1.70	1.70
16	2.12	2.03	1.63	5.98	4.28	1.73	1.53	.83	1.00	1.40	1.85	1.75
17	2.12	2.03	1.63	5.23	4.13	1.98	1.43	.73	.90	1.40	2.20	1.80
18	2.25	2.13	1.53	5.03	3.98	1.83	1.38	.73	.00	1.50	2.85	1.75
19	2.45	2.13	1.53	5.33	3.78	1.93	1.28	.63	.65	1.65	3.05	1.60
20	2.60	2.28	1.43	5.43	3.33	1.93	1.18	.63	.85	2.20	2.95	1.50
21	3.47	2.53	1.23	5.58	2.93	1.83	1.13	1.03	.75	2.05	2.75	1.50
22	3.97	2.78	1.43	5.83	2.63	1.83	1.03	1.23	.80	2.00	2.55	1.40
23	5.27	2.93	1.53	5.33	2.28	1.73	1.03	1.33	1.65	2.05	2.35	1.40
24	7.77	3.03	1.63	4.63	2.18	1.73	.93	1.43	1.60	1.90	2.15	1.40
25	5.27	3.08	1.73	4.28	2.08	1.78	.93	1.53	1.65	1.80	1.95	1.30
26	4.72	2.98	1.73	3.93	2.83	1.73	.93	1.53	1.25	1.70	2.15	1.30
27	4.37	2.78	2.13	3.83	3.38	1.63	.83	1.53	.95	1.80	2.50	1.30
28	4.08	2.63	2.53	3.53	3.93	1.53	.83	1.43	.75	1.90	2.75	1.20
29	3.53	.....	2.73	3.13	3.48	1.43	.83	1.33	1.15	1.80	2.95	1.20
30	3.28	.....	2.68	3.48	2.93	1.83	.93	1.33	1.90	1.60	2.55	1.20
31	2.93	.....	2.63	.....	2.43	.....	1.78	1.23	.....	1.35	.....	1.20

NOTE.—The river was not entirely closed by ice during 1906. There was considerable shore ice during the latter part of February and through March, ice going out the 4th of April. At times needle ice forms on the rifts below the gage and causes backwater. During the frozen period, gage heights were taken to water surface through a hole in the ice.

Rating table for Moose River at Moose River, N. Y., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	103	1.40	354	2.80	914	5.40	3,180
0.10	115	1.50	382	2.90	968	5.60	3,440
0.20	127	1.60	412	3.00	1,023	5.80	3,700
0.30	140	1.70	444	3.20	1,139	6.00	3,980
0.40	154	1.80	477	3.40	1,264	6.20	4,260
0.50	170	1.90	511	3.60	1,399	6.40	4,555
0.60	187	2.00	547	3.80	1,545	6.60	4,855
0.70	205	2.10	585	4.00	1,700	6.80	5,160
0.80	223	2.20	626	4.20	1,870	7.00	5,480
0.90	242	2.30	669	4.40	2,060	7.20	5,800
1.00	262	2.40	715	4.60	2,260	7.40	6,130
1.10	282	2.50	763	4.80	2,480	7.60	6,470
1.20	304	2.60	812	5.00	2,700	7.80	6,810
1.30	328	2.70	862	5.20	2,940		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1906, and is well defined between gage heights 1.0 foot and 5.0 feet. Measurements above gage height 6.0 feet are impossible at this station, owing to the flashy character of the stream and to large quantities of ice and logs running during high stages. Hence discharges of over 4,000 second-feet are liable to error.

Monthly discharge of Moose River at Moose River, N. Y., for 1906.

[Drainage area, 346 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	6,760	593	1,320	3.82	4.40
April	3,950	639	1,710	4.94	5.51
May	4,160	577	1,530	4.42	5 10
June	1,420	362	557	1.61	1.80
July	1,280	228	500	1.45	1.67
August	454	192	324	.936	1.08
September	511	[a] 103	267	.772	.86
October	626	242	413	1.19	1.37
November	1,050	282	580	1.68	1.87

[a] The low minimum for September was caused by the storage of water by the dam at McKeever.

NOTE.—Values are rated as follows: January to May and September, good; June to August, October, and November, excellent.

ST. LAWRENCE RIVER DRAINAGE.

GENERAL FEATURES.

St. Lawrence River receives the flow of a number of New York streams having their sources in a northerly slope of the Adirondacks and fed by the innumerable lakes with which the region is dotted. Some of these rivers, as the Grass, Raquette, and St. Regis, lie entirely within the United States; others, notably Salmon, Trout, Chateaugay, and English rivers, cross the international boundary and flow northward into the St. Lawrence in Canada, as does also Richelieu River, the outlet of Lake Champlain. The following table gives a list of the principal tributaries of the St. Lawrence in the United States, with the areas drained by them:

Drainage areas of St. Lawrence River tributaries in the United States.

	Square miles.		Square miles.
Oswegatchie River	1,609	Salmon River [a]	273
Grass River	637	Trout River [b]	129
Raquette River	1,219	Chateaugay River [b]	199
St. Regis River	910	English River [b]	53
Little Salmon River [a]	103	Lake Champlain [b]	8,187

The St. Lawrence drains, through Lake Champlain, an area of 4,560 square miles in the State of Vermont. This drainage is practically all from Missisquoi, Lamoille, and Winooski rivers and Otter Creek.

OSWEGATCHIE RIVER BASIN.

DESCRIPTION OF BASIN.

Oswegatchie River has its source in the region of lakes and timbered swamps in the southern part of St. Lawrence County, N. Y.

[a] Above junction near international boundary. [b] Above New York State line.

The largest of the lakes is Cranberry Lake, which affords valuable storage to water-power users on its outlet, East Branch of Oswegatchie River. East and West branches flow in a general northwesterly direction and unite near Talcville. From Gouverneur to Oxbow the river flows southwestward; it then turns sharply and flows northeastward to Rensselaer Falls, turns again to the northwest, receives the outlet of Black Lake at Galilee, and finally enters the St. Lawrence at Ogdensburg.

OSWEGATCHIE RIVER NEAR OGDENSBURG, N. Y.

This station was established May 16, 1903. It is located at Eel Weir Bridge, just below the junction of Oswegatchie River and Black Lake outlet. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 93, where are given also references to publications that contain data for previous years.

Discharge measurements of Oswegatchie River near Ogdensburg, N. Y., in 1903–1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1903.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 5	Covert and Halsey		269	4.70	1,040
May 14	H. H. Halsey		256	4.60	830
May 14	do		256	4.60	729
September 22	C. C. Covert		261	4.70	812
1904.					
April 8	Covert and Swancott		1,170	8.10	9,460
April 10	do		1,180	8.05	9,550
July 4	C. C. Covert		306	4.80	1,210
October 23	A. M. Evans		549	5.68	2,410
October 23	do		536	5.64	2,370
1905.					
March 26	Horton and Mott	269	1,200	8.02	9,240
March 26	do	269	1,230	8.15	9,010
April 14	C. C. Covert	267	1,000	7.24	7,240
April 16	do	267	975	7.12	6,930
April 17	do	267	925	6.92	6,190
1906.					
April 19	C. C. Covert	267	854	6.60	5,430
April 20	do	267	842	6.60	5,380
August 16	Covert and Weeks	240	377	4.90	987
October 27	Barrows and Covert	254	814	6.61	4,640

Daily gage height, in feet, of Oswegatchie River near Ogdensburg, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.2	7.0	5.75	6.8	5.55	5.2	4.9	4.7	4.5	4.65	6.4	6.6
2	7.4	6.85	5.4	6.65	5.4	5.1	4.9	4.7	4.5	4.7	6.35	6.55
3	7.3	6.5	5.25	6.5	5.5	5.1	4.85	4.7	4 5	4.75	6.15	6.45
4	7.2	6.15	5.25	6.55	5.55	5.0	4.9	4.95	4.5	4.8	6.0	6.25
5	7.2	6.0	5.6	6.3	5.5	5.0	5.05	5.1	4.55	4.8	5.95	6.05
6	7.1	5.9	5.7	6.1	5.7	4.9	5.3	5.3	4.75	4.95	5.85	5.9
7	7.1	5.7	5.7	6.05	5.65	4.8	5.45	5.35	4.9	5.1	5.7	5.9
8	7.1	5.55	5.65	5.9	5.55	5.25	5.55	5.2	4.9	5.3	5.7	5.95
9	6.85	5.45	5.55	5.9	5.55	5.75	5.55	5.1	4.85	5.75	5.7	5.95
10	6.8	5.4	5.45	5.9	5.5	6.2	5.5	5.0	4.8	5.75	5.55	5.8

Daily gage height, in feet, of Oswegatchie River near Ogdensburg, N. Y., for 1906— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	6.65	5.3	5.4	5.95	5.5	6.4	5.5	5.0	4.8	5.75	5.4	5.8
12	6.4	5.2	5.25	6.1	5.4	6.5	5.4	4.8	4.8	6.0	5.4	5.8
13	6.35	5.1	5.2	6.15	5.4	6.6	5.4	4.8	4.8	6.1	5.65	5.65
14	6.2	5.1	5.2	6.3	5.35	6.5	5.4	4.8	4.8	6.1	5.65	5.5
15	6.05	5.1	5.15	6.2	5.55	6.4	5.4	4.75	4.8	6.15	5.4	5.55
16	5.9	5.0	5.1	6.25	5.6	6.35	5.4	4.75	4.8	6.1	5.45	5.5
17	5.9	5.0	5.1	6.25	5.95	6.15	5.3	4.7	4.8	6.1	5.4	5.7
18	5.85	4.9	5.1	6.35	5.95	6.0	5.2	4.7	4.7	6.05	5.45	5.95
19	6.1	4.9	5.1	6.45	5.9	6.0	4.95	4.6	4.7	6.0	5.65	6.15
20	5.85	4.9	5.0	6.5	5.85	5.8	4.9	4.6	4.7	6.1	5.7	5.9
21	5.85	5.0	5.0	6.5	5.85	5.65	4.9	4.6	4.6	6.1	5.7	5.8
22	6.3	5.2	4.95	6.35	5.65	5.55	4.9	4.55	4.6	6.55	6.6	5.6
23	7.15	5.65	4.9	6.3	5.6	5.4	4.9	4.45	4.6	6.65	6.45	5.8
24	7.45	5.7	4.85	6.3	5.55	5.4	4.8	4.4	4.6	6.65	6.35	5.5
25	7.8	5.8	4.75	6.25	5.4	5.4	4.8	4.4	4.6	6.7	6.35	5.6
26	7.9	5.9	4.7	6.2	5.4	5.3	4.8	4.5	4.6	6.7	6.3	5.4
27	8.1	5.85	5.0	6.2	5.15	5.15	4.8	4.5	4.6	6.6	6.3	5.3
28	7.95	5.85	5.5	6.0	5.2	5.1	4.7	4.5	4.6	6.7	6.35	5.3
29	7.9	.....	6.1	5.9	5.2	5.1	4.7	4.5	4.75	6.65	6.5	5.3
30	7.55	.....	6.65	5.9	5.25	4.9	4.7	4.5	4.7	6.45	6.55	5.3
31	7.3	.....	6.8	.....	5.2	.....	4.7	4.5	.....	6.3	.....	5.3

NOTE.—The river never freezes over at the gage owing to the swift current. Ice forming on rifts, about one-half mile below, occasionally causes backwater.

Rating table for Oswegatchie River near Ogdensburg, N. Y., for 1903–1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.40	590	5.60	2,400	6.80	5,775	8.00	9,350
4.50	680	5.70	2,640	6.90	6,070	8.20	9,960
4.60	780	5.80	2,890	7.00	6,365	8.40	10,570
4.70	890	5.90	3,100	7.10	6,660	8.60	11,180
4.80	1,010	6.00	3,440	7.20	6,955	8.80	11,790
4.90	1,140	6.10	3,730	7.30	7,250	9.00	12,400
5.00	1,280	6.20	4,020	7.40	7,550	9.20	13,020
5.10	1,440	6.30	4,310	7.50	7,850	9.40	13,640
5.20	1,610	6.40	4,600	7.60	8,150	9.60	14,260
5.30	1,790	6.50	4,890	7.70	8,450	9.80	14,880
5.40	1,980	6.60	5,185	7.80	8,750	10.00	15,500
5.50	2,180	6.70	5,480	7.90	9,050		

NOTE.—The above table is applicable only for open-channel conditions. It is based on nineteen discharge measurements made during 1903–1906. Although the discharge measurements plot somewhat erratically, the curve may be considered fairly well defined owing to the constancy of conditions of flow from year to year.

Monthly discharge of Oswegatchie River near Ogdensburg, N. Y., for 1903–1906.

[Drainage area, 1,580 square miles.]

Month.	Discharge in second-feet			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1903.					
April (22–30)	4,020	1,790	2,670	1.69	0.57
May	1,520	590	903	.572	.66
June	2,180	590	1,210	.766	.85
July	1,790	680	1,220	.772	.89
August	2,890	950	2,070	1.31	1.51
September	1,010	680	876	.554	.62
October	5,480	680	3,090	1.96	2.26
November	2,400	1,010	1,660	1.05	1.17
December	1,610	890	1,060	.671	.77

Monthly discharge of Oswegatchie River near Ogdensburg, N. Y., for 1903–1906—Cont'd.

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1904.					
January	3,880	780	1,400	0.886	1.02
February	1,980	1,280	1,610	1.02	1.10
March	15,300	1,610	6,150	3.89	4.48
April	14,300	4,160	7,860	4.97	5.54
May	5,480	1,790	3,260	2.06	2.38
June	2,520	780	1,360	.861	.96
July	1,610	780	1,120	.709	.82
August	1,520	680	1,020	.646	.74
September	3,730	1,140	1,460	.924	1.03
October	5,180	1,980	3,040	1.92	2.21
November	2,890	780	1,480	.937	1.05
December	1,520	680	838	.530	.61
The year	15,300	680	2,550	1.61	21.94
1905.					
January	5,630	890	1,830	1.16	1.34
February	890	680	796	.504	.52
March	15,800	680	3,750	2.37	2.73
April	15,800	2,760	7,470	4.73	5.28
May	4,160	2,180	2,960	1.87	2.16
June	5,480	1,790	4,000	2.53	2.82
July	5,480	1,440	2,770	1.75	2.02
August	3,730	1,440	2,310	1.46	1.68
September	2,400	1,140	1,710	1.08	1.20
October	3,160	1,010	1,690	1.07	1.23
November	3,160	1,610	2,210	1.40	1.56
December	6,660	1,440	3,120	1.97	2.27
The year	15,800	680	2,880	1.82	24.81
1906.					
January	9,660	3,020	6,070	3.84	4.43
February	6,360	1,140	2,520	1.59	1.66
March	5,780	890	2,030	1.28	1.48
April	5,780	3,160	4,120	2.61	2.91
May	3,300	1,520	2,280	1.44	1.66
June	5,180	1,010	2,600	1.65	1.84
July	2,290	890	1,460	.924	1.07
August	1,880	590	977	.618	.71
September	1,140	680	886	.561	.63
October	5,480	835	3,410	2.16	2.49
November	5,180	1,980	3,320	2.10	2.34
December	5,180	1,790	2,910	1.84	2.12
The year	9,660	590	2,720	1.72	23.34

NOTE.—Above values 1903–1906 are rated as good.

RAQUETTE RIVER BASIN.

DESCRIPTION OF BASIN.

Raquette River drains a long, narrow basin extending from northern Hamilton County to St. Lawrence River. Its sources are on an elevated plateau, dotted with mountains interspersed with lakes. The region is timbered, but numerous marsh and swamp areas exist, many of which are on the divide and feed streams flowing in opposite directions. The lakes of the headwaters afford ample opportunities for storage development.

Observations at the dam of the Hannawa Falls Power Company were taken from September, 1902, to March 31, 1903. The discharge has not been computed. The Sunday flow of this stream, like many

others in this State, is often held back during the low-water season while ponds at mills above are being refilled. Where there is extensive pondage of this character the resultant effect may be shown in the stream for several days.

RAQUETTE RIVER AT MASSENA SPRINGS, N. Y.

This station was established at the highway bridge at Massena Springs, September 21, 1903. Observations were continued until October 17, 1903, when the station was temporarily abandoned. It was resumed April 9, 1904. The conditions at this station and the bench marks[a] are described in Water-Supply Paper No. 170, page 94, where are given also references to publications that contain data for previous years.

Discharge measurements of Raquette River at Massena Springs, N. Y., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 19	C. C. Covert	176	954	5.38	3,390
April 20	do	176	975	5.45	3,500
August 14	Covert and Weeks	175	581	3.38	1,440
August 15	E. F. Weeks	175	426	2.53	1,010
October 27	Barrows and Covert	172	629	3.65	1,780

Daily gage height, in feet, of Raquette River at Massena Springs, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.2	6.65	5.5	4.0	5.85	5.45	3.55	3.6	2.2	2.45	3.2	4.0
2	4.75	6.45	5.15	5.1	5.75	5.5	4.0	3.45	1.5	2.4	3.5	3.9
3	4.8	6.25	5.1	5.2	5.55	5.35	3.9	3.15	2.1	2.35	3.35	4.75
4	5.7	5.8	5.0	4.55	5.5	5.3	2.5	2.9	2.0	2.2	2.2	5.75
5	5.8	6.2	4.65	4.15	5.5	5.35	4.15	1.8	1.95	2.1	3.15	7.0
6	5.8	5.8	4.55	4.0	5.5	5.5	4.0	2.85	1.85	2.1	3.15	7.55
7	4.4	5.75	4.45	4.0	5.5	5.4	4.1	2.9	1.8	1.6	3.0	7.9
8	5.65	5.95	4.6	3.75	5.5	5.55	3.65	2.8	1.8	2.05	2.4	8.5
9	5.8	6.0	4.75	4.05	5.6	6.3	3.95	2.8	1.65	2.15	3.05	8.05
10	5.7	6.1	4.9	3.95	5.45	5.95	4.0	2.9	2.8	2.2	3.25	7.85
11	5.7	5.75	4.9	3.8	5.35	6.45	4.0	2.9	2.8	2.45	3.05	8.05
12	5.55	6.5	4.75	3.7	5.55	5.9	4.0	2.05	2.7	2.5	3.4	7.35
13	5.45	6.05	4.7	3.75	5.1	5.8	4.0	2.85	2.65	2.5	3.35	7.6
14	4.75	6.0	4.7	3.7	6.9	5.75	3.9	2.75	2.6	2.0	3.05	7.5
15	5.55	5.9	4.7	3.05	6.45	5.7	3.25	2.35	2.6	2.5	2.75	7.5
16	5.3	5.95	4.55	5.3	6.3	5.7	4.0	2.1	1.8	2.5	2.7	7.4
17	4.95	5.95	4.45	5.1	6.25	5.65	4.0	2.25	2.6	2.6	3.05	7.7
18	5.0	5.6	4.35	5.75	6.05	5.95	4.0	2.3	2.7	2.6	2.6	7.3
19	5.05	5.8	4.2	5.6	5.85	5.6	4.0	1.2	2.7	2.6	4.05	6.7
20	5.3	5.7	4.2	5.35	5.05	5.35	4.0	1.95	2.7	2.6	3.95	6.9
21	5.7	5.75	4.1	5.5	5.85	5.05	3.85	1.85	2.6	2.2	3.6	6.9
22	9.65	5.85	4.3	5.45	5.70	4.75	3.5	1.8	2.6	2.9	3.8	6.9
23	10.6	6.0	4.6	6.1	5.65	4.55	3.65	1.75	1.7	2.9	3.8	6.9
24	9.05	6.0	4.7	5.95	5.55	4.1	3.55	1.7	2.65	2.9	3.85	6.5
25	7.5	5.85	3.45	6.05	5.45	4.0	3.4	1.7	2.7	3.85	3.45	5.7

[a] During 1906 the vertical staff gage used in previous years was replaced by a standard chain gage, length of chain 28.84 feet. All 1906 gage heights are referred to its datum which is 1 foot below that of the staff gage. Previous gage heights should have 1 foot added to correspond to those of 1906. The gage was read during 1906 by G. T. Buffum and C. A. Waitt. The bench mark is on the upstream corner of the right abutment; elevation 25.39 feet. The reference point is on the end of the needle beam to sidewalk near the zero of gage scale; elevation 24.31 feet; elevations are above the datum of the new gage.

Daily gage height, in feet, of Raquette River at Massena Springs, N. Y., for 1906—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	7.3	5.8	4.7	6.0	5.40	4.0	3.5	1.45	2.7	4.05	4.05	5.2
27	7.05	5.75	5.2	5.85	4.80	4.0	3.5	1.9	2.65	3.85	4.15	6.3
28	6.65	5.7	6.3	5.65	4.95	4.0	3.5	1.95	2.6	3.4	4.1	6.1
29	6.3	.....	6.45	4.85	5.15	4.0	2.8	2.1	2.6	3.85	3.95	5.2
30	6.35	.....	6.15	5.9	5.35	3.9	3.7	2.2	1.5	3.6	4.1	6.3
31	6.9	.....	5.8	.....	5.35	.....	3.8	2.2	.....	3.15	.....	5.6

NOTE.—The following ice conditions prevailed during 1906: River began to freeze over about the middle of January, one-fourth mile below gage being entirely closed; ice about 0.65 foot thick. Freezing began at the gage about February 1; February 28 ice all gone at gage; river still frozen over about one-fourth mile below. Ice went out of river about March 31. Needle ice forms at times and causes backwater. December 2, river began filling with needle ice below gage, causing a rise of nearly 4 feet. During the frozen period in December gage heights were taken to top of ice. The following comparative readings were also taken:

Date.	Water surface.	Top of ice.	Thickness of ice at gage.
	Feet.	*Feet.*	*Feet.*
December 15	7.5	7.4	[a] 0.65
December 19	6.5	6.7	[a] .83
December 22	6.8	6.9	.83
December 26	5.0	5.2	1.16
December 29	4.9	5.2	[b] 1.70

[a] Anchor ice. [b] Anchor ice gone.

Rating table for Raquette River at Massena Springs, N. Y., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	265	2.60	1,005	3.90	2,040	5.40	3,435
1.30	310	2.70	1,070	4.00	2,130	5.60	3,625
1.40	355	2.80	1,140	4.10	2,220	5.80	3,820
1.50	400	2.90	1,210	4.20	2,310	6.00	4,020
1.60	445	3.00	1,285	4.30	2,400	6.20	4,220
1.70	495	3.10	1,360	4.40	2,490	6.40	4,420
1.80	545	3.20	1,435	4.50	2,580	6.60	4,620
1.90	595	3.30	1,515	4.60	2,675	6.80	4,820
2.00	650	3.40	1,595	4.70	2,770	7.00	5,020
2.10	705	3.50	1,680	4.80	2,865	8.00	6,020
2.20	760	3.60	1,770	4.90	2,960	9.00	7,020
2.30	820	3.70	1,860	5.00	3,055	10.00	8,020
2.40	880	3.80	1,950	5.20	3,245	11.00	9,020
2.50	940						

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1906, and is well defined below gage height 7 feet.

Monthly discharge of Raquette River at Massena Springs, N. Y., for 1906.

[Drainage area, 1,170 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	8,620	2,490	4,140	3.54	4.08
March	4,470	1,640	2,910	2.49	2.87
April	4,120	1,320	2,920	2.50	2.79
May	4,920	2,860	3,640	3.11	3.58
June	4,470	2,040	3,250	2.78	3.10
July	2,260	940	1,900	1.62	1.87
August	1,770	265	875	.748	.86
September	1,140	400	851	.727	.81
October	2,180	445	1,100	.940	1.08
November	2,260	760	1,600	1.37	1.53

NOTE.—Values are rated as follows: January and March, fair; April to November, excellent.

LAKE CHAMPLAIN DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Lake Champlain occupies a long and narrow valley, extending in a north-south direction, and forming a part of the boundary between New York and Vermont. The elevation of the lake is about 95 feet above tide, and the water-surface area is 436 square miles.

The drainage basin is irregular in form, being about 75 miles wide from a point opposite Middlebury, Vt., northward to the outlet of the lake at Rouse Point, on the international boundary. South of Middlebury the average width of the basin is about 35 miles and the lake itself is very narrow, forming virtually a drowned river. The drainage is received almost entirely through large tributaries, there being little direct coast drainage into the lake. The outlet of the lake is Richelieu River, which flows northward from Rouse Point to St. Lawrence River.

In estimating the run-off from this basin in previous years the drainage area has been taken as 7,500 square miles. The areas of the tributary basins are given in Water-Supply Paper No. 170, pages 97–98.

The land drainage area above Rouse Point is 7,463 square miles; hence the run-off as heretofore computed represents substantially the outflow expressed as depth in inches on the land surface. As the precipitation on the lake probably exceeds the evaporation, the water surface of the lake, 436 square miles, should be added to the land area and the run-off computed for the whole drainage basin, 7,899 square miles.

The daily discharge of the lake has been determined from observations of the depth and discharge over the Chambly dam, 35 miles below the head of Richelieu River, made in 1898 by the United States Board on Deep Waterways. A rating table has been derived from the observations at the Chambly dam and the gage readings taken at Rouse Point. The area tributary to the river between Rouse Point and Chambly is 310 square miles, making the total drainage basin above Chambly 8,209 square miles.

RICHELIEU RIVER AT FORT MONTGOMERY, N. Y.

A record of the height of Lake Champlain at Rouse Point, at the head of Richelieu River, the outlet of the lake, has been kept by the United States Corps of Engineers, beginning in 1875. Through the courtesy of Capt. Harry Taylor, the gage readings taken by William McComb, the fort keeper, at 9 a. m. each day are reported weekly to the United States Geological Survey. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 98, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of Richelieu River at Fort Montgomery, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.05	3.55	3.0	3.1	4.7	4.3	3.5	2.5	1.5	1.1	0.7	1.5
2	2.2	3.4	3.05	3.15	4.75	4.25	3.65	2.5	1.6	1.15	.8	1.5
3	2.15	3.5	3.0	3.2	4.7	4.2	3.4	2.5	1.5	1.1	.9	1.5
4	2.3	3.7	3.0	3.2	4.75	4.1	3.45	2.55	1.45	1.1	.8	1.4
5	2.25	3.35	3.05	3.15	4.65	4.05	3.4	2.5	1.6	1.1	.75	1.4
6	2.3	3.3	3.15	3.2	4.6	4.1	3.4	2.45	1.75	1.35	.8	1.4
7	2.25	3.25	3.2	3.25	4.5	4.0	3.35	2.3	1.6	1.0	.7	1.45
8	2.2	3.3	3.1	3.3	4.5	4.15	3.3	2.25	1.5	1.05	.75	1.5
9	2.25	3.15	3.05	3.4	4.65	4.1	3.4	2.25	1.55	1.5	.7	1.5
10	2.3	3.2	3.05	3.4	4.5	4.15	3.25	2.4	1.5	.9	.75	1.5
11	2.25	3.2	3.05	3.45	4.4	4.05	3.2	2.6	1.55	.9	.8	1.5
12	2.2	3.15	3.0	3.5	4.7	4.1	3.2	2.4	1.65	.8	.7	1.5
13	2.1	3.05	3.05	3.55	4.65	4.05	3.3	2.3	1.8	1.0	.75	1.55
14	2.15	3.0	2.95	4.1	4.55	4.1	3.15	2.05	1.45	.9	.8	1.5
15	2.2	3.0	2.9	3.9	4.65	4.0	3.25	1.95	1.3	.9	.8	1.6
16	2.4	3.1	2.85	3.8	4.7	4.1	3.2	2.0	1.45	.75	.8	1.45
17	2.1	3.05	2.85	4.0	4.65	4.1	3.0	2.15	1.5	.85	.85	1.5
18	2.2	3.1	2.75	4.25	4.7	3.95	3.0	2.0	1.4	.8	1.05	1.4
19	2.1	3.0	2.8	4.3	4.55	3.85	3.05	2.0	1.3	1.0	.95	1.45
20	2.4	3.1	2.7	4.45	4.5	3.75	3.15	1.95	1.3	.75	1.1	1.45
21	2.25	3.15	2.8	4.6	4.4	3.75	3.0	1.9	1.2	.75	1.15	1.4
22	2.3	3.0	2.65	4.7	4.4	3.65	2.95	1.8	1.2	.8	1.2	1.5
23	2.45	3.05	2.55	4.75	4.4	3.6	2.8	1.7	1.15	.9	1.2	1.5
24	2.95	3.2	2.52	4.75	4.3	3.6	2.75	1.65	1.1	.9	1.2	1.5
25	3.2	3.1	2.5	4.85	4.35	3.65	2.6	1.9	1.2	.85	1.35	1.45
26	3.5	3.05	2.55	4.9	4.45	3.75	2.75	1.85	1.4	.9	1.4	1 45
27	3.6	3.05	2.7	4.8	4.35	3.7	2.7	1.8	1.05	1.15	1.3	1.5
28	3.5	3.0	2.55	4.85	4.25	3.6	2.6	1.6	1.1	1.2	1.45	1.55
29	3.55	.....	2.75	4.9	4.3	3.7	2.75	1.5	1.4	.9	1.4	1.6
30	3.7	.....	2.95	4.85	4.3	3.65	2.8	1.55	1.05	.85	1.6	1.6
31	3.5	.....	3.0	.....	4.4	.....	2.5	1.45	.....	.7	.....	1.65

NOTE.—The following ice conditions prevailed during 1906: December 6, 1905, to January 15, 1906, lake closed; ice from 0.5 to 1.0 foot thick. January 20 to February 2, lake open. February 3, lake frozen over, no ice in channel near gage; ice about 0.3 foot thick above gage near breakwater. February 14, ice 0.65 foot thick below gage and 0.35 foot thick above gage. March 15, channel open below gage; ice 0.35 foot thick above gage. March 31, ice all out below breakwater.

Rating table for Richelieu River at Fort Montgomery, N. Y., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.70	5,680	1.70	9,080	2.70	12,520	3.70	16,260
0.80	6,020	1.80	9,420	2.80	12,880	3.80	16,640
0.90	6,360	1.90	9,760	2.90	13,240	3.90	17,020
1.00	6,700	2.00	10,100	3.00	13,600	4.00	17,400
1.10	7,040	2.10	10,440	3.10	13,980	4.20	18,240
1.20	7,380	2.20	10,780	3.20	14,360	4.40	19,080
1.30	7,720	2.30	11,120	3.30	14,740	4.60	19,940
1.40	8,060	2.40	11,460	3.40	15,120	4.80	20,820
1.50	8,400	2.50	11,800	3.50	15,500	5.00	21,700
1.60	8,740	2.60	12,160	3.60	15,880		

NOTE.—The above table is based on discharge measurements made at Chambly dam in 1898 by the United States Board on Deep Waterways.

Monthly discharge of Richelieu River at Fort Montgomery, N. Y., for 1906.

[Drainage area, 7,750 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	16,300	10,300	12,000	1.55	1.79
February	16,300	13,600	14,300	1.85	1.93
March	14,400	11,800	13,200	1.70	1.96
April	21,300	14,000	17,500	2.26	2.52
May	20,600	18,700	19,600	2.53	2.92
June	18,700	15,900	17,200	2.22	2.48
July	16,100	11,800	14,000	1.81	2.09
August	12,200	8,230	10,400	1.34	1.54
September	9,420	6,870	8,070	1.04	1.16
October	8,400	5,680	6,580	.849	.98
November	8,740	5,680	6,650	.858	.96
December	8,910	8,060	8,370	1.08	1.24
The year	21,300	5,680	12,300	1.59	21.57

NOTE.—Discharge not affected by ice conditions on the lake.

SARANAC RIVER NEAR PLATTSBURG, N. Y.

A gaging station was established at the dam of the Plattsburg Electric Light and Power Company, 6 miles above Plattsburg, March 17, 1903. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 102, where are given also references to publications that contain data for previous years.

Daily discharge, in second-feet, of Saranac River near Plattsburg, N. Y., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	763	994	551	1,100	512	966	1,020	610	381	181	722	686
2	660	828	595	946	775	1,050	1,140	501	72	312	581	210
3	603	742	524	723	488	708	964	477	162	337	550	606
4	718	538	1,100	980	889	1,060	950	509	310	412	206	403
5	770	528	1,300	1,100	1,130	688	994	585	385	330	222	326
6	796	513	977	1,160	1,350	749	958	831	373	242	363	548
7	751	496	781	961	1,120	893	806	520	447	80	390	313
8	547	554	654	842	877	739	800	599	338	336	537	550
9	582	539	613	782	882	1,020	1,160	484	106	617	384	156
10	518	624	639	811	785	861	1,000	390	491	471	394	264
11	518	714	546	799	754	1,040	1,210	319	447	434	70	411
12	[a] 408	760	416	663	769	980	835	[a] 338	305	417	479	368
13	299	671	510	738	1,350	1,020	513	356	335	478	346	359
14	554	660	532	1,130	2,120	898	445	399	426	136	307	492
15	403	554	502	1,880	2,090	863	278	539	291	400	286	492
16	717	539	363	1,710	1,820	844	316	476	52	417	408	458
17	572	562	321	1,550	1,520	762	333	438	224	491	487	706
18	496	695	329	1,790	1,600	945	506	330	395	437	109	809
19	469	678	376	1,500	1,260	795	202	[a] 489	419	382	843	403
20	497	479	348	1,270	1,100	609	314	648	381	364	564	453
21	748	940	374	1,340	984	704	421	296	404	42	898	383
22	1,770	1,510	318	1,060	930	1,000	[a] 425	365	415	246	755	423
23	2,260	1,130	372	1,110	694	1,160	430	276	128	398	870	332
24	2,940	1,050	368	1,040	928	587	580	338	185	476	742	275
25	2,350	1,200	419	731	1,280	647	493	339	411	597	321	454
26	1,820	1,610	534	576	1,250	376	514	[a] 332	372	680	848	456
27	1,700	1,030	878	740	1,250	613	638	[a] 332	265	628	648	491
28	1,880	602	1,640	710	1,080	502	656	324	309	328	784	400
29	1,450	.....	1,450	674	1,110	482	170	338	287	557	906	530
30	1,150	.....	1,450	614	1,020	540	514	309	210	556	465	308
31	1,010	.....	1,530	.....	1,000	.....	544	325	.....	637	.....	286

[a] Discharge interpolated.

NOTE.—During January, February, March, and December the dam is slightly obstructed by ice, and discharges are liable to error.

Monthly discharge of Saranac River near Plattsburg, N. Y., for 1906.

[Drainage area, 624 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	2,940	299	991	1.59	1.83
February	1,610	513	776	1.24	1.29
March	1,640	318	687	1.10	1.27
April	1,790	576	1,030	1.65	1.84
May	2,090	488	1,120	1.79	2.06
June	1,160	376	803	1.29	1.44
July	1,210	170	649	1.04	1.20
August	831	276	436	.699	.81
September	491	52	311	.498	.57
October	680	42	401	.643	.74
November	906	70	516	.827	.92
December	809	156	431	.691	.80
The year	2,940	42	679	1.09	14.76

NOTE.—Values are rated as follows: January to March and December, good; April to November, excellent.

OTTER CREEK AT MIDDLEBURY, VT.

This station was established April 1, 1903, by H. K. Barrows. It is located at the railway bridge about one-half mile south of the railway station at Middlebury, Vt. The conditions at this station and the bench marks are described in Water-Supply Paper No. 170, page 106, where are given also references to publications that contain data for previous years.

Discharge measurements of Otter Creek at Middlebury, Vt., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 29[a]	Butterfield and Brett	120	597	15.65	3,760
April 1[a]	A. D. Butterfield	120	711	16.72	4,900
April 4[a]	do	120	768	17.22	5,560
April 10[a]	do	120	581	15.52	3,750
April 10[b]	do	189	1,520	15.50	3,430
May 1[a]	Butterfield and Brett	120	367	13.40	1,370
May 12[a]	G. M. Brett	118	334	12.90	946
1906.					
March 10[c]	H. K. Barrows	106	352	13.40	1,160
April 14	G. M. Brett	133	465	14.25	2,100
September 26	A. D. Butterfield	117	229	12.35	316
November 8	do	117	229	12.27	344

[a] From arch bridge.
[b] From railroad bridge.
[c] River frozen at gage, but open 500 feet below gage for some 800 feet to arch bridge and dam. Gage height to bottom of ice, 12.77 feet; average thickness of ice, 0.70 foot.

Daily gage height, in feet, of Otter Creek at Middlebury, Vt., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		13.4		15.6	14.0	15.45	13.95	13.2	12.6	12.2	12.6	12.85
2		13.2	13.2	15.5	13.75	15.5	14.2	12.8	12.45	12.8	12.6	12.8
3				15.15	14.0	15.55	13.8	12.6	12.35	12.3	12.5	12.55
4				14.75	14.45	15.3	13.4	12.5	12.7	12.3	12.5	.....
5				14.45	14.5	14.9	13.6	12.65	12.6	12.2	12.35	.....
6	13.4			14.6	14.4	14.25	13.4	12.9	12.5	12.15	12.4	.....
7		13.2		14.5	14.1	13.9	13.1	13.15	12.4	12.1	12.4	.....
8				14.2	13.8	14.1	12.85	13.0	12.4	12.0	12.35	.....
9				13.9	13.5	14.5	12.7	12.75	12.4	12.1	12.3	.....
10			13.45	13.7	14.15	14.5	12.8	12.55	12.1	12.2	12.3	.....

Daily gage height, in feet, of Otter Creek at Middlebury, Vt., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	.....	.....	13.7	14.4	14.45	13.0	12.5	12.25	12.2	12.3	.....
12	.....	.....	.....	13.9	14.35	14.2	12.85	12.6	12.3	12.35	12.3	.....
13	12.8	12.5	.....	13.95	14.3	13.7	12.7	12.5	12.3	12.4	12.6	12.35
14	.....	.....	.....	14.25	14.5	13.2	12.6	12.5	12.4	12.6	12.6	.....
15	.....	.....	.....	15.3	14.55	12.95	12.5	12.4	12.4	12.1	12.55	.....
16	.....	.....	12.4	15.5	14.3	12.9	12.4	12.4	12.3	12.3	12.5	.....
17	.....	.....	.....	15.5	14.05	13.0	12.4	12.4	12.0	12.3	12.4	.....
18	.....	.....	.....	15.7	13.8	13.7	12.45	12.4	12.15	12.25	12.45	.....
19	.....	.....	.....	15.95	13.6	13.7	12.4	12.25	12.3	12.15	13.6	12.5
20	12.8	.....	.....	16.3	13.25	13.3	12.4	12.0	12.3	12.05	14.3	.....
21	.....	12.4	.....	16.4	13.1	13.0	12.4	12.5	12.2	13.0	14.2	.....
22	.....	.....	12.3	16.45	12.95	12.9	12.4	12.5	12.2	13.0	13.85	.....
23	.....	.....	.....	16.35	12.8	12.85	12.9	12.45	12.3	12.85	13.6	.....
24	15.5	.....	.....	16.25	12.8	13.2	12.9	12.5	12.2	12.5	13.3	.....
25	15.25	.....	.....	16.15	12.85	13.5	12.7	12.5	12.3	12.5	13.15	.....
26	15.25	.....	.....	15.9	13.1	13.4	12.5	12.6	12.35	12.7	12.9	12.3
27	15.55	.....	.....	15.65	13.5	13.1	12.4	13.05	12.3	12.9	13.25	.....
28	15.25	.....	14.7	15.3	14.6	12.85	12.4	14.7	12.2	12.75	13.5	.....
29	14.7	.....	.....	14.9	14.9	12.7	12.7	13.6	12.2	12.6	13.45	.....
30	14.4	.....	.....	14.5	15.1	12.9	13.4	13.2	12.3	12.6	13.1	.....
31	13.7	.....	15.7	.....	15.3	.....	13.6	12.8	.....	12.6	.....	.....

NOTE.—Creek was frozen January 1 to 24, February 3 to March 31, and December 3 to 31. During the frozen period gage heights were taken to water surface through a hole in the ice. The following comparative readings were taken:

Comparative ice and water readings.

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 6	13.4	13.45	0.3	March 10	13.45	13.5	0.6
January 13	12.8	12.9	.6	March 16	12.4	12.45	.5
January 20	12.8	12.9	.5	March 22	12.3	12.4	.6
February 7	13.2	13.3	.5	March 28 [a]	14.7	.....	.....
February 13	12.5	12.3	.5	December 13	12.35	12.35	.5
February 21	12.4	12.5	.9	December 19	12.5	12.6	.6
March 2	13.2	13.3	.7	December 26	12.3	12.45	.7

[a] Water flowing on top of ice.

Rating table for Otter Creek at Middlebury, Vt., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
12.00	220	13.10	1,030	14.20	2,080	15.60	3,610
12.10	275	13.20	1,120	14.30	2,180	15.80	3,830
12.20	335	13.30	1,210	14.40	2,290	16.00	4,070
12.30	400	13.40	1,300	14.50	2,400	16.20	4,310
12.40	470	13.50	1,390	14.60	2,510	16.40	4,550
12.50	540	13.60	1,480	14.70	2,620	16.60	4.790
12.60	615	13.70	1,580	14.80	2,730	16.80	5,030
12.70	695	13.80	1,680	14.90	2,840	17.00	5,270
12.80	775	13.90	1,780	15.00	2,950	17.20	5,510
12.90	860	14.00	1,880	15.20	3,170	17.40	5,750
13.00	945	14.10	1,980	15.40	3,390		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905–6, and is well defined between gage heights 13.0 feet and 18.0 feet. Mean monthly discharge computed from the above should be reasonably close, but daily discharges for gage heights below 13.0 feet are liable to considerable error. Fluctuations caused by the dam below render variable the relation between gage height and the elevation of the water surface at the measuring section.

Monthly discharge of Otter Creek at Middlebury, Vt., for 1905–6.

[Drainage area, 615 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
April	5,630	1,210	2,950	4.80	5.36
May	1,300	400	871	1.42	1.64
June	2,400	335	1,210	1.97	2.20
July	2,620	220	904	1.47	1.70
August	2,730	305	951	1.55	1.79
September	2,890	655	1,570	2.55	2.84
October	860	400	590	.960	1.11
November	1,430	400	625	1.02	1.14
December	2,130	600	969	1.58	1.82
1906.					
April	4,610	1,580	3,130	5.09	5.68
May	3,280	775	1,870	3.04	3.50
June	3,560	695	1,710	2.78	3.10
July	2,080	470	881	1.43	1.65
August	2,620	220	738	1.20	1.38
September	695	220	421	.685	.76
October	945	220	498	.810	.93
November	2,180	400	869	1.41	1.57

NOTE.—Values are rated as follows: October to December, 1905, September and October, 1906, fair; all others, good.

WINOOSKI RIVER AT RICHMOND, VT.

This station was established June 25, 1903, by H. K. Barrows, at the steel highway bridge one-fourth mile south of the railway station at Richmond, Vt. The conditions [a] at this station and the bench marks are described in Water-Supply Paper No. 170, page 108, where are given also references to publications that contain data for previous years.

Discharge measurements of Winooski River at Richmond, Vt., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 9 [b]	H. K. Barrows	70	348	5.53	585
March 29	A. D. Butterfield	182	1,590	6.96	3,190
April 13	do	182	1,470	6.57	3,500
April 18	Butterfield and Nye	183	1,960	9.55	9,180
April 25	A. D. Butterfield	180	1,430	6.50	3,380
April 25	G. M. Brett	180	1,430	6.50	3,210
May 23	Butterfield and Brett	180	1,130	4.97	1,240
May 23	do	180	1,130	4.97	1,290
September 25	A. D. Butterfield	145	180	3.92	389
November 30	do	178	1,110	5.10	1,350

[a] Length of chain, 29.47 feet. Gage datum is at elevation 287.63 feet above mean sea level, as determined during 1906 by connecting with the aluminum tablet bench mark of United States Geological Survey in Universalist church foundation.

[b] River frozen at gage; channel open 1,000 feet upstream and one-half mile downstream. Ice very rough, broken, and tilted, reaching to bottom for about two-thirds of section. Gage height is to water surface; gage height to bottom of ice about 3.4 feet; average thickness of ice about 2.8 feet.

Daily gage height, in feet, of Winooski River at Richmond, Vt., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.
1	.....	5.4	.....	5.7	6.6	5.4	5.45	5.05	4.05	4.25	4.5	5.15
2	.....	5.45	5.9	5.4	6.15	5.25	5.1	4.45	3.85	4.05	4.4	5.5
3	.....	6.3	.....	5.3	6.9	5.3	4.75	4.25	5.55	4.1	4.3	5.4
4	.....	6.3	.....	5.5	6.7	5.1	4.9	4.15	6.25	3.8	4.3	6.5
5	5.95	6.3	.....	6.5	6.45	4.85	5.2	4.1	5.0	3.8	4.35	6.2
6	.....	5.9	.....	7.35	6.15	5.1	4.8	4.25	4.6	3.9	4.3	6.1
7	.....	6.25	.....	6.3	5.8	6.55	4.45	5.75	4.4	4.1	4.25	6.0
8	.....	5.9	.....	6.35	5.5	5.9	4.35	4.7	4.05	3.8	4.1	.....
9	.....	5.8	5.5	6.1	5.75	6.1	4.3	4.25	3.95	4.15	4.0	.....
10	.....	.....	.....	5.9	7.3	5.6	4.3	4.15	4.15	4.25	4.2	.....
11	.....	.....	.....	5.6	6.5	5.5	5.35	4.15	4.1	4.25	4.0	.....
12	5.5	.....	.....	6.6	6.05	5.2	4.85	3.75	3.85	4.75	4.6	.....
13	.....	.....	.....	6.7	10.2	4.95	4.5	3.85	3.85	4.7	4.6	.....
14	.....	.....	.....	7.8	8.4	4.8	4.3	3.95	3.95	4.6	4.4	5.9
15	.....	.....	.....	11.7	6.8	4.5	4.05	4.0	3.95	4.5	4.3	.....
16	.....	5.55	5.3	11.4	6.35	4.5	4.25	3.85	3.75	4.7	4.8	.....
17	.....	.....	.....	9.8	6.1	4.5	3.95	3.85	3.7	4.45	4.9	.....
18	.....	.....	.....	9.25	6.1	5.45	3.95	3.75	3.85	4.2	5.3	.....
19	5.4	.....	.....	9.15	5.75	5.05	4.3	3.55	4.15	4.15	7.95	.....
20	.....	.....	.....	8.35	5.35	4.7	4.05	3.45	3.85	5.5	6.55	.....
21	.....	.....	.....	9.5	5.15	4.5	4.65	3.95	3.85	5.7	5.8	5.7
22	.....	.....	.....	9.9	5.25	4.7	5.15	3.75	3.85	5.0	5.7	.....
23	11.2	8.55	5.4	8.1	4.95	5.35	4.55	3.75	3.75	4.7	5.8	.....
24	13.8	.....	.....	7.0	4.85	7.7	4.25	4.0	3.95	4.55	5.3	.....
25	7.75	.....	.....	6.4	5.85	6.4	4.05	3.95	3.95	4.8	4.9	.....
26	6.7	.....	.....	6.3	6.5	5.7	4.0	3.65	3.95	5.3	4.95	.....
27	6.35	.....	.....	6.1	7.25	5.2	4.15	4.15	4.15	4.9	5.7	.....
28	6.2	.....	7.6	6.05	8.15	4.8	3.95	7.9	4.0	4.6	6.15	5.7
29	5.6	.....	6.9	5.9	6.7	5.1	3.9	5.05	4.2	4.7	5.7	.....
30	5.5	.....	6.45	6.4	6.1	5.35	6.65	4.55	4.65	4.5	5.15	.....
31	5.5	.....	6.3	.....	5.65	.....	6.05	4.35	.....	4.4	.....	.....

NOTE.—River frozen January 1 to 22, February 7 to March 28, and December 4 to 31. During the frozen period gage heights were taken to water surface through a hole in the ice. The following comparative readings were taken:

Comparative ice and water readings.

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 5[a]	5.95	5.7	1.1	December 7	6.0	6.15	0.8
January 12	5.5	5.65	1.3	December 14	5.9	6.1	1.4
January 19	5.4	5.55	1.4	December 21	5.7	5.95	1.5
March 9[b]	5.5	6.2	2.8	December 28	5.7	5.9	1.5

[a] Water on top of ice.

[b] During the period from about January 23 to March 28 gage heights give little or no indication of discharge owing to an ice jam at the bridge. See note to measurement made March 9, 1906.

Rating table for Winooski River at Richmond, Vt., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.40	215	4.80	1,060	6.20	2,830	8.20	6,350
3.50	235	4.90	1,165	6.30	2,980	8.40	6,750
3.60	260	5.00	1,275	6.40	3,140	8.60	7,160
3.70	290	5.10	1,385	6.50	3,300	8.80	7,580
3.80	330	5.20	1,500	6.60	3,460	9.00	8,000
3.90	380	5.30	1,615	6.70	3,620	9.20	8,420
4.00	435	5.40	1,735	6.80	3,790	9.40	8,840
4.10	495	5.50	1,860	6.90	3,960	9.60	9,270
4.20	560	5.60	1,985	7.00	4,130	9.80	9,710
4.30	630	5.70	2,115	7.20	4,470	10.00	10,150
4.40	705	5.80	2,250	7.40	4,830	11.00	12,400
4.50	785	5.90	2,390	7.60	5,190	12.00	14,700
4.60	870	6.00	2,530	7.80	5,570		
4.70	960	6.10	2,680	8.00	5,950		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1906 and the form of previous curves. It is well defined between gage heights 3.9 feet and 10.0 feet. An increase in discharge for a given gage height is taking place at this station from year to year. These yearly changes may be due to the scouring effect of ice jams.

Monthly discharge of Winooski River at Richmond, Vt., for 1906.

[Drainage area, 885 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
April	14,000	1,620	5,000	5.65	6.30
May	10,600	1,110	3,230	3.65	4.21
June	5,380	785	1,700	1.92	2.14
July	3,540	380	964	1.09	1.26
August	5,760	225	753	.851	.98
September	2,900	290	615	.695	.78
October	2,120	330	831	.939	1.08
November	5,860	435	1,390	1.57	1.75

NOTE.—Values are rated as follows: April to June, good; July to November, fair.

INDEX.

CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 206.]

The publications of the United States Geological Survey consist of (1) Annual Reports, (2) Monographs, (3) Professional Papers, (4) Bulletins, (5) Mineral Resources, (6) Water-Supply and Irrigation Papers, (7) Topographic Atlas of United States—folios and separate sheets thereof, (8) Geologic Atlas of United States—folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists can be had on application.

Most of the above publications can be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they can be obtained, free of charge (except classes 2, 7, and 8), on application.

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3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they can be had at practically cost.

4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they can be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, hydrographic progress reports.

Series P.—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements (* means out of stock). A detailed index of these reports (1888–1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II*.
1889. Eleventh Annual Report, Part II*.
1890. Twelfth Annual Report, Part II*.
1891. Thirteenth Annual Report, Part III*.
1892. Fourteenth Annual Report, Part II*.
1893. Bulletin No. 131*.
1894. Bulletin No. 131*; Sixteenth Annual Report, Part II*.
1895. Bulletin No. 140*.
1896. Water-Supply Paper No. 11*; Eighteenth Annual Report, Part IV*.
1897. Water-Supply Papers Nos. 15* and 16*; Nineteenth Annual Report, Part IV*.
1898. Water-Supply Papers Nos. 27* and 28*; Twentieth Annual Report, Part IV*.
1899. Water-Supply Papers Nos. 35*, 36*, 37*, 38*, and 39*; Twenty-first Annual Report, Part IV*.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.

1901. East of Mississippi River, Water-Supply Papers Nos. 65* and 75*.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75*.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Water-Supply Papers Nos. 165*, 166*, 167, 168*, 169, 170, and 171.
West of Mississippi River, Water-Supply Papers Nos. 171, 172*, 173*, 174, 175*, 176, 177, and 178.
1906. East of Mississippi River, Water-Supply Papers Nos. 201, 202, 203, 204, 205, 206, and 207.
West of Mississippi River, Water-Supply Papers Nos. 207, 208, 209, 210, 211, 212, 213, and 214.

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