Irrigation Paper No. 203 Series P, Hydrographic Progress Reports, 57

DEPARTMENT OF THE INTERIOR
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CHARLES D. WALCOTT, DIRECTOR

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JAMES, ROANOKE, AND YADKIN
RIVER DRAINAGES)

N. C. GROVER
DISTRICT HYDROGRAPHER

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SURFACE WATER SUPPLY OF MIDDLE ATLANTIC STATES, 1906

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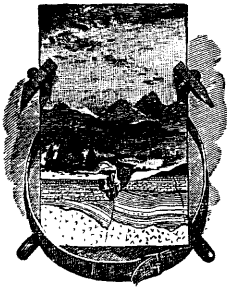

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N. C. GROVER,
District hydrographer.[b]

INTRODUCTION.

SCOPE OF WORK.

The water supply of the United States is of more importance to the life and pursuits of the people than 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 covering several years. The rapid increase in the development of the water

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

[b] The data presented in this report have been collected by local hydrographers, mostly under the direction of N. C. Grover. They have been prepared for publication under the direction of John C. Hoyt, and assistance has been given both in the field and in the office by R. H. Bolster, Robert Follansbee, F. F. Henshaw, H. D. Padgett, and J. E. Stewart.

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.

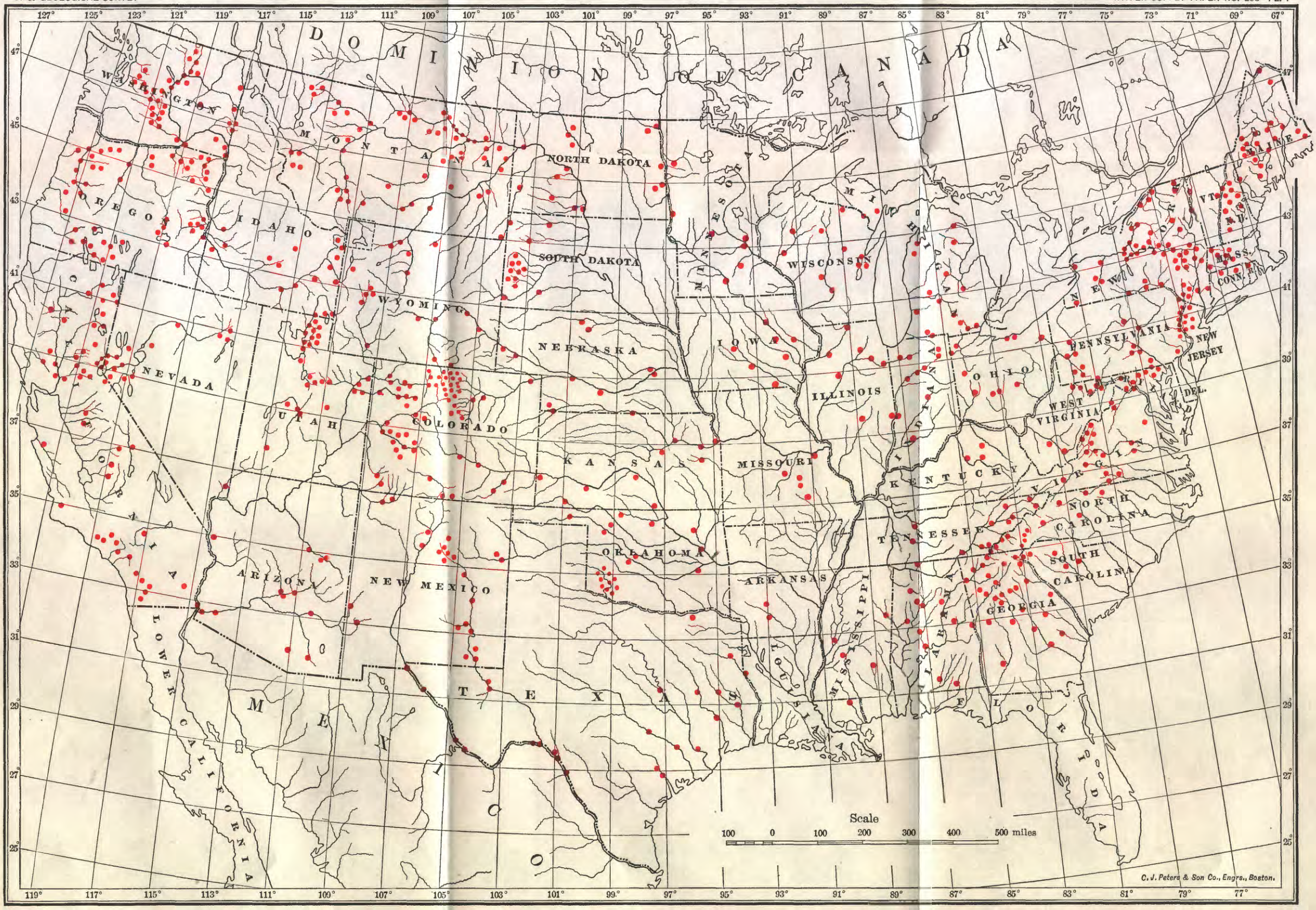
Owing to the broad scope of these hydrographic investigations and the length of time they should cover in order that the records may be of greatest value, it is in general impossible for private individuals to collect the necessary data, and as many of the streams traverse more than one State this work 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.)
205. Surface water supply of the Ohio and lower eastern Mississippi river drainages, 1906.



MAP OF UNITED STATES SHOWING LOCATION OF PRINCIPAL RIVER STATIONS MAINTAINED DURING 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 drainages, 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 drainages in California and Colorado River drainage below Yuma.)
214. Surface water supply of the North Pacific Coast, 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 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 rivers and eastern Gulf of Mexico drainages	65 75	83	98	127	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	176	212
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 drainage	66 75	85	100	135	178	214

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

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 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, name of the

hydrographer, width and area of cross section, gage height, and 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 readings 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 18.7 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-feet.
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. Geol. 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; and (3) those with constantly shifting beds. In determining the daily flow special methods are necessary for each class. The data on which the 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 of the area of the cross section. The method chosen for any case depends on 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 estimating 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 method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining 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 flashboards 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-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] Water-Supply Paper No. 200 replaces No. 150, the edition of which has been exhausted.

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 on 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.

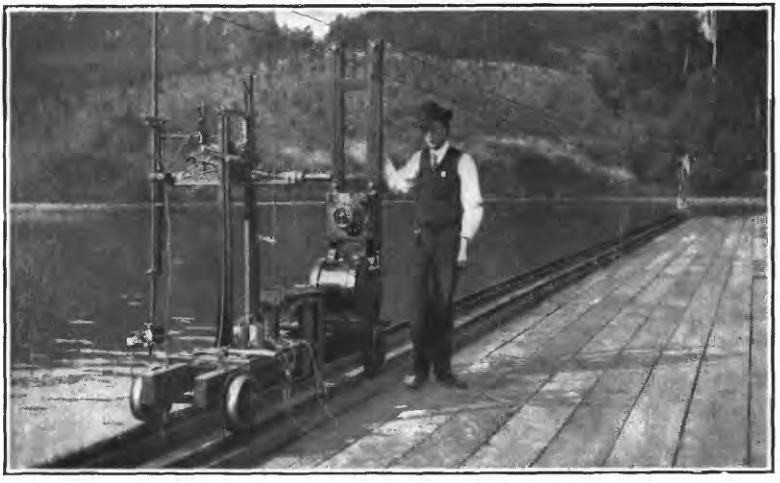
The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

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.

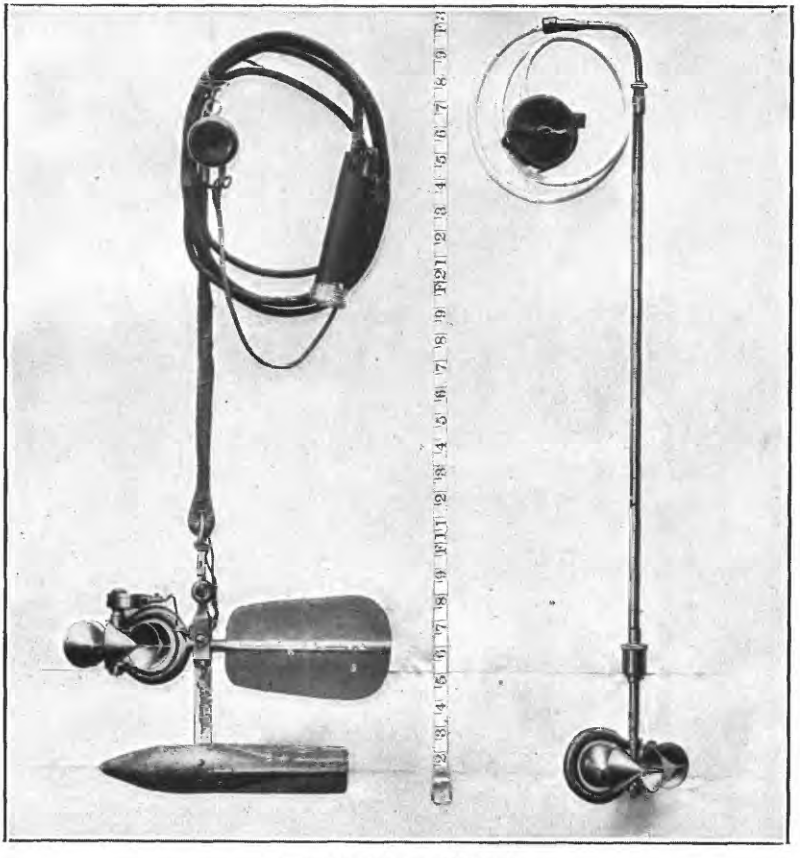
Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, shown in Pl. II, *B*, which has been largely developed and 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, cable, 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 on 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, area, and discharge are determined independently, so that conditions existing



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



B. PRICE CURRENT METERS.

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 of time required to

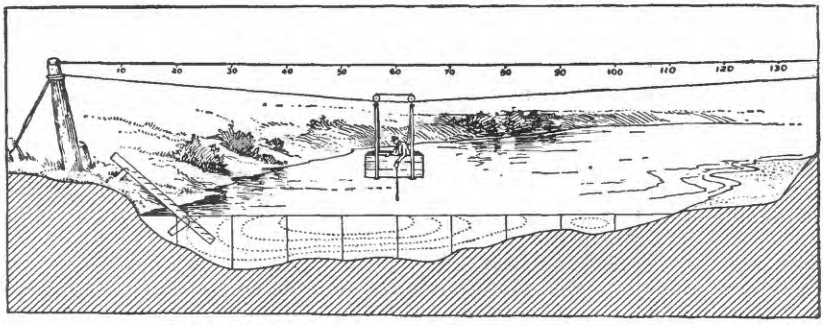


FIG. 1.—Cable station, showing section of river, car, gage, etc.

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 on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially 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 on 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 on 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 on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and the 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 on 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.

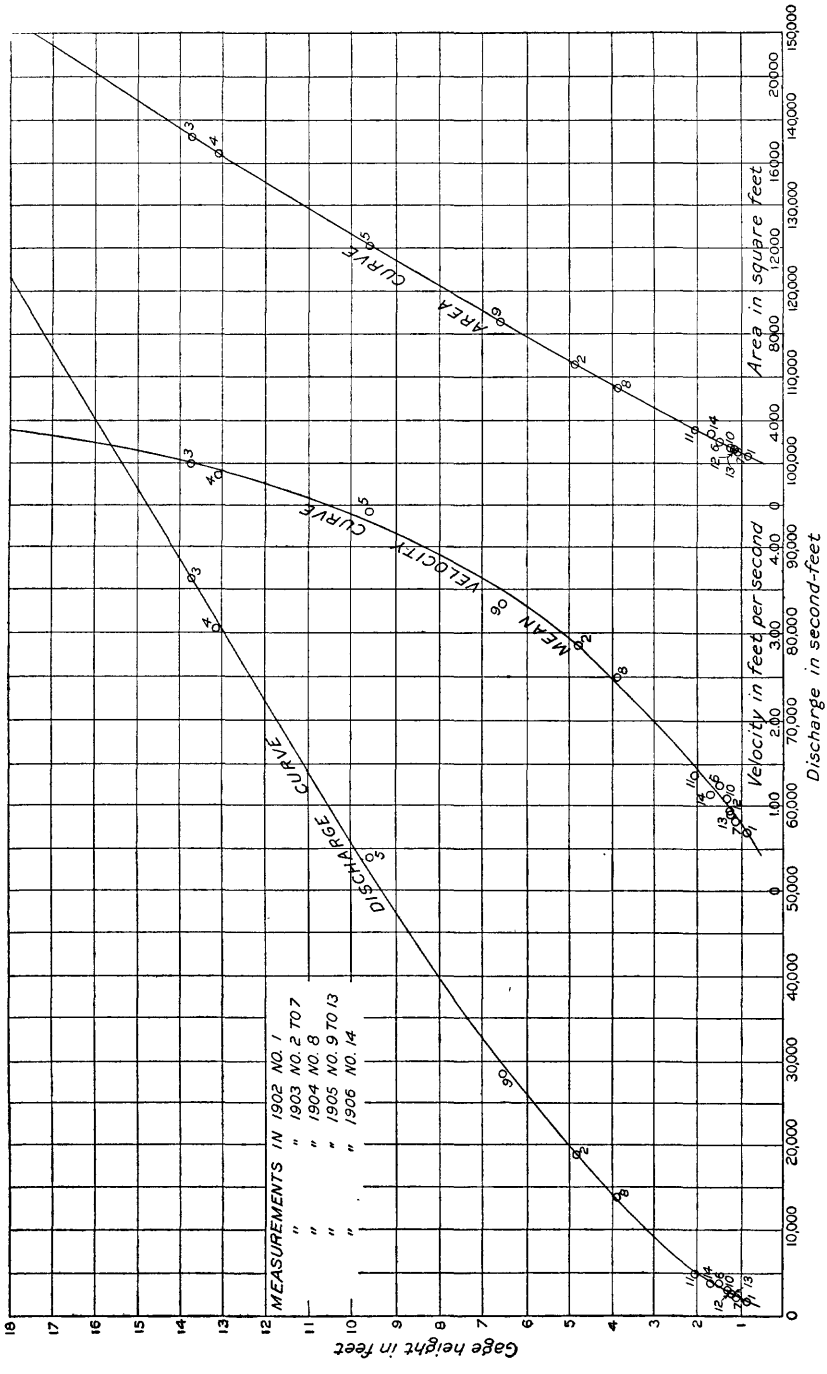


FIG. 2.—Discharge, area, and mean-velocity curves for Potomac River at Point of Rocks, Md.

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 on 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 determinations 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 discharges 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.

COOPERATION AND ACKNOWLEDGMENTS.

Assistance has been rendered or records furnished by the following, to whom special acknowledgment is due: The Maryland Geological Survey; E. Mather, president of the board of water commissioners, Harrisburg, Pa.; M. C. Nagle, chief engineer of the board of water commissioners, Harrisburg, Pa.; Cary T. Hutchinson, chief engineer of McCall Ferry Power Company; Dr. C. A. Schenck, director of the Biltmore School of Forestry.

MIDDLE ATLANTIC STATES DRAINAGES.

SUSQUEHANNA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Susquehanna River rises in Otsego Lake, in northern Otsego County, N. Y., at an elevation of 1,193 feet above tide, and flows in a general southerly direction into Chesapeake Bay. Its course is in many places extremely tortuous, crossing the State boundary between New York and Pennsylvania three times. The entire length of the river is about 500 miles, and it drains an area of 27,400 square miles, of which 21,060 square miles lie in Pennsylvania, 6,080 in New York, and 260 in Maryland.

The topography of the basin varies widely in character. In New York the stream and its tributaries flow through a rolling and in places rather broken country, bounded on the north by a mountainous area. In this part of the course its bed is of gravel or sand, with occasional rock ledges, and its banks are moderately high and not extensively subject to overflow. In Pennsylvania the river enters a mountain region, its banks are high, and it winds and twists among the parallel ranges in a bed composed generally of drift materials, gravel, sand, and bowlders. In the lower part of its course, from Marietta to Havre de Grace, it occupies a broad, deep valley,

A

B

POWER-PLANT CONSTRUCTION.

A, On Susquehanna River, near McCall Ferry, Pa.; *B*, On Shenandoah River, near Millville, W. Va.

varying in width from a few hundred feet to more than a mile, and is for the most part bounded on either shore by rocky bluffs and tablelands elevated from 100 to 500 feet above its waters.

Above the mouth of the West Branch the fall of the stream is uniform and gradual; below that point the fall becomes more irregular, and there are at many places rapids where the stream flows over a rocky bottom. The elevation of the river at the mouth of the West Branch is 400 feet above mean sea level at Havre de Grace, the distance between the two points being 125 miles. The slope is, however, extremely variable.

The fall in the lower part of the river offers exceptional opportunities for power developments, the value of which is greatly enhanced by their proximity to an unlimited market in the adjacent large cities. The hydrographic investigations of the Geological Survey along Susquehanna River have been of great assistance to engineers in investigating these powers. Pl. III, *A*, shows the construction at McCall Ferry, where the McCall Ferry Power Company is developing a large power plant. In estimating for this development the records of the Geological Survey played an important part.

In early days a complete system of canals was built along the river from the New York State line to the bay, but these have been abandoned with the establishment of railroads. The head of navigation is at the fall line, near the mouth of the stream, but various stretches are navigable for flatboats.

All available hydrographic data for Susquehanna River basin prior to 1905 have been collected and published in Water-Supply and Irrigation Papers Nos. 108 and 109. No. 108 treats principally of the quality of the water, and No. 109 gives in detail information relative to fluctuations in stage and quantity of water flowing.

SUSQUEHANNA RIVER AT BINGHAMTON, N. Y.

This station was established July 31, 1901. It is located at the Washington Street Bridge, about 800 feet upstream from the junction of Chenango and Susquehanna rivers. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 17, where are given also references to publications that contain data for previous years.

Discharge measurements of Susquehanna River at Binghamton, N. Y., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 24	C. C. Covert	207	1,260	2.33	1,670
October 5	do	298	1,100	1.98	732
November 9	do	305	1,210	2.25	1,070

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

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.62	3.3	3.1	8.12	2.91	4.0	3.12	2.08	2.2	1.98	2.75	2.9
2	3.28	3.02	3.08	6.42	2.91	3.65	3.66	2.08	2.2	2.02	2.65	2.92
3	2.95	2.72	3.0	5.45	3.46	3.33	3.26	2.1	2.15	2.02	2.6	2.85
4	3.08	2.72	6.9	5.27	5.01	3.17	2.99	2.22	2.15	2.0	2.45	2.48
5	4.02	2.62	9.3	6.45	4.31	3.0	2.79	2.08	2.1	2.0	2.4	2.8
6	4.45	2.82	6.35	7.59	3.78	3.85	2.74	2.0	2.12	2.0	2.32	3.5
7	3.55	2.85	4.6	6.72	3.58	4.23	2.44	2.0	2.1	1.95	2.28	6.12
8	3.1	2.68	4.1	5.82	3.44	3.75	2.41	2.78	2.1	2.0	2.25	3.92
9	2.88	2.55	3.75	5.42	3.28	3.15	2.36	2.38	2.02	2.02	2.22	3.48
10	2.72	2.62	3.6	7.12	3.21	3.45	2.42	2.22	2.05	1.98	2.2	3.52
11	2.88	2.68	3.5	9.35	3.28	4.05	2.64	2.15	2.02	2.0	2.22	3.8
12	2.8	2.98	3.18	8.49	3.14	4.3	2.54	2.05	1.9	1.98	2.52	3.65
13	3.0	2.42	3.08	7.19	3.01	3.55	2.42	2.05	1.9	1.98	2.4	3.42
14	3.2	2.45	2.92	6.47	2.98	3.13	2.29	2.02	.....	1.92	2.42	3.45
15	3.08	2.48	2.88	8.92	3.06	2.86	2.23	1.98	1.85	2.0	2.4	3.5
16	2.95	2.45	2.67	9.64	2.95	2.86	2.08	1.95	1.88	2.0	2.42	5.9
17	2.92	2.52	2.79	9.14	2.9	3.64	2.13	1.92	1.88	2.0	2.3	5.9
18	3.1	2.52	2.72	6.54	3.0	4.22	2.28	1.9	1.9	1.98	2.45	4.75
19	3.05	2.38	2.67	5.58	3.03	4.86	2.31	1.85	1.75	2.0	5.18	3.45
20	2.85	2.35	2.47	5.01	2.85	4.42	2.31	1.9	1.8	4.25	6.1	3.1
21	2.98	2.45	2.67	4.61	2.7	3.86	2.28	2.0	1.85	3.8	5.32	3.2
22	4.75	4.0	2.85	4.36	2.5	3.39	2.23	2.28	1.92	3.6	5.12	3.4
23	7.55	5.8	2.85	4.44	2.47	3.06	2.15	2.3	1.92	3.0	4.88	3.1
24	9.6	5.32	2.42	4.26	2.43	2.96	2.33	2.45	1.92	2.62	4.2	2.75
25	8.1	5.2	2.39	3.88	2.4	2.82	2.21	2.28	2.02	2.5	3.65	2.7
26	5.95	5.78	2.42	3.56	2.85	2.69	2.21	2.15	2.08	2.58	3.45	3.05
27	4.8	5.18	3.59	3.36	4.43	2.56	2.16	2.58	2.02	2.52	3.28	2.65
28	4.32	3.6	9.72	3.16	7.55	2.44	2.05	2.55	1.95	2.7	3.2	2.65
29	3.95	.....	9.35	3.04	7.7	2.56	2.08	3.15	1.95	2.68	3.22	2.6
30	3.62	.....	7.17	2.94	5.9	2.64	2.12	2.82	1.9	2.6	3.1	2.65
31	3.4	.....	9.42	.....	4.7	.....	2.05	2.55	.....	2.62	.....	4.5

NOTE.—River seldom freezes over at the gage. There is considerable anchor ice during January and February and parts of March and December.

Rating table for Susquehanna River at Binghamton, N. Y., for 1901 to 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.*
1.75	210	3.00	3,025	4.30	6,300	6.20	12,040
1.80	315	3.10	3,265	4.40	6,570	6.40	12,680
1.90	525	3.20	3,505	4.50	6,845	6.60	13,320
2.00	740	3.30	3,755	4.60	7,125	6.80	13,960
2.10	960	3.40	4,005	4.70	7,405	7.00	14,600
2.20	1,180	3.50	4,255	4.80	7,690	7.20	15,260
2.30	1,400	3.60	4,505	4.90	7,980	7.40	15,920
2.40	1,625	3.70	4,755	5.00	8,280	7.60	16,590
2.50	1,855	3.80	5,005	5.20	8,880	7.80	17,270
2.60	2,085	3.90	5,255	5.40	9,495	8.00	17,950
2.70	2,315	4.00	5,510	5.60	10,120	9.00	21,500
2.80	2,545	4.10	5,770	5.80	10,760	10.00	25,100
2.90	2,785	4.20	6,030	6.00	11,400		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1901–1906. It is well defined between gage heights 2 feet and 5 feet. The upper part of the curve is based on one measurement at 16.3 feet.

Monthly discharge of Susquehanna River at Binghamton, N. Y., for 1906.

[Drainage area, 2,400 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	23,700	2,360	5,720	2.38	2.74
February	10,800	1,510	3,740	1.56	1.62
March	24,000	1,600	6,790	2.83	3.26
April	23,800	2,880	11,500	4.79	5.34
May	16,900	1,620	4,560	1.90	2.19
June	7,840	1,720	4,070	1.70	1.90
July	4,660	850	1,710	.712	.82
August	3,380	420	1,220	.503	.59
September	1,180	210	705	.294	.33
October	6,160	567	1,580	.658	.76
November	11,700	1,180	3,470	1.45	1.62
December	11,800	1,810	4,380	1.82	2.10
The year	24,000	210	4,120	1.72	23.27

NOTE.—Values for January, February, March, and December are probably slightly in excess of the true values owing to anchor ice. Values for January to March and September and December are good. Values for April to August, and October, and November are excellent.

The following table gives the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge and shows the number of days on which the flow and the corresponding horsepower were respectively less than the amounts given in the columns for "discharge" and "horsepower:"

Discharge and horsepower table for Susquehanna River at Binghamton, N. Y., from 1901 to 1906.

Discharge in second-feet.	Horsepower (80 per cent efficiency) per foot fall.	Number of days of deficient flow.					
		1901.[a]	1902.	1903.	1904.	1905.	1906.
330	30	.....	.....	6	.....	.....	2
385	35	.....	.....	7	.....	.....	2
440	40	1	.....	13	.....	.....	5
495	45	6	.....	17	.....	.....	8
550	50	10	.....	19	.....	.....	14
660	60	29	2	23	2	.....	23
770	70	36	6	27	11	.....	41
880	80	60	10	33	28	1	54
990	90	63	14	45	31	7	64
1,100	100	74	31	54	36	15	73
1,320	120	89	52	71	55	33	85
1,540	140	101	77	90	74	66	100
1,760	160	111	96	104	91	89	125
1,980	180	117	133	119	107	117	138

[a] August 1 to December 31.

NOTE.—The minimum flow in the period August 1, 1901, to December 31, 1906, was 210 second-feet, giving 19 horsepower per foot of fall on one day in September, 1906.

SUSQUEHANNA RIVER AT WILKESBARRE, PA.

This station was established March 30, 1899. It is located at the Market Street Bridge, Wilkesbarre, Pa. Gage heights are furnished by the United States Weather Bureau. The conditions at this station and the bench marks are described in Water-Supply

Paper No. 167, page 19, where are given also references to publications that contain data for previous years.

The following discharge measurement was made July 2, 1906:

Area, 4,800 square feet; gage height, 5.51 feet; discharge, 9,400 second-feet.

Daily gage height, in feet, of Susquehanna River at Wilkesbarre, Pa., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.0	6.0	7.6	17.7	5.6	8.6	5.7	3.4	4.1	2.4	5.3	5.4
2	7.0	5.9	6.4	14.8	5.4	8.5	5.5	3.2	3.7	2.8	5.3	5.2
3	6.2	5.6	5.2	12.7	5.4	6.8	7.5	3.3	3.5	2.7	5.4	5.0
4	6.0	6.7	11.4	11.0	5.4	6.2	8.5	3.3	4.0	2.7	5.2	5.0
5	6.1	6.1	13.0	11.1	7.0	5.7	7.1	3.8	3.3	3.1	5.0	4.8
6	6.6	5.7	11.6	12.8	7.4	5.4	6.1	3.4	3.1	3.4	4.8	4.8
7	7.1	5.3	10.8	14.2	6.7	7.4	5.4	4.1	3.1	3.2	4.6	6.2
8	6.3	4.7	8.7	12.6	6.4	7.8	5.0	4.1	2.8	3.1	4.4	9.9
9	5.8	4.8	7.4	11.0	6.0	6.9	4.7	4.2	3.0	3.1	4.2	8.8
10	6.3	5.1	6.9	11.6	5.9	6.2	4.5	5.0	2.9	3.1	4.0	7.0
11	5.9	5.0	6.4	14.8	5.6	6.5	4.4	4.5	2.8	3.3	3.9	6.3
12	6.2	5.1	6.0	15.6	5.6	6.6	4.5	3.9	2.7	3.1	4.0	6.3
13	5.9	4.9	5.8	14.3	5.6	6.4	4.8	4.3	2.7	3.2	4.1	8.0
14	5.8	5.2	5.4	12.5	5.3	6.1	4.7	4.0	2.7	3.2	4.4	9.2
15	5.7	5.1	5.3	12.4	5.2	5.4	4.4	3.7	2.7	3.3	4.5	8.6
16	5.4	4.7	5.0	15.1	5.2	4.9	4.1	3.3	2.6	3.3	4.7	7.7
17	5.4	4.1	5.0	15.2	5.2	5.3	3.9	3.2	2.6	3.2	4.5	9.3
18	4.9	4.2	4.8	13.4	5.3	7.2	4.0	3.1	2.6	3.1	4.4	9.2
19	5.0	4.3	4.6	11.4	5.7	9.9	4.1	3.0	2.5	3.0	5.7	8.0
20	5.1	4.4	4.4	9.8	6.0	10.2	4.2	2.8	2.5	3.2	8.5	6.6
21	5.1	4.3	4.2	8.8	5.6	10.0	4.2	2.8	2.6	5.5	9.4	5.9
22	5.2	5.3	4.2	8.1	5.2	8.6	4.2	2.9	2.6	8.6	9.0	5.8
23	6.2	5.6	4.0	7.6	4.8	7.3	4.0	3.7	2.6	7.2	9.1	6.2
24	11.9	10.4	4.0	8.5	4.4	6.4	3.8	3.7	2.5	6.6	8.3	5.9
25	14.8	8.8	4.1	8.7	4.2	5.8	4.0	3.8	2.5	5.7	7.5	8.2
26	12.6	9.3	4.2	8.2	4.0	5.3	3.7	3.7	2.6	5.5	6.7	7.4
27	10.3	8.8	4.3	7.4	4.0	5.0	3.6	3.9	2.9	5.1	6.3	6.9
28	8.3	8.3	9.8	6.8	5.1	4.7	3.5	4.1	2.8	5.1	5.8	7.1
29	7.5	.....	17.4	6.3	14.0	4.4	3.4	4.0	2.8	5.1	5.6	8.2
30	6.8	.....	15.3	5.9	12.6	5.9	3.2	4.3	2.8	5.2	5.5	7.5
31	6.4	.....	15.0	.....	10.4	.....	3.5	4.7	.....	5.2	.....	6.2

Rating table for Susquehanna River at Wilkesbarre, Pa., 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.*
2.40	1,050	3.70	3,540	5.00	7,150	7.60	17,130
2.50	1,180	3.80	3,780	5.20	7,800	7.80	18,010
2.60	1,320	3.90	4,030	5.40	8,490	8.00	18,910
2.70	1,470	4.00	4,280	5.60	9,210	9.00	23,700
2.80	1,630	4.10	4,540	5.80	9,950	10.00	28,760
2.90	1,810	4.20	4,800	6.00	10,710	11.00	33,960
3.00	2,000	4.30	5,070	6.20	11,470	12.00	39,510
3.10	2,200	4.40	5,340	6.40	12,240	13.00	45,400
3.20	2,410	4.50	5,620	6.60	13,020	14.00	51,700
3.30	2,620	4.60	5,910	6.80	13,810	15.00	58,400
3.40	2,840	4.70	6,210	7.00	14,610	16.00	65,500
3.50	3,070	4.80	6,520	7.20	15,430	17.00	73,000
3.60	3,300	4.90	6,830	7.40	16,270	18.00	80,900

NOTE.—The above table is applicable only for open-channel conditions. It is based on 26 discharge measurements made during 1899–1906. It is well defined between gage heights 2.2 feet and 21 feet. Below gage height 6 feet the table is the same as for 1904.

Monthly discharge of Susquehanna River at Wilkesbarre, Pa., for 1906.

[Drainage area, 9,810 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	57,000	6,830	15,400	1.57	1.81
February	30,800	4,540	10,700	1.09	1.14
March	76,100	4,280	18,700	1.91	2.20
April	78,500	10,300	37,400	3.81	4.25
May	51,700	4,280	12,100	1.23	1.42
June	29,800	5,340	13,900	1.42	1.58
July	21,200	2,410	6,490	.662	.76
August	7,150	1,630	3,660	.373	.43
September	4,540	1,180	1,870	.191	.21
October	21,700	1,050	5,130	.523	.60
November	25,700	4,030	10,100	1.03	1.15
December	28,200	6,520	15,000	1.53	1.76
The year	78,500	1,050	12,500	1.28	17.31

NOTE.—Owing to ice there may have been considerable backwater during the last week in December. The discharge was computed for open-channel conditions. Values for 1906 are excellent, with the exception of those for September and December, which are good.

SUSQUEHANNA RIVER AT DANVILLE, PA.

This station was established March 25, 1899. It is located at Mill Street Bridge, 600 feet south of the public square, Danville, Pa., near the Pennsylvania Railroad station, South Danville. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 23, where are given also references to publications that contain data for previous years.

The following discharge measurement was made June 30, 1906:

Width, 870 feet; area, 3,560 square feet; gage height, 4.23 feet; discharge, 9,360 second-feet.

Daily gage height, in feet, of Susquehanna River at Danville, Pa., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.7	5.0	6.1	14.2	5.0	7.4	5.1	3.1	3.9	2.5	4.6	4.3
2	6.1	4.9	5.4	12.5	4.8	6.6	4.8	3.0	3.5	2.5	4.6	4.3
3	5.5	4.5	5.5	10.6	4.6	6.4	4.6	3.0	3.7	2.6	4.6	4.1
4	5.0	4.2	9.25	9.25	4.9	6.3	5.3	3.0	3.3	2.5	4.6	4.3
5	5.2	.....	10.7	8.8	4.6	5.5	6.3	3.3	3.1	2.9	4.4	4.0
6	5.3	.....	9.75	10.3	4.6	4.7	5.5	3.4	3.0	3.1	4.3	4.6
7	5.8	.....	8.8	11.4	5.8	5.2	5.0	3.2	2.9	3.1	4.1	5.7
8	5.4	.....	7.8	11.0	5.6	6.3	4.5	3.6	2.8	3.0	3.9	6.5
9	5.0	.....	6.8	9.3	5.0	6.0	4.2	3.7	2.8	2.9	3.8	7.1
10	4.5	.....	6.2	9.2	5.0	5.5	4.0	3.9	2.8	2.8	3.7	7.6
11	4.4	.....	6.0	11.8	4.8	5.1	4.0	4.1	2.7	2.9	3.7	6.0
12	4.3	.....	5.3	12.7	4.6	5.4	3.8	3.7	2.7	3.0	3.6	5.3
13	4.0	.....	5.3	11.8	4.6	5.1	3.9	3.4	2.6	3.0	3.5	5.3
14	4.2	.....	5.0	10.5	4.5	5.2	4.1	3.7	2.5	2.9	3.5	5.2
15	4.3	.....	4.1	12.3	4.3	4.8	3.9	3.5	2.5	2.9	3.8	5.1
16	4.5	.....	4.5	13.2	4.3	4.4	.....	3.2	2.1	2.9	3.9	5.1
17	4.5	.....	4.5	12.7	4.4	4.3	.....	3.0	2.4	2.9	4.0	5.7
18	4.5	.....	4.3	11.5	4.3	5.4	.....	2.9	2.4	2.9	4.0	7.6
19	4.3	.....	4.3	9.75	4.5	8.75	.....	2.8	2.3	2.8	4.1	6.8
20	4.2	.....	4.0	8.7	4.8	9.4	.....	2.7	2.3	2.8	5.4	5.6
21	4.4	.....	3.8	7.45	4.7	8.8	.....	2.6	2.3	3.3	7.5	5.5
22	5.1	7.9	3.9	7.1	4.6	8.6	.....	2.7	2.4	6.6	7.5	5.2
23	7.3	12.0	3.8	7.0	4.2	6.9	.....	2.7	2.4	6.5	7.3	5.0
24	9.3	7.5	3.7	6.8	3.9	6.0	.....	3.3	2.4	5.9	7.0	4.7
25	11.6	7.4	3.8	6.9	3.8	5.4	.....	3.3	2.3	5.2	6.5	4.3

Daily gage height, in feet, of Susquehanna River at Danville, Pa., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	11.0	7.8	3.8	6.6	3.6	4.9	.....	3.5	2.3	4.8	5.7	4.1
27	9.1	7.5	3.7	6.3	3.7	4.5	.....	3.6	2.4	4.6	5.4	3.7
28	7.5	6.6	6.65	5.9	4.1	4.4	.....	3.8	2.5	4.5	5.1	3.6
29	6.7	.....	13.5	5.5	10.1	4.1	.....	3.6	2.5	4.3	4.7	3.4
30	5.9	.....	12.8	5.1	10.1	4.1	.....	3.5	2.5	4.4	4.5	3.7
31	5.6	.....	12.5	.....	8.7	.....	.....	3.8	.....	4.5	.....	4.8

NOTE.—River frozen February 5–21; backwater, February 23.

Rating table for Susquehanna River at Danville, Pa., 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	1,640	3.40	5,600	4.70	11,500	7.00	24,500
2.20	1,840	3.50	6,000	4.80	12,020	7.20	25,720
2.30	2,060	3.60	6,400	4.90	12,540	7.40	26,960
2.40	2,300	3.70	6,800	5.00	13,060	7.60	28,260
2.50	2,560	3.80	7,220	5.20	14,150	7.80	29,580
2.60	2,840	3.90	7,660	5.40	15,250	8.00	30,940
2.70	3,140	4.00	8,100	5.60	16,350	9.00	38,200
2.80	3,460	4.10	8,560	5.80	17,450	10.00	46,220
2.90	3,780	4.20	9,040	6.00	18,550	11.00	54,920
3.00	4,120	4.30	9,520	6.20	19,710	12.00	64,320
3.10	4,480	4.40	10,000	6.40	20,900	13.00	74,420
3.20	4,840	4.50	10,500	6.60	22,100	14.00	85,120
3.30	5,220	4.60	11,000	6.80	23,300		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 23 discharge measurements made during 1899–1906. It is well defined between gage heights 1.5 feet and 19 feet.

Monthly discharge of Susquehanna River at Danville, Pa., for 1906.

[Drainage area, 11,100 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	60,500	8,100	18,800	1.69	1.95
February	29,600	5,500	13,000	1.17	1.22
March	79,700	6,800	22,800	2.05	2.36
April	87,300	13,600	44,800	4.04	4.51
May	47,100	6,400	14,000	1.26	1.45
June	41,300	8,560	18,200	1.64	1.83
July	20,300	3,000	8,100	.730	.84
August	8,560	2,840	5,330	.480	.55
September	7,660	1,640	3,200	.288	.32
October	22,100	2,560	7,000	.631	.73
November	27,600	6,000	12,300	1.11	1.24
December	28,300	5,600	14,000	1.26	1.45
The year	87,300	1,640	15,100	1.36	18.45

NOTE.—The mean and minimum flows for February and July were determined by comparison with the flow at Wilkesbarre. Values for 1906 are excellent, with the exception of February and July, which are good.

The following table gives the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge and shows the number of days on which the flow and the corresponding horsepower were, respectively, less than the amounts given in the columns for "discharge" and "horsepower."

Discharge and horsepower table for Susquehanna River at Danville, Pa., from 1899 to 1906.

Discharge in second-feet.	Horsepower (80 per cent efficiency) per foot fall.	Number of days of deficient flow.							
		1899.[a]	1900.	1901.	1902.	1903.	1904.[b]	1905.	1906.
880	80	.....	3	.....	.....	.....	.....	.....	.....
990	90	.....	30	.....	.....	.....	.....	.....	.....
1,100	100	.....	30	.....	.....	.....	.....	.....	.....
1,320	120	31	55	.....	.....	.....	.....	.....	.....
1,540	140	42	75	.....	.....	.....	.....	.....	.....
1,760	160	59	89	.....	.....	.....	.....	.....	1
1,980	180	71	104	.....	.....	.....	.....	.....	1
2,200	200	83	120	.....	.....	.....	.....	.....	6
2,750	250	127	147	14	6	6	8	.....	21
3,300	300	137	154	29	12	15	39	3	30
3,850	350	142	163	44	16	25	67	10	50
4,400	400	158	173	71	32	39	83	23	61
4,950	450	169	179	91	48	50	95	37	70
5,500	500	173	182	113	53	58	111	60	81
6,600	600	193	186	151	91	75	139	96	105
7,700	700	207	194	171	111	98	156	121	138

[a] March 25 to December 31, 1899.
[b] No records at Danville for 1904. These results are obtained by using the Wilkesbarre records, increased in proportion to the drainage areas of the two stations.

NOTE.—During the period covered by the above table the minimum flow was 830 second-feet, giving 75 horsepower per foot of fall, on three consecutive days in September, 1900.

SUSQUEHANNA RIVER AT HARRISBURG, PA.

Regular daily observations of the stage of Susquehanna River at Harrisburg were started in 1890 by E. Mather, president of the Harrisburg water board. During the first half of 1906 the gage heights were furnished by Mr. Mather and during the last half by the United States Weather Bureau, which now maintains this station. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 26, where are given also references to publications that contain data for previous years.

The following discharge measurement was made June 29, 1906:

Width, 2,500 feet; area, 10,100 square feet; gage height, 2.44 feet; discharge, 17,100 second-feet.

Daily gage height, in feet, of Susquehanna River at Harrisburg, Pa., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.2	3.9	3.65	10.75	3.35	5.45	2.2	1.7	2.3	1.0	2.8	2.6
2	4.95	3.4	3.5	10.6	3.2	4.6	2.75	1.7	2.2	1.0	2.8	2.5
3	4.4	3.3	3.0	9.1	3.05	4.0	2.45	1.6	2.0	1.0	2.8	2.4
4	4.4	2.8	3.7	7.9	3.05	3.6	2.3	1.7	2.1	1.0	2.7	2.2
5	4.85	2.7	7.5	7.2	3.1	3.2	3.4	1.8	2.5	1.8	2.7	2.1
6	5.15	2.2	7.0	7.3	3.15	3.1	3.3	2.2	2.2	2.2	2.5	2.3
7	5.1	1.8	6.1	8.3	3.6	2.85	2.85	2.2	2.1	1.9	2.4	2.2
8	4.9	1.9	5.8	8.25	3.4	2.9	2.55	2.1	1.9	1.8	2.3	2.3
9	4.1	2.0	4.8	7.4	3.2	3.5	2.3	2.2	1.7	1.6	2.2	4.6
10	3.65	2.0	4.2	7.2	3.0	3.8	2.2	2.3	1.6	1.6	2.1	4.6
11	3.0	2.05	4.0	8.95	3.0	3.3	2.05	2.3	1.5	1.4	2.0	3.9
12	3.0	2.1	3.6	10.1	2.85	2.9	2.0	2.9	1.5	1.4	2.0	3.5
13	3.0	1.9	3.5	9.5	2.8	2.95	1.9	3.7	1.4	1.5	1.9	3.6
14	3.1	2.15	3.5	8.2	2.7	2.8	1.75	3.2	1.4	1.5	1.9	3.5
15	3.2	2.5	3.2	8.85	2.6	2.7	1.9	2.8	1.3	1.4	2.0	3.5

Daily gage height, in feet, of Susquehanna River at Harrisburg, Pa., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	3.35	2.5	3.1	11.2	2.7	2.6	1.8	2.5	1.2	1.3	2.0	3.3
17	3.1	2.1	3.1	9.9	2.5	2.4	1.8	2.1	1.1	1.3	2.1	3.4
18	3.55	2.2	2.9	8.9	2.55	2.7	1.8	1.9	1.1	1.3	2.1	3.9
19	3.5	2.0	2.7	7.8	2.5	3.9	1.7	1.7	1.0	1.3	2.1	4.5
20	3.3	2.0	2.7	6.6	2.7	6.8	2.4	1.6	1.1	2.0	2.2	4.1
21	3.3	2.15	2.5	5.8	2.75	5.9	2.2	2.1	1.0	3.5	3.2	3.8
22	3.6	2.7	2.5	5.35	2.6	5.4	2.2	2.3	1.0	4.4	4.2	3.9
23	3.55	2.55	2.6	4.9	2.45	4.9	2.1	2.0	1.0	5.1	4.2	3.8
24	4.5	3.9	2.3	4.6	2.3	4.2	2.0	2.0	.9	4.4	4.2	3.3
25	9.15	3.75	2.35	4.8	2.1	3.7	1.9	2.4	.9	4.0	4.0	2.9
26	8.75	4.3	2.4	4.6	2.05	3.3	1.8	2.2	1.0	3.6	3.7	2.9
27	7.4	4.6	2.3	4.5	2.15	2.95	1.8	2.2	1.0	3.3	3.3	2.5
28	6.35	4.0	3.1	4.25	2.25	2.7	1.7	2.8	1.0	3.0	3.0	2.1
29	5.3	.....	8.05	3.85	3.8	2.45	1.7	3.2	1.0	2.9	2.9	2.2
30	4.7	.....	10.2	3.6	7.2	2.35	1.7	2.8	1.0	2.9	2.7	2.5
31	4.4	.....	9.5	.....	6.6	.....	1.7	2.4	.....	2.8	.....	3.0

NOTE.—Ice conditions existed during portions of January, February, and March.

Rating table for Susquehanna River at Harrisburg, Pa., for 1905 and 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	6,030	2.20	15,050	3.50	29,430	5.60	61,700
1.00	6,550	2.30	15,980	3.60	30,800	5.80	65,000
1.10	7,090	2.40	16,950	3.70	32,200	6.00	68,400
1.20	7,650	2.50	17,960	3.80	33,600	6.20	71,900
1.30	8,240	2.60	19,010	3.90	35,000	6.40	75,500
1.40	8,850	2.70	20,100	4.00	36,400	6.60	79,200
1.50	9,520	2.80	21,210	4.20	39,200	6.80	82,900
1.60	10,200	2.90	22,340	4.40	42,200	7.00	86,600
1.70	10,930	3.00	23,480	4.60	45,400	8.00	105,600
1.80	11,700	3.10	24,620	4.80	48,600	9.00	125,100
1.90	12,500	3.20	25,760	5.00	51,900	10.00	145,600
2.00	13,300	3.30	26,910	5.20	55,100	11.00	167,500
2.10	14,160	3.40	28,130	5.40	58,400	12.00	190,500

NOTE.—The above table is applicable only for open-channel conditions. It is based on 45 discharge measurements made during 1897–1906. It is well defined throughout. Below 7 feet the table is the same as for 1904.

Monthly discharge of Susquehanna River at Harrisburg, Pa., for 1906.

[Drainage area, 24,000 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	128,000	23,500	45,800	1.91	2.20
February	45,400	11,700	21,000	.875	.91
March	150,000	16,000	42,700	1.78	2.05
April	172,000	30,800	95,300	3.97	4.43
May	90,400	13,700	25,600	1.07	1.23
June	82,900	16,500	32,200	1.34	1.50
July	28,100	10,900	14,800	.617	.71
August	32,200	10,200	16,200	.675	.78
September	18,000	6,030	9,470	.395	.44
October	53,500	6,550	17,400	.725	.84
November	39,200	12,500	20,800	.867	.97
December	45,400	14,200	26,100	1.09	1.26
The year	172,000	6,030	30,600	1.28	17.32

NOTE.—The computation of discharge for January, February, and March is based on open-channel conditions; the effect of ice was immaterial. Values for 1906 are excellent.

The following table gives the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge and shows the number of days on which the flow and the corresponding horsepower were respectively less than the amounts given in the columns for "discharge" and "horsepower."

Discharge and horsepower table for Susquehanna River at Harrisburg, Pa., from 1891 to 1906.

Discharge in second-feet.	Horsepower (80 per cent efficiency) per foot fall.	Number of days of deficient flow.							
		1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.
2,750	250	.....	.....	.....	.....	4	.....	.....	.....
3,300	300	.....	.....	.....	2	20	9	.....	.....
3,850	350	.....	.....	11	10	50	18	.....	.....
4,400	400	.....	9	16	11	62	22	3	.....
4,950	450	.....	14	22	14	89	28	21	7
5,500	500	.....	16	24	18	104	31	32	15
6,600	600	.....	37	31	31	133	39	53	33
7,700	700	.....	49	34	47	139	42	66	37
8,800	800	.....	59	40	59	158	48	80	43
9,900	900	.....	76	55	72	169	70	94	50
11,000	1,000	10	88	75	78	172	93	104	57
12,100	1,100	14	100	92	82	178	108	117	61
13,200	1,200	18	106	96	84	183	114	119	68
14,300	1,300	45	124	134	93	188	125	133	85
15,400	1,400	54	132	142	96	188	128	138	89
16,500	1,500	72	144	158	108	192	141	142	105
17,600	1,600	78	150	160	116	195	146	144	109
18,700	1,700	90	163	178	127	201	158	160	120
19,800	1,800	102	166	181	135	203	163	162	122
20,900	1,900	122	174	194	144	213	179	180	137
22,000	2,000	127	187	203	153	218	183	185	139

Discharge in second-feet.	Horsepower (80 per cent efficiency) per foot fall.	Number of days of deficient flow.							
		1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
2,750	250	.....	23	.....	.....	.....	.....	.....	.....
3,300	300	3	38	.....	.....	.....	.....	.....	.....
3,850	350	17	44	.....	.....	.....	.....	.....	.....
4,400	400	28	53	.....	.....	.....	.....	.....	.....
4,950	450	48	72	.....	.....	.....	.....	.....	.....
5,500	500	62	84	.....	.....	.....	.....	.....	.....
6,600	600	83	118	1	13	3	5	.....	15
7,700	700	100	134	7	19	5	26	.....	19
8,800	800	119	148	15	28	16	53	.....	24
9,900	900	139	154	28	36	21	82	.....	33
11,000	1,000	147	157	55	54	36	116	15	48
12,100	1,100	153	164	86	65	42	142	32	58
13,200	1,200	157	187	97	73	52	163	60	68
14,300	1,300	164	180	121	83	72	174	86	100
15,400	1,400	167	190	125	96	84	179	100	122
16,500	1,500	175	198	141	111	101	185	124	135
17,600	1,600	181	205	150	123	106	188	143	147
18,700	1,700	196	214	161	126	109	200	160	162
19,800	1,800	201	217	171	138	122	203	170	167
20,900	1,900	210	220	182	146	128	206	180	182
22,000	2,000	215	224	186	151	141	209	187	195

NOTE.—From 1891 to 1906 the minimum flow was 2,330 second-feet, giving 212 horsepower, on two consecutive days in September, 1900. For days on which no gage readings were made at this station the table is based on discharges at McCall Ferry, with appropriate reduction. No correction has been made for ice except in 1904. In general the results would probably be affected only slightly by ice conditions.

SUSQUEHANNA RIVER NEAR M'CALL FERRY, PA.

This station was established May 17, 1902, by Boyd Ehle, who furnishes the gage heights. It is located at a narrow and rocky part of Susquehanna River, about 20 miles above its mouth and 1 mile above the village of McCall Ferry.

The measurements at this station have been referred to two permanent gages, designated as Nos. 2 and 5, which give elevations directly above sea level. No. 2 is about three-fourths mile below the village of McCall Ferry, in the tailrace of the proposed power house. It was read daily from June, 1902, through February, 1906, when operations at the dam began to cause backwater at the gage. Gage No. 5 is about 2 miles below McCall Ferry, at the foot of Cullys Falls, and is so located as to be entirely out of the influence of the dam. Regular readings on this gage were not made until March 1, 1906, since which time it has been used exclusively. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 29, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of Susquehanna River near McCall Ferry, Pa., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	107.17	106.24	105.8	116.0	105.7	109.2	103.1	103.0	103.8	101.3	104.2	104.0
2	105.97	105.88	105.8	117.8	105.4	107.7	102.8	102.9	103.7	101.8	104.2	104.0
3	106.15	105.02	105.6	115.9	105.3	106.6	103.1	103.1	103.6	101.5	104.1	104.0
4	106.96	104.41	110.7	113.9	105.2	106.0	103.0	103.3	103.2	101.0	104.0	103.5
5	106.75	104.33	111.1	112.0	105.0	105.6	103.8	104.9	103.2	102.5	104.0	103.5
6	108.28	103.90	112.0	111.4	105.0	105.1	105.0	103.7	104.0	104.2	104.0	103.5
7	108.28	102.98	111.0	112.0	105.1	104.9	104.8	103.7	103.6	103.2	103.9	103.5
8	107.89	102.57	109.6	113.4	105.9	104.7	104.2	103.5	103.2	103.0	103.5	103.2
9	107.17	102.41	108.8	112.5	105.7	104.8	103.9	103.6	102.8	102.4	103.2	103.2
10	105.29	102.81	107.5	113.0	105.1	105.9	103.5	103.6	102.5	102.2	103.3	106.8
11	105.29	102.98	.....	113.3	104.9	105.9	103.5	103.6	103.0	102.0	103.3	107.0
12	104.55	102.81	106.0	115.9	104.8	105.0	103.4	103.8	103.4	101.8	103.0	105.7
13	104.94	102.73	105.9	115.8	104.6	104.5	103.0	104.6	102.0	101.8	102.6	105.2
14	104.94	103.14	105.8	114.2	104.6	104.8	102.9	105.2	102.1	101.8	102.5	105.2
15	105.11	103.56	105.5	114.0	104.5	104.6	102.8	104.9	102.0	102.1	102.5	105.0
16	105.11	104.07	105.9	119.0	104.4	104.5	102.9	104.5	102.4	101.7	102.5	105.0
17	105.46	103.64	105.1	117.0	104.3	105.1	103.2	103.8	102.4	101.7	102.5	105.0
18	105.62	103.39	104.8	115.3	104.2	104.4	103.0	103.5	102.4	101.6	102.6	105.8
19	105.62	103.47	104.8	113.4	104.1	105.5	102.9	103.0	102.0	101.4	102.6	106.5
20	105.37	103.39	104.8	111.6	104.1	108.3	102.7	102.9	101.9	102.0	102.6	106.7
21	105.29	103.64	104.1	110.0	104.1	110.0	103.5	102.8	101.9	104.6	103.0	106.0
22	105.20	104.94	104.3	109.0	104.2	109.5	103.4	103.7	101.5	105.4	105.0	106.2
23	105.29	105.62	104.1	108.1	104.1	108.6	103.5	103.9	101.5	106.8	106.0	105.9
24	105.62	106.34	103.9	107.6	103.7	107.2	103.4	103.2	101.2	107.4	106.0	104.9
25	110.77	105.97	103.8	107.4	103.3	106.2	103.3	102.9	101.5	106.4	106.0	104.4
26	114.73	107.76	103.6	107.3	103.1	105.6	103.2	103.8	101.1	105.6	105.6	103.6
27	112.84	107.40	103.7	107.3	102.9	105.1	103.0	103.6	101.2	105.2	105.2	103.5
28	110.65	106.64	104.7	106.9	103.1	104.5	103.0	103.9	101.3	104.8	104.8	103.4
29	109.45	.....	107.5	106.2	103.4	103.9	103.2	104.5	101.4	104.4	104.4	103.6
30	107.89	.....	116.6	106.0	108.0	103.4	103.1	104.7	101.4	104.0	104.0	103.8
31	106.96	.....	115.8	.....	110.7	.....	103.0	104.2	.....	104.0	.....	104.0

NOTE.—All above gage heights refer to Cullys Falls gage.

Rating table for Susquehanna River near McCall Ferry, Pa., 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.*
101.00	5,300	102.80	14,990	105.20	32,600	111.50	94,300
101.10	5,740	102.90	15,640	105.40	34,240	112.00	100,500
101.20	6,190	103.00	16,300	105.60	35,920	112.50	106,980
101.30	6,650	103.10	16,960	105.80	37,640	113.00	113,700
101.40	7,120	103.20	17,640	106.00	39,400	113.50	120,660
101.50	7,600	103.30	18,320	106.20	41,160	114.00	127,800
101.60	8,090	103.40	19,000	106.40	42,940	114.50	135,000
101.70	8,600	103.50	19,700	106.60	44,740	115.00	142,300
101.80	9,120	103.60	20,400	106.80	46,560	115.50	149,600
101.90	9,650	103.70	21,120	107.00	48,400	116.00	157,000
102.00	10,200	103.80	21,840	107.50	53,000	116.50	164,500
102 10	10,760	103.90	22,560	108.00	57,600	117.00	172,000
102.20	11,330	104 00	23,300	108.50	62,300	117.50	179,600
102.30	11,910	104.20	24,800	109.00	67,100	118.00	187,300
102.40	12,500	104.40	26,320	109.50	71,960	119.00	202,900
102.50	13,110	104.60	27,860	110.00	77,000	120.00	218,800
102.60	13,720	104 80	29,420	110.50	82,500		
102.70	14,350	105.00	31,000	111.00	88,300		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 27 discharge measurements made during 1902–1904. It is well defined above gage height 10.12 feet.

Monthly discharge of Susquehanna River near McCall Ferry, Pa., for 1906.

[Drainage area, 26,800 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	138,000	27,400	49,700	1.85	2.13
February	55,400	12,500	26,800	1.00	1.04
March	166,000	20,400	51,000	1.90	2.19
April	203,000	39,400	107,000	3.99	4.45
May	84,800	15,600	29,900	1.12	1.29
June	77,000	19,000	39,200	1.46	1.63
July	31,000	14,400	18,600	.694	.80
August	32,600	15,000	21,600	.806	.93
September	23,300	5,740	12,800	.478	.53
October	52,100	5,300	19,000	.709	.82
November	39,400	13,100	22,600	.843	.94
December	48,400	17,600	29,100	1.09	1.26
The year	203,000	5,300	35,600	1.33	18.01

NOTE.—Values for entire year are excellent.

CHENANGO RIVER AT BINGHAMTON, N. Y.

This station, which was established July 31, 1901, is located at the Court Street Bridge, Binghamton. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 32, where are given also references to publications that contain data for previous years.

Discharge measurements of Chenango River at Binghamton, N. Y., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
October 3	C. C. Covert	225	464	5.30	396
November 8	....do	300	681	5.95	1,050

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

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.65	6.88	5.99	11.36	6.32	7.25	7.23	5.58	5.5	5.28	6.68	6.5
2	7.32	6.6	6.22	9.74	6.22	6.88	7.36	5.5	5.4	5.28	6.55	6.55
3	6.92	5.82	6.19	8.81	8.22	6.58	6.76	5.5	5.4	5.28	6.38	6.48
4	7.1	6.02	11.02	8.71	8.56	6.43	6.46	5.68	5.5	5.28	6.25	5.92
5	8.1	6.22	12.47	10.23	7.64	6.25	6.33	6.2	5.42	5.3	6.18	5.8
6	7.78	6.12	9.09	11.07	7.52	7.13	6.21	5.9	5.42	5.28	6.12	6.78
7	7.15	6.0	7.62	9.9	7.26	7.20	6.01	6.2	5.4	5.25	6.02	10.05
8	7.0	6.02	5.72	9.07	6.96	6.84	5.93	6.02	5.3	5.72	5.9	7.48
9	6.52	5.92	6.92	8.73	6.76	6.34	5.89	5.82	5.28	5.65	5.88	6.98
10	6.3	5.95	6.72	10.37	6.94	6.72	6.76	5.45	5.15	5.58	5.82	7.25
11	6.4	5.95	6.47	12.9	6.76	7.07	7.31	5.62	5.2	5.6	5.8	7.48
12	6.5	5.98	6.39	11.83	6.56	7.27	7.03	5.72	5.2	5.75	6.28	7.12
13	6.5	5.88	6.27	10.45	6.49	6.57	6.53	5.75	5.0	5.6	6.22	6.85
14	6.6	5.95	6.19	9.75	6.99	6.24	6.26	5.58	5.12	5.6	6.22	6.88
15	6.5	5.82	6.08	12.07	7.06	6.12	6.09	5.52	5.25	5.5	6.1	6.9
16	6.45	5.82	6.04	13.03	6.46	6.22	5.96	5.42	5.22	5.48	6.08	10.4
17	6.62	5.8	5.98	11.3	6.38	6.57	5.93	5.42	5.05	5.42	6.0	9.6
18	6.6	5.75	5.94	9.6	6.68	7.17	6.01	5.38	5.08	5.32	6.18	8.35
19	6.5	5.8	5.91	8.73	6.63	7.97	5.93	5.3	4.95	5.3	9.12	7.05
20	6.4	5.75	5.71	8.17	6.33	7.94	5.88	5.3	5.0	8.7	9.2	6.7
21	6.68	5.87	5.98	7.73	6.21	7.27	5.9	5.82	5.3	8.3	8.5	6.9
22	8.9	8.25	6.06	7.6	6.05	6.87	5.8	6.18	5.4	7.5	8.38	7.1
23	11.5	9.02	5.96	7.65	5.95	6.54	5.68	5.8	5.32	6.85	8.25	6.8
24	13.45	8.29	5.91	7.4	5.93	6.40	5.65	5.8	5.38	6.48	7.42	6.25
25	11.65	8.35	5.81	7.03	5.88	6.24	5.58	5.52	5.48	6.42	7.05	6.0
26	9.35	8.89	5.78	6.79	6.33	6.12	5.5	5.4	5.38	6.58	6.85	6.05
27	8.3	7.99	6.84	6.59	8.85	6.02	5.48	5.5	5.32	6.35	6.7	6.2
28	7.75	6.37	13.41	6.52	11.78	5.93	5.48	6.15	5.3	6.52	6.7	6.25
29	7.32	.....	12.66	6.32	10.98	6.06	5.45	6.15	5.28	6.55	6.7	6.3
30	6.88	.....	10.51	6.26	8.93	6.11	5.5	5.82	5.2	6.48	6.6	6.3
31	6.95	.....	13.08	.....	7.83	.....	5.55	5.7	.....	6.52	.....	8.5

NOTE.—River seldom freezes over at the gage, but there was considerable needle ice during January and February and part of December.

Rating table for Chenango River at Binghamton, 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.*
4.90	115	6.20	1,360	7.50	3,220	9.60	6,790
5.00	175	6.30	1,490	7.60	3,375	9.80	7,140
5.10	240	6.40	1,625	7.70	3,535	10.00	7,500
5.20	315	6.50	1,760	7.80	3,695	10.20	7,860
5.30	396	6.60	1,900	7.90	3,855	10.40	8,220
5.40	480	6.70	2,040	8.00	4,020	10.60	8,590
5.50	570	6.80	2,180	8.20	4,355	10.80	8,970
5.60	665	6.90	2,325	8.40	4,695	11.00	9,350
5.70	765	7.00	2,470	8.60	5,040	12.00	11,250
5.80	875	7.10	2,615	8.80	5,390	13.00	13.250
5.90	990	7.20	2,765	9.00	5,740	14.00	15,300
6.00	1,110	7.30	2,915	9.20	6,090		
6.10	1,235	7.40	3,065	9.40	6,440		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1901–1906. It is well defined between gage heights 5.3 feet and 10 feet, and is based on one high-water measurement above 10 feet.

Monthly discharge of Chenango River at Binghamton, N. Y., for 1906.

[Drainage area, 1,530 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	14,200	1,490	3,550	2.32	2.68
February	5,780	820	1,930	1.26	1.31
March	14,100	776	3,520	2.30	2.65
April	13,300	1,440	6,220	4.07	4.54
May	10,800	967	2,910	1.90	2.19
June	3,970	1,030	2,040	1.33	1.48
July	3,000	525	1,300	.850	.98
August	1,360	396	789	.516	.59
September	570	145	380	.248	.28
October	5,220	355	1,260	.824	.95
November	6,090	875	2,180	1.42	1.58
December	8,220	875	2,700	1.76	2.03
The year	14,200	145	2,400	1.57	21.26

NOTE.—Values for January, February, and December are probably slightly in excess of the true value owing to needle ice. Values for entire year are excellent except January, February, and December, which are good.

CHEMUNG RIVER AT CHEMUNG, N. Y.

This station was established September 7, 1903. It is located at the suspension highway bridge, midway between Chemung, N. Y., and Willawana, Pa., near the State line. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 35, where are given also references to publications that contain data for previous years.

Discharge measurements of Chemung River at Chemung, N. Y., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 21	F. H. Brundage	391	3,380	9.46	16,500
March 22	do	389	3,410	9.49	16,600
March 22	do	389	3,090	8.84	13,900
March 26	W. B. Freeman	393	4,460	12.10	29,300
March 26	do	393	4,190	11.39	25,900
May 18	H. R. Beebe	220	1,040	2.64	714
July 20	Murphy and Covert	216	1,060	2.62	748
August 23	Covert and Weeks	197	904	2.28	435
1906.					
February 17	Covert and Weeks	225	1,040	[a] 2.85	674
March 30	Horton and Mott	393	2,560	7.20	9,850
March 31	R. E. Horton	395	4,340	11.73	27,500
March 31	do	394	4,120	11.40	25,600
July 27	C. C. Covert	200	935	2.29	416
September 15	do	186	860	1.89	216
October 4	do	203	879	2.03	381

[a] Ice conditions; gage height to bottom of ice, 2.42 feet; average thickness of ice, .53 feet: considerable needle ice.

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

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.27	3.4	2.52	7.42	3.15	4.44	3.34	2.28	2.19	1.55	3.46	3.33
2	3.93	3.16	2.56	6.54	3.09	4.15	3.42	2.24	2.04	1.73	3.31	2.86
3	3.54	3.24	2.57	5.93	3.28	3.73	5.2	2.2	2.14	1.89	3.25	2.87
4	3.70	3.36	8.6	6.23	3.99	3.48	4.15	2.18	2.16	1.77	3.27	2.6
5	4.44	3.24	5.2	7.3	3.75	3.35	3.57	3.29	2.08	1.95	3.2	2.35
6	4.0	2.94	3.96	7.92	3.8	5.25	3.28	3.05	2.14	1.74	3.06	3.32
7	3.52	2.8	3.64	6.8	3.65	5.06	3.03	2.96	2.12	1.8	2.89	6.26
8	2.97	2.84	3.4	5.92	3.35	4.12	2.85	3.68	.....	2.87	2.81	4.56
9	2.66	2.92	3.3	5.68	3.25	3.74	2.83	3.76	.....	2.58	2.77	3.56
10	2.74	2.84	3.14	8.32	3.63	3.58	2.74	3.28	.....	2.38	2.64	3.55
11	2.86	2.71	2.97	8.4	3.55	3.65	2.68	3.85	1.78	2.12	2.62	3.26
12	3.02	2.88	2.9	7.14	3.26	3.47	2.66	4.15	1.81	2.31	2.66	3.72
13	2.92	2.66	2.85	6.33	3.24	3.15	2.55	3.52	1.96	2.36	2.74	3.28
14	2.86	2.64	2.74	5.82	3.22	2.84	2.45	3.1	2.09	2.4	2.92	3.42
15	2.86	2.7	2.7	6.73	3.2	2.85	2.4	2.82	1.78	2.41	2.97	3.54
16	2.79	2.72	2.71	6.82	3.2	3.38	2.33	2.58	1.62	2.36	2.96	5.48
17	2.6	2.8	2.6	5.92	3.29	6.53	2.35	2.46	1.74	2.22	2.9	4.6
18	2.78	2.8	2.32	5.36	4.94	7.11	2.44	2.39	1.62	2.17	3.04	3.96
19	2.78	2.6	2.56	4.92	4.54	6.12	2.6	2.32	1.56	2.14	6.13	2.74
20	2.79	2.62	2.2	4.56	3.92	6.13	2.59	2.61	1.52	5.4	5.84	2.48
21	2.78	2.79	2.38	4.24	3.44	4.92	2.47	3.36	1.54	5.32	5.63	3.37
22	4.54	3.31	2.58	4.34	3.28	4.29	2.51	3.1	1.54	4.9	5.6	3.36
23	7.02	3.35	2.44	4.25	3.18	3.9	2.34	2.66	1.63	4.28	4.88	3.45
24	8.08	2.94	2.58	3.7	3.06	3.81	2.32	3.1	1.84	3.8	4.34	4.97
25	5.77	2.58	2.43	3.96	3.25	3.43	2.3	3.04	1.8	3.48	3.78	4.46
26	4.56	2.7	2.54	3.81	3.14	3.2	2.28	2.68	1.72	3.36	3.76	3.94
27	4.14	2.86	3.88	3.56	6.72	3.04	2.28	2.67	1.74	3.28	3.58	4.36
28	3.93	2.54	11.94	3.37	8.68	2.93	2.36	2.6	1.54	3.09	3.36	4.42
29	3.64	.....	7.25	3.29	6.9	3.5	2.59	2.69	1.53	3.16	3.26	4.32
30	3.51	.....	7.06	3.21	5.42	3.48	2.38	2.44	1.49	3.1	3.16	4.32
31	3.33	.....	11.09	.....	4.72	.....	2.31	2.2	.....	3.08	.....	5.82

NOTE.—Ice conditions as follows: Shore ice only in January; river frozen over February 2 and probably remained frozen until the latter part of the month; considerable anchor ice during the greater part of December; river frozen over December 25; ice went out December 31.

Rating table for Chemung River at Chemung, N. Y., for 1905 and 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.*
1.50	85	3.00	1,010	4.50	3,200	7.00	9,220
1.60	115	3.10	1,110	4.60	3,400	7.20	9,790
1.70	145	3.20	1,220	4.70	3,610	7.40	10,390
1.80	180	3.30	1,335	4.80	3,820	7.60	11,010
1.90	220	3.40	1,455	4.90	4,030	7.80	11,650
2.00	270	3.50	1,580	5.00	4,240	8.00	12,300
2.10	325	3.60	1,710	5.20	4,680	9.00	15,800
2.20	385	3.70	1,850	5.40	5,130	10.00	19,700
2.30	450	3.80	2,000	5.60	5,590	11.00	24,000
2.40	515	3.90	2,160	5.80	6,060	12.00	28,700
2.50	585	4.00	2,320	6.00	6,550	13.00	33,500
2.60	660	4.10	2,480	6.20	7,070	14.00	39,300
2.70	740	4.20	2,650	6.40	7,590		
2.80	825	4.30	2,830	6.60	8,130		
2.90	915	4.40	3,010	6.80	8,670		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1906. It is well defined above gage height 1.9 feet.

Monthly discharge of Chemung River at Chemung, N. Y., for 1905–6.

[Drainage area, 2,440 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
January 1–15 [a]	5,920	615	2,050	0.840	0.47
March 19–31 [a]	39,800	8,130	22,600	9.26	4.48
April	6,420	1,580	3,280	1.34	1.50
May	1,430	385	728	.298	.34
June	22,000	298	2,960	1.21	1.35
July	4,280	337	1,040	.426	.49
August	2,400	220	622	.255	.29
September	757	204	390	.160	.18
October	1,010	200	491	.201	.23
November	2,350	314	579	.237	.26
December	9,360	630	2,900	1.19	1.37
1906.					
January	12,600	660	2,300	.943	1.09
February [b]			2,000	.820	.85
March	28,400	385	3,670	1.50	1.73
April	13,600	1,230	6,040	2.48	2.77
May	14,600	1,070	2,680	1.10	1.27
June	9,530	861	2,780	1.14	1.27
July	4,680	437	905	.371	.43
August	2,560	373	975	.400	.46
September	379	82	204	.084	.09
October	5,130	100	1,120	.459	.53
November	6,890	676	1,960	.803	.90
December [b]	7,230	482	2,090	.857	.99
The year	28,400	82	2,230	.913	12.38

[a] A comparison of these figures with those for the discharge of Susquehanna River at McCall Ferry indicates that the mean discharge at the station for the period in 1905 not included in the table was approximately as follows: January 16–31, about 1,700 second-feet; February, about 900 second-feet; March 1–18, about 2,500 second-feet.

[b] Estimates for frozen period of 1906 are based on discharge of Susquehanna River at Binghamton.

NOTE.—Values for 1905 and 1906 are excellent, except those for February, 1906, which are fair.

WEST BRANCH OF SUSQUEHANNA RIVER AT WILLIAMSPORT, PA.

This station at Williamsport was established March 1, 1895, by George D. Snyder, who was at that time city engineer, and daily gage heights have been recorded since that date. It is located at the Market Street Bridge. The conditions at this station and the bench marks are described in Water Supply Paper No. 167, page 37, where are given also references to publications that contain data for previous years.

The following discharge measurement was made June 30, 1906:

Width, 744 feet; area, 3,620 square feet; gage height, 1.27 feet; discharge, 2,360 second-feet.

Daily gage height, in feet, of West Branch of Susquehanna River at Williamsport, Pa., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.7	3.7	1.9	10.7	2.9	5.2	1.1	1.4	1.3	0.9	2.2	2.2
2	5.2	3.4	1.2	9.6	2.7	4.5	1.0	1.3	1.0	.8	2.2	2.1
3	4.5	2.5	1.3	8.2	2.7	3.9	1.1	1.1	1.3	.9	2.3	2.1
4	4.3	2.3	4.4	7.6	2.8	3.4	1.1	1.9	2.7	1.0	2.1	1.9
5	5.4	2.5	5.3	7.6	2.9	2.9	1.1	2.2	2.5	.9	2.1	1.7
6	6.3	2.6	4.0	8.5	3.1	2.7	1.1	1.8	2.5	1.2	2.1	1.8
7	5.3	2.0	3.4	8.5	2.8	2.8	.9	1.7	2.1	1.4	1.9	2.5
8	4.6	1.9	3.1	7.5	2.6	2.6	.8	1.7	1.6	1.4	1.8	5.2
9	3.7	2.0	2.7	6.4	2.4	2.3	.8	1.7	1.2	1.4	1.9	4.8
10	3.7	2.2	2.8	7.7	2.4	2.1	.7	2.7	1.1	1.5	1.7	4.2
11	3.4	2.1	2.5	10.8	2.5	2.1	.6	3.9	.8	1.3	1.6	3.9
12	2.7	1.9	2.4	10.1	2.5	2.1	.4	5.7	.7	1.3	1.7	4.1
13	3.3	1.8	2.2	8.5	2.4	1.9	.5	4.6	1.0	1.4	1.7	3.9
14	3.2	1.9	2.1	7.3	2.3	1.7	.5	3.8	.9	1.2	1.7	3.8
15	3.1	2.3	2.1	7.2	2.2	1.5	.6	3.0	1.0	1.2	1.7	3.7
16	2.9	2.2	1.9	8.0	2.2	1.4	.4	2.4	1.0	1.2	1.6	3.5
17	2.9	1.6	1.9	7.4	2.1	2.0	.4	2.2	.9	1.1	1.6	4.1
18	3.1	1.4	1.8	6.5	2.8	2.0	3.5	1.7	.9	1.0	1.6	4.1
19	3.2	1.4	1.7	5.8	2.7	3.0	2.5	1.4	1.0	1.1	2.3	3.6
20	3.4	1.6	1.6	5.2	2.4	3.6	2.3	1.4	.8	2.1	3.1	3.0
21	3.9	1.5	1.3	4.9	2.2	3.1	2.3	1.7	.8	5.7	3.5	3.2
22	3.8	1.7	1.5	4.5	2.0	2.9	1.9	1.9	.9	5.2	3.7	3.4
23	5.6	1.9	1.7	4.3	1.8	2.2	1.7	2.4	1.0	4.3	3.9	3.3
24	11.4	1.8	1.6	4.3	1.7	1.9	1.7	2.2	1.1	3.6	3.9	3.0
25	10.7	1.9	1.4	4.2	1.9	1.7	1.5	2.0	1.1	3.3	3.4	2.1
26	8.4	2.0	1.6	4.0	2.3	1.5	1.5	1.9	1.0	2.9	3.2	1.6
27	6.9	1.9	1.9	3.7	2.3	1.4	1.4	1.7	.9	2.6	3.1	1.8
28	6.1	1.2	4.3	3.4	7.7	1.3	1.2	2.2	.9	2.6	2.7	1.9
29	5.2	.....	8.9	3.2	8.3	1.2	1.2	2.0	.8	2.4	2.5	2.4
30	4.8	.....	7.7	3.1	7.3	1.2	1.6	1.8	.8	2.3	2.5	2.7
31	4.1	.....	8.4	.....	6.0	.....	1.5	1.5	.....	2.3	.....	2.9

Rating table for West Branch of Susquehanna River at Williamsport, Pa., 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.*
0.40	1,120	1.70	3,460	3.00	6,580	5.60	16,250
0.50	1,280	1.80	3,660	3.20	7,170	5.80	17,150
0.60	1,440	1.90	3,860	3.40	7,780	6.00	18,060
0.70	1,610	2.00	4,070	3.60	8,400	6.20	18,980
0.80	1,780	2.10	4,300	3.80	9,030	6.40	19,940
0.90	1,960	2.20	4,530	4.00	9,690	6.60	20,900
1.00	2,140	2.30	4,770	4.20	10,400	6.80	21,900
1.10	2,320	2.40	5,010	4.40	11,150	7.00	22,900
1.20	2,510	2.50	5,250	4.60	11,940	8.00	28,000
1.30	2,700	2.60	5,500	4.80	12,750	9.00	33,460
1.40	2,890	2.70	5,760	5.00	13,600	10.00	39,180
1.50	3,080	2.80	6,020	5.20	14,470	11.00	45,400
1.60	3,270	2.90	6,300	5.40	15,350	12.00	52,400

NOTE.—The above table is applicable only for open-channel conditions. It is based on the discharge measurements made during 1901–1906. It is well defined between gage heights 1.4 feet and 16 feet.

Monthly discharge of West Branch of Susquehanna River at Williamsport, Pa., for 1906.

[Drainage area, 5,640 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	48,000	5,760	14,100	2.50	2.88
February	8,710	2,510	4,270	.757	.79
March	32,900	2,510	7,600	1.35	1.56
April	44,100	6,870	22,000	3.90	4.35
May	29,600	3,460	7,630	1.35	1.56
June	14,500	2,510	5,320	.943	1.05
July	8,090	1,120	2,700	.479	.55
August	16,700	2,320	4,900	.869	1.00
September	5,760	1,610	2,530	.449	.50
October	16,700	1,780	4,540	.805	.93
November	9,360	3,270	5,120	.908	1.01
December	14,500	3,270	7,020	1.24	1.43
The year	48,000	1,120	7,310	1.30	17.61

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

The following table gives the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge, and shows the number of days on which the flow and the corresponding horsepower were respectively less than the amounts given in the columns for "discharge" and "horsepower."

Discharge and horsepower table for West Branch of Susquehanna River at Williamsport, Pa., from 1895 to 1906.

Discharge in second-feet.	Horsepower (80 per cent efficiency) per foot fall.	Number of days of deficient flow.										
		1895.[a]	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
440	40	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
495	45	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
550	50	17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
660	60	28	.....	2	.....	3	.....	.....	.....	.....	.....	.....	.....
770	70	43	.....	5	.....	13	17	.....	.....	.....	.....	.....	.....
880	80	76	.....	8	.....	24	37	.....	5	.....	15	.....	.....
990	90	96	2	18	.....	47	46	.....	6	.....	32	.....	.....
1,100	100	96	2	18	.....	47	46	.....	6	.....	32	.....	.....
1,320	120	112	17	39	19	75	55	4	25	1	67	.....	5
1,540	140	118	27	47	30	89	63	18	30	4	86	.....	7
1,760	160	124	30	56	40	96	76	28	30	5	103	2	9
1,980	180	136	36	71	53	106	113	50	43	10	118	7	27
2,200	200	142	43	84	66	114	131	64	54	23	132	10	37
2,750	250	160	59	108	90	133	150	100	89	46	150	24	67
3,300	300	186	86	125	111	150	159	126	119	77	168	54	101
3,850	350	195	101	138	131	150	169	138	137	98	185	87	130
4,400	400	207	127	162	160	170	194	158	158	125	194	119	174

[a] March 1 to December 31, 1895.

NOTE.—During period covered by the above table the minimum flow was 410 second-feet, giving 37 horsepower per foot of fall for five days in 1905.

JUNIATA RIVER AT NEWPORT, PA.

This gaging station was established March 21, 1899, and discontinued July 14, 1906. Until the autumn of 1904 it was located on the covered wagon bridge 800 feet east of the public square at Newport, Pa. In the latter part of 1904 this bridge was removed and a steel structure erected on the same site. The conditions at this station and the bench marks are described in Water-Supply Paper No. 137, page 40, where are given also references to publications that contain data for previous years.

The following discharge measurement was made June 28, 1906:

Width, 534 feet; area, 1,190 square feet; gage height, 378 feet; discharge, 2,330 second-feet.

Daily gage height, in feet, of Juniata River at Newport, Pa., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	5.0	3.9	3.7	10.0	4.0	3.4	4.4
2	4.9	3.9	3.8	9.8	4.0	3.4	4.2
3	5.0	3.9	4.0	9.7	4.0	3.4	4.2
4	7.5	3.8	6.1	8.8	4.0	3.4	4.0
5	7.5	3.8	6.0	8.4	4.0	3.3	3.8
6	7.4	3.7	5.9	7.9	4.0	3.3	4.6
7	6.7	3.7	5.9	7.9	4.2	3.3	3.7
8	5.9	3.7	5.6	7.9	4.2	3.3	3.8
9	5.4	3.7	5.0	8.0	4.0	4.35	3.7
10	4.8	3.8	4.8	7.7	4.0	6.0	3.7
11	4.8	3.7	4.6	9.3	3.9	4.2	3.6
12	4.6	3.7	4.6	8.2	3.9	3.6	3.5
13	4.6	3.6	4.5	8.2	3.8	3.6	3.4
14	4.6	3.6	4.5	8.0	3.6	3.6	3.4
15	4.8	3.6	4.5	9.7	3.6	3.4	.....
16	5.0	3.6	4.5	9.4	3.6	3.4	.....
17	5.2	3.5	4.7	8.3	3.6	3.4	.....
18	5.2	3.5	4.6	6.6	3.5	4.0	.....
19	5.1	3.4	4.4	6.1	3.5	6.9	.....
20	5.0	3.4	4.4	5.6	3.5	6.7	.....
21	5.0	3.4	4.4	5.3	3.4	5.3	.....
22	5.0	3.4	4.3	5.0	3.4	4.7	.....
23	5.4	3.4	4.3	5.1	3.4	4.6	.....
24	7.0	3.4	4.5	5.2	3.4	4.4	.....
25	7.1	3.6	4.3	4.8	3.4	4.2	.....
26	6.8	3.6	4.2	4.6	3.4	4.2	.....
27	6.0	3.7	4.2	4.3	3.6	4.0	.....
28	5.6	3.7	6.6	4.2	4.2	3.8	.....
29	5.4	.....	10.0	4.1	4.3	3.8	.....
30	5.0	.....	9.0	4.1	4.0	3.7	.....
31	4.8	.....	11.0	.....	3.6	.....	.....

Rating table for Juniata River at Newport, Pa., 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.*
3.30	1,580	4.50	4,400	5.70	7,930	7.80	15,200
3.40	1,790	4.60	4,670	5.80	8,250	8.00	15,960
3.50	2,000	4.70	4,950	5.90	8,570	8.20	16,740
3.60	2,210	4.80	5,230	6.00	8,890	8.40	17,520
3.70	2,430	4.90	5,520	6.20	9,540	8.60	18,320
3.80	2,650	5.00	5,810	6.40	10,200	8.80	19,120
3.90	2,880	5.10	6,100	6.60	10,880	9.00	19,940
4.00	3,120	5.20	6,400	6.80	11,560	10.00	24,140
4.10	3,360	5.30	6,700	7.00	12,260	11.00	28,540
4.20	3,610	5.40	7,000	7.20	12,970		
4.30	3,870	5.50	7,310	7.40	13,700		
4.40	4,130	5.60	7,620	7.60	14,440		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1899–1906. It is well defined between gage heights 2.8 feet and 6.2 feet. The table has been extended beyond these limits, being based on one measurement at 8.2 feet. The table is the same as that for 1904 up to gage height 4 feet.

Monthly discharge of Juniata River at Newport, Pa., for 1906.

[Drainage area, 3,480 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	14,100	4,670	7,600	2.18	2.51
February	2,880	1,790	2,290	.658	.69
March	28,500	2,430	7,020	2.02	2.33
April	24,100	3,360	13,100	3.76	4.20
May	3,870	1,790	2,620	.753	.87
June	11,900	1,580	3,560	1.02	1.14
July 1-14	4,670	1,790	2,820	.810	.42

NOTE.—Values for entire year are excellent.

The following tables give the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge, and shows the number of days on which the flow and the corresponding horsepower were respectively less than the amounts given in the columns for "discharge" and "horsepower."

Discharge and horsepower table for Juniata River at Newport, Pa., from 1899–1906.

Discharge in second-feet.	Horsepower (80 per cent efficiency per foot fall).	Number of days of deficient flow.							
		1899.[a]	1900.	1901.	1902.	1903.	1904.	1905.	1906.[b]
275	25	7	.....	.....	.....	.....	2	.....	.....
330	30	12	.....	.....	.....	.....	4	2	.....
385	35	12	.....	.....	.....	.....	4	2	.....
440	40	24	.....	.....	.....	.....	8	5	.....
495	45	24	.....	.....	.....	.....	8	5	.....
550	50	24	.....	.....	.....	.....	8	5	.....
660	60	36	39	.....	4	.....	18	10	.....
770	70	62	67	.....	20	.....	74	10	.....
880	80	62	67	.....	20	.....	89	10	.....
990	90	90	108	30	25	.....	94	11	.....
1,100	100	90	108	30	25	.....	94	11	.....
1,320	120	125	128	39	38	2	120	11	.....
1,540	140	136	141	50	64	11	136	24	.....
1,760	160	160	172	67	86	42	144	29	4
1,980	180	175	185	90	108	63	145	44	25
2,200	200	185	199	117	126	111	151	76	31
2,750	250	209	228	163	167	138	178	192	69

[a] March 21 to December 31.

[b] January 1 to July 14.

NOTE.—From March 21, 1899, to July 14, 1906, the minimum flow was 230 second-feet, giving 21 horsepower per foot of fall, on 6 consecutive days in June, 1899, 1 day in July, 1899, November, 1903, and December, 1903.

BROAD CREEK AT MILL GREEN, MD.

This gaging station was established December 14, 1904. It is located in the village of Mill Green, on the steel highway bridge, and is best reached from Cardiff, Md. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 43.

Discharge measurements of Broad Creek at Mill Green, Md., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 23	Grover and Lyman	14.5	8.8	2.40	16.2
November 2	G. F. Harley	26	26	2.20	11.9
November 2	do	17	12.1	2.25	12.8
1906.					
March 17	Follansbee and Henshaw	31	38	2.48	27.0
March 30	F. F. Henshaw	29	41	2.63	34.9
April 10	do	32	51	2.96	61
April 10	do	32	51	2.92	55

Daily gage height, in feet, of Broad Creek at Mill Green, Md., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.38	2.42	2.45	2.52	2.54	2.36	2.25	2.22	2.25	2.12	2.36	2.23
2	2.4	2.45	2.45	2.49	2.54	2.35	2.25	3.21	2.22	2.12	2.34	2.24
3	2.5	2.55	3.2	2.51	2.53	2.34	2.25	3.3	2.2	2.14	2.3	2.25
4	3.08	2.48	2.55	2.5	2.5	2.31	2.4	2.3	2.2	2.52	2.3	2.24
5	2.55	2.45	2.5	2.52	2.5	2.3	2.37	2.23	2.2	2.39	2.3	2.24
6	2.45	2.55	2.48	2.5	2.49	2.3	2.3	2.23	2.2	2.21	2.3	2.42
7	2.42	2.48	2.5	2.5	2.5	2.3	2.28	2.22	2.18	2.2	2.29	2.36
8	2.38	2.45	2.48	2.49	2.5	2.3	2.25	2.24	2.18	2.2	2.26	2.25
9	2.32	2.65	2.48	3.7	2.49	2.46	2.25	2.24	2.18	2.24	2.26	2.25
10	2.38	2.55	2.45	2.97	2.46	2.34	2.25	2.23	2.18	2.24	2.25	2.26
11	2.4	2.5	2.48	2.67	2.45	2.31	2.25	2.23	2.18	2.21	2.32	2.39
12	2.7	2.45	2.45	2.62	2.46	2.3	2.24	2.22	2.18	2.14	2.32	2.28
13	2.4	2.65	2.45	2.6	2.44	2.3	2.23	2.2	2.17	2.12	2.3	2.25
14	2.45	3.62	2.52	2.61	2.42	2.3	2.2	2.2	2.16	2.12	2.3	2.25
15	2.52	2.62	2.5	3.98	2.4	2.3	2.2	2.2	2.15	2.13	2.3	2.25
16	2.55	2.45	2.58	2.72	2.4	2.38	2.38	2.2	2.15	2.12	2.34	2.26
17	2.42	2.42	2.45	2.67	2.4	2.48	2.52	2.19	2.15	2.14	2.34	3.38
18	2.35	2.38	2.48	2.59	2.4	2.49	2.44	2.18	2.15	2.15	2.51	2.54
19	2.38	2.45	2.52	2.6	2.4	2.56	2.26	2.18	2.15	2.85	2.66	2.32
20	2.32	2.42	2.52	2.6	2.39	2.39	2.25	2.21	2.15	3.42	2.39	3.22
21	2.38	2.48	2.56	2.58	2.35	3.1	2.24	2.2	2.15	2.64	2.35	2.68
22	2.42	2.45	2.5	2.61	2.35	2.69	2.38	2.21	2.15	2.39	2.35	2.32
23	2.45	2.42	2.54	2.64	2.36	2.36	2.34	2.2	2.15	2.35	2.34	2.3
24	2.5	2.45	2.52	2.6	2.35	2.35	2.24	3.55	2.15	2.34	2.3	2.3
25	2.48	2.52	2.48	2.59	2.35	2.34	2.22	2.6	2.14	2.6	2.29	2.29
26	2.45	2.48	2.56	2.56	2.35	2.31	2.21	2.3	2.12	2.35	2.28	2.26
27	2.42	2.45	3.68	2.55	2.35	2.3	2.34	2.26	2.12	2.35	2.27	2.25
28	2.52	2.48	2.72	2.54	2.4	2.29	2.24	2.36	2.12	2.32	2.25	2.25
29	2.45	.....	2.59	2.55	2.36	2.26	2.46	2.44	2.13	2.3	2.24	2.29
30	2.45	.....	2.64	2.55	2.35	2.25	2.28	2.32	2.12	2.3	2.23	2.36
31	2.48	.....	2.76	.....	2.44	.....	2.22	2.28	.....	2.39	.....	3.2

Rating table for Broad Creek at Mill Green, Md., 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.*
2.00	6	2.70	39	3.40	105	4.10	199
2.10	8	2.80	47	3.50	117	4.20	214
2.20	11	2.90	55	3.60	129	4.30	230
2.30	15	3.00	64	3.70	142	4.40	246
2.40	20	3.10	74	3.80	155	4.50	262
2.50	26	3.20	84	3.90	169	4.60	278
2.60	32	3.30	94	4.00	184	4.70	294

NOTE.—The above table is applicable only for open-channel conditions. It is based on 6 discharge measurements made during 1905–6. It is well defined between gage heights 2.2 feet and 3.3 feet.

Monthly discharge of Broad Creek at Mill Green, Md., for 1904–6.

[Drainage area, 16.4 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1904.					
December 14–31	76	.....	15.0	0.915	0.61
1905.					
January	184	.....	31.7	1.93	2.22
February	60	.....	14.2	.866	.90
March	187	29	54.2	3.30	3.80
April	64	26	33.7	2.05	2.29
May	84	16	23.6	1.44	1.66
June	86	13	19.8	1.21	1.35
July	246	11	29.3	1.79	2.06
August	286	11	29.7	1.81	2.09
September	49	13	16.1	.982	1.10
October	111	8	16.0	.976	1.13
November	45	9	13.0	.793	.88
December	184	11	26.1	1.59	1.83
The year	286	.....	25.6	1.56	21.31
1906.					
January	72	16	24.3	1.48	1.71
February	132	19	28.9	1.77	1.84
March	139	23	33.0	2.01	2.32
April	181	25	40.3	2.46	2.74
May	28	18	21.8	1.33	1.53
June	74	13	20.1	1.23	1.37
July	27	11	15.0	.915	1.05
August	123	10	21.8	1.33	1.53
September	13	9	9.9	.605	.67
October	107	9	19.0	1.16	1.34
November	36	12	16.4	1.00	1.12
December	103	12	23.1	1.41	1.63
The year	181	9	22.8	1.39	18.85

NOTE.—Flow during ice periods was determined by comparison with flow at other eastern Maryland gaging stations. Values are rated as follows: December, 1904, approximate, owing to ice conditions December 14–26; January and February, 1905, fair, owing to ice conditions January 25 to February 23; all others, 1905 and 1906, excellent; daily discharge above 180 second-feet, fair.

DEER CREEK NEAR CHURCHVILLE, MD.

This station was established December 14, 1904. It is located at the highway bridge on the Deer Creek road about 3 miles north of Churchville, and is best reached by driving from Belair. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 44, where are given also references to publications that contain data for previous years.

Discharge measurements of Deer Creek near Churchville, Md., 1904–1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1904.					
November 8	N. C. Grover	70	86	1.48	73
1905.					
June 23	Grover and Lyman	89	170	2.05	208
November 2	G. F. Harley	89	150	1.81	119
1906.					
March 17	Follansbee and Henshaw	91	185	2.20	233
March 30	F. F. Henshaw	91	219	2.54	380
April 10	do	92	282	3.11	696

Daily gage height, in feet, of Deer Creek near Churchville, Md., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.0	2.05	2.32	2.22	2.0	1.75	1.9	1.8	1.6	1.9	1.7
2	1.9	1.9	2.05	2.28	2.2	1.95	1.8	1.95	1.75	1.6	1.95	1.75
3	1.95	1.8	2.9	2.2	2.2	1.92	1.78	1.9	1.7	1.6	1.92	1.72
4	3.25	2.0	3.4	2.22	2.18	1.9	3.1	1.92	1.7	1.82	1.92	1.72
5	2.28	1.95	2.55	2.2	2.15	1.9	1.95	1.75	1.7	2.5	1.9	1.7
6	2.2	1.98	2.38	2.2	2.25	1.9	1.92	1.85	1.7	1.95	1.9	2.2
7	2.1	2.08	2.22	2.15	2.28	1.9	1.9	1.85	1.7	1.85	1.8	1.9
8	2.1	1.92	2.32	3.7	2.22	1.9	1.9	1.85	1.7	1.75	1.75	1.85
9	2.02	2.5	2.25	3.65	2.18	1.9	1.82	1.95	1.7	1.7	1.75	1.8
10	2.02	2.35	2.1	2.72	2.18	2.35	1.82	1.9	1.7	1.7	1.75	1.8
11	2.15	1.98	2.15	2.65	2.12	2.55	1.8	1.9	1.7	1.7	1.75	2.2
12	2.32	2.08	2.12	2.45	2.1	1.98	1.82	1.8	1.7	1.7	1.75	1.9
13	2.25	2.32	2.0	2.45	2.05	1.9	1.82	1.8	1.7	1.7	1.75	1.8
14	2.25	2.15	2.15	2.45	2.05	1.9	1.8	1.85	1.7	1.7	1.75	1.75
15	2.15	2.55	2.4	5.0	2.05	1.9	1.82	1.8	1.7	1.7	1.75	1.8
16	3.3	2.15	2.22	2.8	2.05	2.2	1.8	1.8	1.68	1.65	1.75	1.85
17	2.18	2.02	2.2	2.75	2.0	1.95	2.3	1.72	1.65	1.65	1.75	3.2
18	2.12	2.22	2.1	2.55	2.0	2.9	1.95	1.75	1.6	1.65	1.7	2.45
19	2.1	2.08	2.12	2.45	2.0	2.2	1.85	1.75	1.6	1.82	2.6	1.9
20	1.95	2.08	2.25	2.45	2.0	2.02	2.3	1.8	1.6	3.25	1.88	3.3
21	2.05	2.22	2.15	2.4	2.0	1.95	2.78	4.35	1.7	2.58	1.8	2.58
22	2.05	2.32	2.18	2.4	2.0	3.2	2.75	1.95	1.68	2.2	1.75	2.35
23	2.08	2.12	2.18	2.4	2.0	2.18	2.72	1.8	1.65	1.9	1.75	2.1
24	2.28	2.12	2.1	2.35	2.0	2.3	2.2	1.78	1.6	1.9	1.72	2.0
25	2.92	2.22	2.12	2.3	2.0	1.92	1.9	1.9	1.6	1.9	1.7	2.12
26	2.0	2.2	2.2	2.3	2.0	1.9	2.0	1.9	1.6	1.95	1.7	2.05
27	2.0	2.15	2.92	2.3	2.0	1.9	2.0	2.0	1.6	1.95	1.7	2.0
28	2.35	1.88	2.82	2.3	2.3	1.9	3.2	1.9	1.6	1.95	1.7	2.0
29	2.12	.....	2.5	2.28	2.3	1.88	3.45	1.9	1.6	1.9	1.7	2.0
30	2.95	.....	2.52	2.25	2.1	1.8	2.4	1.95	1.6	1.9	1.7	1.9
31	2.05	.....	2.52	.....	2.0	.....	1.9	1.85	.....	1.9	.....	3.8

NOTE.—There was considerable slush ice February 3–16, but the figures obtained from the rating table are probably not more than 10 per cent larger than the true values.

Rating table for Deer Creek near Churchville, Md., 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.*
1.50	72	2.70	445	3.90	1,210	5.10	2,280
1.60	87	2.80	495	4.00	1,290	5.20	2,380
1.70	105	2.90	550	4.10	1,370	5.30	2,485
1.80	126	3.00	605	4.20	1,450	5.40	2,590
1.90	150	3.10	665	4.30	1,535	5.50	2,700
2.00	178	3.20	725	4.40	1,620	5.60	2,810
2.10	209	3.30	790	4.50	1,710	5.70	2,920
2.20	242	3.40	855	4.60	1,800	5.80	3,030
2.30	277	3.50	920	4.70	1,890	5.90	3,140
2.40	315	3.60	990	4.80	1,985	6.00	3,260
2.50	355	3.70	1,060	4.90	2,080		
2.60	400	3.80	1,135	5.00	2,180		

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1904–1906. It is well defined between gage heights 1.5 feet and 3.5 feet.

Monthly discharge of Deer Creek near Churchville, Md., for 1904–1906.

[Drainage area, 141 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1904.					
December 14-31	522	.....	130	0.922	0.62
1905.					
January	3,200	.....	264	1.87	2.16
February	695	.....	162	1.15	1.20
March	955	164	377	2.67	3.08
April	635	178	254	1.80	2.01
May	296	105	153	1.09	1.26
June	335	96	144	1.02	1.14
July	495	96	162	1.15	1.33
August	2,680	96	249	1.77	2.04
September	920	105	194	1.38	1.54
October	822	105	168	1.19	1.37
November	323	105	130	.922	1.03
December	2,230	115	265	1.88	2.17
The year	3,200	.....	210	1.49	20.33
1906.					
January	790	150	273	1.94	2.24
February	377	126	219	1.55	1.61
March	855	178	301	2.13	2.46
April	2,180	225	426	3.02	3.37
May	277	178	211	1.50	1.73
June	725	126	212	1.50	1.67
July	887	115	251	1.78	2.05
August	1,580	109	187	1.33	1.53
September	126	87	99.2	.704	.79
October	758	87	165	1.17	1.35
November	400	105	132	.936	1.04
December	1,140	105	243	1.72	1.98
The year	2,180	87	227	1.60	21.82

NOTE.—The flow during the frozen period of 1904 to 1905 was determined by intercomparison of flow at eastern Maryland stations. Discharge computations for 1906 were not corrected for ice conditions. Values are rated as follows: December, 1904, approximate, owing to ice conditions December 14 to 27; January and February, 1905, fair, owing to ice conditions January 27 to February 22; March, 1905, to December, 1906, excellent; daily discharge above 2,000 second-feet, fair.

GUNPOWDER RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The headwaters of Gunpowder River lie in York County, Pa., near the Maryland line. Thence the river flows southeastward through Baltimore County, Md., and empties into Chesapeake Bay about 10 miles northeast of Baltimore. The river, though small, has steep slopes, and the powers have considerable value on account of their proximity to a large city. A portion of the water supply for Baltimore is taken from this river at Loch Raven, and the city has purchased all the power rights below this place. Little Gunpowder Falls, which is tributary below the fall line, has the same general characteristics as the larger river. Throughout its entire length it forms the boundary between Harford and Baltimore counties, Md. There are several small power developments.

GUNPOWDER FALLS AT GLENCOE, MD.

This station was established December 15, 1904. It is located at a steel highway bridge near the Pennsylvania Railroad station at Glencoe. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 46.

Discharge measurements of Gunpowder Falls at Glencoe, Md., in 1905 and 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 22	Grover and Lyman	66	93	1.53	138
November 3	F. F. Henshaw	66	89	1.80	138
1906.					
March 31	F. F. Henshaw	74	211	2.99	439
April 9	do	76	269	3.80	722
April 9	do	76	314	4.27	978

Daily gage height, in feet, of Gunpowder Falls at Glencoe, Md., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	2.12	2.22	2.7	2.52	2.5	1.68	2.0	1.88	1.52	2.02	1.62
2	2.02	2.0	2.1	2.65	2.5	2.2	1.65	3.2	1.8	1.48	1.85	1.58
3	2.25	3.05	2.85	2.52	2.5	2.0	1.7	2.6	1.82	1.58	1.82	1.62
4	3.88	3.65	3.25	2.5	2.48	2.0	2.9	2.58	1.7	2.02	1.78	1.58
5	2.78	3.4	3.12	2.5	2.6	1.9	2.15	2.28	1.65	2.68	1.78	1.7
6	2.6	3.18	2.8	2.5	2.5	1.9	2.0	2.15	1.7	1.82	1.8	2.02
7	2.38	3.25	2.65	2.4	2.7	1.92	1.9	2.08	1.72	1.72	1.72	1.92
8	2.32	3.32	2.68	2.4	2.45	1.9	1.85	2.0	1.7	1.68	1.72	1.62
9	2.32	3.65	2.58	3.68	2.48	2.2	1.8	2.0	1.6	1.6	1.72	1.65
10	2.28	3.62	2.48	4.42	2.4	2.4	1.85	1.92	1.52	1.9	1.7	1.75
11	3.88	3.15	2.38	3.4	2.38	2.25	2.22	1.95	1.55	1.75	1.75	2.32
12	3.58	3.18	2.4	3.1	2.4	1.98	1.95	1.9	1.55	1.6	1.88	1.78
13	2.55	3.25	2.38	2.9	2.32	1.95	1.8	1.98	1.6	1.6	1.75	1.75
14	2.42	3.75	2.35	2.9	2.3	1.88	1.75	1.88	1.6	1.58	1.7	1.78
15	2.45	2.88	2.6	5.9	2.25	1.88	1.7	1.8	1.55	1.55	1.72	1.75
16	2.55	2.22	2.42	3.5	2.25	1.85	1.72	1.8	1.55	1.5	1.75	1.75
17	2.42	2.18	2.4	3.22	2.3	2.0	2.28	1.8	1.5	1.58	1.78	2.85
18	2.32	2.05	2.35	3.12	2.2	2.62	1.95	1.8	1.52	1.8	1.7	2.7
19	2.3	2.15	2.45	3.0	2.15	2.6	1.75	1.65	1.55	2.25	2.3	2.08
20	2.25	2.18	2.45	2.9	2.1	2.15	1.7	2.95	1.52	3.25	1.95	3.05
21	2.2	2.22	2.32	2.9	2.1	2.75	1.8	1.95	1.6	2.68	1.88	2.8
22	2.2	2.98	2.4	2.95	2.1	2.98	5.1	1.85	1.62	2.85	1.8	2.52
23	2.2	2.42	2.32	2.98	2.08	2.52	2.6	1.78	1.52	2.3	1.8	2.28
24	2.45	2.4	2.28	2.82	2.08	2.3	2.1	5.0	1.42	2.42	1.72	1.85
25	2.15	2.5	2.25	2.72	2.05	2.05	1.82	2.22	1.5	2.5	1.68	3.78
26	2.1	2.6	2.45	2.72	2.02	1.9	1.75	2.0	1.5	2.1	1.65	3.88
27	2.1	2.38	4.0	2.68	2.1	1.9	1.75	2.32	1.6	2.0	1.68	3.5
28	2.5	2.3	3.42	2.6	2.52	1.9	2.9	2.42	1.55	1.98	1.65	3.75
29	2.3	.....	2.98	2.55	2.4	1.8	3.4	2.28	1.55	1.9	1.6	3.32
30	2.12	.....	3.05	2.58	2.1	1.78	2.35	2.18	1.52	1.85	1.6	2.92
31	2.15	.....	3.02	.....	2.05	.....	2.08	1.95	.....	2.0	.....	3.05

NOTE.—Ice jam January 11-12, and February 3-5 and 13. River frozen over February 6-12. Ice jam December 24-30.

Rating tables for Gunpowder Falls at Glencoe, Md.

DECEMBER 15, 1904, TO AUGUST 25, 1905.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	100	2.40	335	3.50	730	4.00	1,240
1.40	114	2.50	365	3.60	770	4.70	1,295
1.50	130	2.60	395	3.70	810	4.80	1,350
1.60	147	2.70	430	3.80	855	4.90	1,405
1.70	166	2.80	465	3.90	900	5.00	1,460
1.80	186	2.90	500	4.00	945	6.00	2,070
1.90	207	3.00	535	4.10	990	7.00	2,740
2.00	230	3.10	570	4.20	1,040	8.00	3,440
2.10	254	3.20	610	4.30	1,090	9.00	4,160
2.20	280	3.30	650	4.40	1,140		
2.30	307	3.40	690	4.50	1,190		

[a] This table is applicable only for open-channel conditions. It is based on 1 discharge measurement made during 1905 and on the form of the 1905-6 curve.

AUGUST 26, 1905, TO DECEMBER 31, 1906.[b]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	77	2.80	375	4.20	910	5.60	1,650
1.50	90	2.90	407	4.30	955	5.70	1,710
1.60	104	3.00	440	4.40	1,000	5.80	1,770
1.70	119	3.10	475	4.50	1,050	5.90	1,835
1.80	135	3.20	510	4.60	1,100	6.00	1,900
1.90	152	3.30	545	4.70	1,150	6.10	1,965
2.00	170	3.40	580	4.80	1,200	6.20	2,030
2.10	190	3.50	620	4.90	1,255	6.30	2,095
2.20	212	3.60	660	5.00	1,310	6.40	2,160
2.30	235	3.70	700	5.10	1,365	6.50	2,230
2.40	260	3.80	740	5.20	1,420	6.60	2,300
2.50	286	3.90	780	5.30	1,475		
2.60	314	4.00	820	5.40	1,530		
2.70	344	4.10	865	5.50	1,590		

[b] This table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1905 and 1906. It is fairly well defined between gage heights 1.8 feet and 5 feet.

NOTE.—At times of measurements the error in discharge determinations may be less than 5 per cent, at other times it may be as much as 25 per cent at low stages, and 10–15 per cent at high stages for short periods.

Monthly discharge of Gunpowder Falls at Glencoe, Md., for 1904–1906.

[Drainage area, 160 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1904.					
December 15–31			150	0.938	0.59
1905.					
January	3,510		311	1.94	2.24
February			150	.938	.98
March	1,140		463	2.89	3.33
April	810	203	298	1.86	2.08
May	242	114	172	1.08	1.24
June	602	114	192	1.20	1.34
July	670	111	240	1.50	1.73
August	3,940	147	361	2.26	2.61
September	820	107	218	1.36	1.52
October	1,270	93	211	1.32	1.52
November	503	111	147	.919	1.03
December	2,260	143	310	1.94	2.24
The year	3,940	93	256	1.60	21.86

Monthly discharge of Gunpowder Falls at Glencoe, Md., for 1904–1906—Continued.

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1906.					
January	772	174	255	1.59	1.83
February	720	170	268	1.68	1.75
March	820	190	330	2.06	2.38
April	1,840	260	461	2.88	3.21
May	344	174	239	1.49	1.72
June	433	132	205	1.28	1.43
July	1,360	111	227	1.42	1.64
August	1,310	111	237	1.48	1.71
September	149	80	104	.650	.72
October	527	86	179	1.12	1.29
November	235	104	132	.825	.92
December	457	101	203	1.27	1.46
The year	1,840	80	237	1.48	20.06

NOTE.—The discharge during the frozen periods was determined by intercomparison of data collected at eastern Maryland gaging stations.
Values for December, 1904, are approximate, owing to ice conditions. Values for January to August, 1905, are fair. Values from September, 1905, to December, 1906, are good. Ice conditions, December, 1904, January 1–6, and January 15 to March 4, 1905. For 1906 ice conditions see footnote to gage heights.

LITTLE GUNPOWDER FALLS NEAR BELAIR, MD.

This station was established December 13, 1904. It is located at a steel highway bridge on the road from Belair to Kingsville, at a distance of about 5 miles from Belair, from which place it is best reached by driving. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 48, where are given also references to publications that contain data for previous years.

Discharge measurements of Little Gunpowder Falls near Belair, Md., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 22	Grover and Lyman	33	32	1.50	49.9
November 1	G. F. Harley	38	47	1.39	44.5
1906.					
March 16	Follansbee and Henshaw	39	69	1.95	91
March 31	F. F. Henshaw	39	71	1.98	101
April 11	do	40	73	2.09	127

Daily gage height, in feet, of Little Gunpowder Falls near Belair, Md., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.52	1.68	1.78	1.86	1.84	2.09	1.54	1.56	1.56	1.47	1.71	1.56
2	1.55	1.58	1.62	1.76	1.88	1.78	1.55	2.16	1.58	1.45	1.56	1.54
3	1.6	1.75	2.18	1.76	1.88	1.69	1.49	2.08	1.59	1.44	1.56	1.58
4	2.55	1.85	2.52	1.82	1.83	1.66	2.04	1.66	1.54	1.92	1.59	1.49
5	1.82	1.65	1.88	1.75	1.94	1.68	1.64	1.6	1.5	2.32	1.58	1.54
6	1.72	1.9	1.75	1.84	2.0	1.68	1.52	1.52	1.46	1.66	1.56	1.92
7	1.6	1.92	1.8	1.81	1.89	1.62	1.58	1.6	1.4	1.59	1.53	1.71
8	1.68	2.0	1.78	1.76	1.86	1.7	1.53	1.38	1.48	1.52	1.52	1.66
9	1.62	2.3	1.78	3.18	1.85	1.64	1.43	1.5	1.5	1.48	1.55	1.59
10	1.85	2.02	1.75	2.9	1.79	1.95	1.52	1.49	1.5	1.68	1.58	1.64
11	1.9	1.85	1.7	2.04	1.84	1.88	1.45	1.46	1.46	1.5	1.7	1.82
12	2.1	1.82	1.7	1.94	1.81	1.6	1.53	1.49	1.53	1.43	1.64	1.6
13	1.85	2.1	1.7	1.86	1.79	1.66	1.54	1.85	1.5	1.58	1.57	1.65
14	1.88	2.48	1.68	1.88	1.78	1.62	1.5	1.62	1.49	1.49	1.6	1.65
15	1.8	2.2	2.05	4.18	1.79	1.63	1.49	1.52	1.42	1.45	1.62	1.56

Daily gage height, in feet, of Little Gunpowder Falls near Belair, Md., for 1906—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	1.88	1.78	1.9	2.24	1.8	1.68	1.49	1.46	1.46	1.48	1.63	1.62
17	1.78	1.75	1.85	2.09	1.72	1.65	2.22	1.45	1.48	1.46	1.6	2.42
18	1.68	1.75	1.82	2.02	1.78	2.42	1.64	1.42	1.46	1.46	1.58	1.98
19	1.7	1.68	1.88	1.95	1.72	2.05	1.58	1.5	1.44	1.99	2.52	1.75
20	1.65	1.65	1.88	1.95	1.7	1.79	1.46	3.34	1.42	2.5	1.88	2.7
21	1.65	1.68	1.85	1.95	1.66	1.72	1.52	2.06	1.62	2.39	1.76	2.09
22	1.58	1.95	1.85	1.94	1.64	2.0	2.42	2.8	1.42	1.84	1.72	1.94
23	1.65	1.68	1.88	1.92	1.69	1.71	1.68	1.75	1.46	1.65	1.65	1.82
24	1.92	1.75	1.8	1.92	1.64	1.82	1.51	1.62	1.46	1.65	1.64	1.82
25	1.62	1.78	1.78	1.88	1.69	1.64	1.48	1.85	1.4	2.26	1.61	2.56
26	1.62	1.68	1.95	1.89	1.72	1.56	1.4	1.74	1.36	1.72	1.67	2.56
27	1.58	1.7	2.62	1.89	1.73	1.62	1.52	1.96	1.46	1.64	1.61	1.76
28	1.85	1.75	2.18	1.86	1.9	1.56	1.48	2.06	1.46	1.64	1.62	1.7
29	1.65	.....	1.92	1.86	1.88	1.56	2.19	2.08	1.36	1.55	1.5	1.8
30	1.68	.....	1.9	1.9	1.74	1.54	1.69	1.8	1.42	1.53	1.59	1.71
31	1.65	.....	1.95	.....	2.49	.....	1.56	1.61	.....	1.66	.....	2.71

NOTE.—Probable backwater, December 25–26.

Rating table for Little Gunpowder Falls near Belair, Md., 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.*
1.20	19	2.00	103	2.80	263	3.60	480
1.30	26	2.10	119	2.90	288	3.70	510
1.40	34	2.20	136	3.00	314	3.80	540
1.50	43	2.30	155	3.10	340	3.90	570
1.60	53	2.40	175	3.20	367	4.00	600
1.70	64	2.50	195	3.30	394	4.10	630
1.80	76	2.60	216	3.40	422	4.20	660
1.90	89	2.70	239	3.50	450		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 6 discharge measurements made during 1904–1906. It is well defined between gage heights 1.4 feet and 2.2 feet. At times of measurements the error in discharge determinations may be less than 5 per cent, but at other times it may be 10 to 15 per cent, owing to shifting of channel.

Monthly discharge of Little Gunpowder Falls near Belair, Md., for 1904–1906.

[Drainage area, 43 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1904.					
December 13–31	.....	.....	40.0	0.930	0.66
1905.					
January	486	.....	75.5	1.76	2.03
February	175	.....	50.2	1.17	1.22
March	416	74	127	2.95	3.40
April	195	62	80.5	1.87	2.09
May	89	41	58.9	1.37	1.58
June	171	30	55.1	1.28	1.43
July	444	32	80.0	1.86	2.14
August	136	25	41.6	.967	1.11
September	165	32	44.6	1.04	1.16
October	116	26	44.0	1.02	1.18
November	136	20	42.2	.981	1.09
December	630	26	74.7	1.74	2.01
The year	630	20	64.5	1.50	20.44

Monthly discharge of Little Gunpowder Falls near Belair, Md., for 1904–1906—Cont'd.

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1906.					
January	205	45	71.7	1.67	1.92
February	191	51	84.6	1.97	2.05
March	221	55	91.1	2.12	2.44
April	654	70	124	2.88	3.21
May	193	57	79.3	1.84	2.12
June	179	47	70.8	1.65	1.84
July	179	34	58.4	1.36	1.57
August	405	32	82.4	1.92	2.21
September	55	31	39.4	.916	1.02
October	195	37	67.9	1.58	1.82
November	199	43	60.0	1.40	1.56
December	241	42	83.5	1.94	2.24
The year	654	31	76.1	1.77	24.00

NOTE.—The discharge during the frozen period was determined by intercomparison of data collected at eastern Maryland gaging stations.

Values for December, 1904, are approximate, owing to ice conditions. Values for 1905 and 1906 are fair, except those for March and April, 1906, which are good. Ice conditions December, 1904, January 1 to 6 and January 26 to February 25, 1905, and December 25 and 26, 1906.

PATAPSCO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Patapsco River is formed by the junction of North Branch and South or Piney Branch near Marriottsville, Md., and flows in a southeasterly direction into Chesapeake Bay, 13 miles south of Baltimore. Both branches rise in the central part of Maryland, and the whole basin, which has an area of about 350 square miles, lies within that State.

The drainage basin is hilly and largely under cultivation. It has no lakes or artificial reservoirs, and the flow of the stream is variable. The maximum estimated flow at the gaging station at Woodstock, Md., where the drainage area is 251 square miles, is about 12,000 second-feet, while the minimum estimated flow has been about 50 second-feet. The record from which these estimates have been taken extends over a period of nine and one-half years. The freshets do not, however, cause very large rises of the water because of the steep slope of the stream. The maximum recorded difference in gage height at Woodstock is 13 feet, while the usual range within a year is about 3 or 4 feet.

The bed is generally rock. The banks are of rock and very little land is subject to overflow. The Baltimore and Ohio Railroad follows the stream closely throughout nearly its entire length.

The river carries a small volume of water, but as it has considerable slope a large number of water powers have been developed along its course. These, though small, are made valuable by their proximity to Baltimore.

PATAPSCO RIVER AT WOODSTOCK, MD.

This station was established August 6, 1896. It is located near the railroad station at Woodstock, 1.5 miles below the mouth of the North Branch. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 49, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of Patapsco River at Woodstock, Md., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.2	4.2	4.15	4.6	4.35	4.05	4.0	3.9	4.25	4.1	3.9	4.0
2	4.1	4.2	4.2	4.5	4.4	4.0	3.9	12.5	4.3	3.95	3.95	4.05
3	4.2	4.05	5.7	4.4	4.45	3.85	3.95	6.9	4.25	3.85	3.8	4.15
4	5.75	4.15	6.6	4.35	4.35	3.9	6.55	4.75	4.15	4.15	3.95	4.1
5	4.65	4.2	4.75	4.35	4.8	3.95	4.6	4.3	4.15	5.05	3.9	3.95
6	4.45	4.85	4.55	4.35	4.35	3.9	4.1	4.35	4.05	4.5	4.0	4.15
7	4.3	4.6	4.45	4.3	4.35	3.85	3.9	4.15	4.15	4.3	4.0	4.0
8	4.3	4.3	4.5	4.35	4.4	3.85	3.9	4.2	4.0	4.15	3.9	4.1
9	4.2	4.85	4.4	4.55	4.3	3.95	4.05	4.1	4.0	4.0	3.85	4.15
10	4.15	4.35	4.3	4.45	4.25	3.9	4.1	4.05	4.1	4.2	4.0	4.15
11	4.2	4.05	4.25	4.35	4.25	4.3	4.0	4.2	4.05	4.05	4.0	4.45
12	4.5	4.1	4.2	4.4	4.3	4.15	4.0	4.45	3.95	3.9	3.95	4.15
13	4.4	4.25	4.2	4.45	4.25	4.05	3.95	4.55	4.0	3.8	3.9	4.15
14	4.4	4.55	4.3	4.35	4.15	3.95	3.85	4.05	3.9	3.85	3.85	4.05
15	4.45	4.6	4.9	9.45	4.15	3.9	3.8	3.95	4.15	3.95	3.95	4.05
16	4.45	4.1	4.6	5.3	4.2	3.85	3.95	4.05	4.05	3.9	3.95	4.35
17	4.3	4.05	4.45	5.0	4.15	4.05	4.0	4.0	4.0	4.25	4.0	5.8
18	4.3	4.05	4.35	4.85	4.05	4.45	4.1	4.25	3.95	4.05	4.15	4.95
19	4.25	4.1	4.35	4.75	4.05	4.4	4.0	4.15	3.9	4.45	4.9	4.65
20	4.2	4.15	4.45	4.7	4.05	4.45	3.85	4.3	4.1	5.65	4.6	4.6
21	4.2	4.25	4.3	4.65	4.05	4.95	3.8	4.25	4.05	7.2	4.45	4.8
22	4.2	4.6	4.35	4.65	4.1	4.65	4.2	4.1	4.2	5.1	4.25	4.6
23	4.2	4.25	4.4	4.6	4.1	4.4	4.65	4.05	4.0	4.25	4.05	4.55
24	4.25	4.2	4.3	4.5	3.95	4.45	4.15	9.5	3.95	4.35	4.1	4.4
25	4.15	4.15	4.35	4.6	4.0	4.25	3.9	6.5	3.85	4.2	4.15	4.35
26	4.15	4.4	4.4	4.5	4.0	4.05	3.75	5.75	4.1	4.25	4.1	4.2
27	4.15	4.25	5.05	4.55	4.05	3.95	3.95	5.9	3.95	3.95	4.05	4.35
28	4.35	4.25	5.15	4.5	4.7	3.9	4.7	5.35	4.0	3.9	4.1	4.25
29	4.2	.....	4.75	4.45	4.3	3.9	4.4	4.65	3.9	3.85	4.15	4.2
30	4.15	.....	4.85	4.45	4.15	3.85	4.05	4.45	3.95	3.8	4.05	4.25
31	4.2	.....	4.85	.....	4.15	.....	3.95	4.4	.....	3.95	.....	5.4

Rating table for Patapsco River at Woodstock, Md., 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.*
3.20	36	4.20	332	5.20	1,026	7.00	2,778
3.30	50	4.30	383	5.30	1,115	7.50	3,273
3.40	66	4.40	438	5.40	1,206	8.00	3,772
3.50	86	4.50	497	5.50	1,300	8.50	4,278
3.60	111	4.60	561	5.60	1,396	9.00	4,788
3.70	139	4.70	629	5.70	1,493	10.00	5,818
3.80	170	4.80	701	5.80	1,591	11.00	6,858
3.90	204	4.90	777	5.90	1,689	12.00	7,908
4.00	242	5.00	857	6.00	1,788		
4.10	285	5.10	940	6.50	2,283		

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1904 and 1905. It is well defined.

Monthly discharge of Patapsco River at Woodstock, Md., for 1906.

[Drainage area, 251 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	1,540	285	410	1.63	1.88
February	739	264	388	1.55	1.61
March	2,380	308	596	2.37	2.73
April	5,250	383	692	2.76	3.08
May	701	223	355	1.41	1.63
June	817	187	303	1.21	1.35
July	2,330	155	341	1.36	1.57
August	8,440	204	1,020	4.08	4.70
September	383	187	264	1.05	1.17
October	2,980	170	446	1.78	2.05
November	777	170	281	1.12	1.25
December	1,590	223	452	1.80	2.08
The year	8,440	155	463	1.84	25.10

NOTE.—Values for entire year are excellent.

The following table gives the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge and shows the number of days on which the flow and the corresponding horsepower were respectively less than the amounts given in the columns for "discharge" and "horsepower:"

Discharge and horsepower table for Patapsco River at Woodstock, Md., from 1896 to 1906.

Discharge in second-feet.	Horsepower (80 per cent efficiency) per foot fall.	Number of days of deficient flow.									
		1896.[a]	1897.	1898.	1899.[b]	1900.[c]	1901.[d]	1902.	1903.	1904.	1905.	1906.
55	5	.....	.....	.....	.....	10	.....	.....	.....	2	.....	.....
66	6	1	1	1	.....	17	.....	.....	.....	12	.....	.....
88	8	6	7	8	3	24	1	.....	.....	77	.....	.....
110	10	22	18	18	5	34	6	1	.....	112	.....	.....
132	12	41	38	53	11	48	22	10	.....	161	9	.....
154	14	96	64	87	27	85	47	51	.....	184	26	.....
176	16	106	88	121	67	108	77	73	.....	222	92	6
198	18	120	101	127	89	120	93	82	2	241	114	19
220	20	126	116	151	134	134	127	110	6	257	145	40
275	25	133	158	202	175	178	179	174	44	325	220	120

[a] August 16 to December 31.
[b] February 1 to December 31.
[c] January 1 to November 30.
[d] Omitting September.

NOTE.—During the period covered by this table the minimum flow was 50 second-feet, giving 4.5 horsepower per foot of fall on two days in July, 1900, eight days in August, 1900, and one day each in June and September, 1904.

POTOMAC RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Potomac River is formed by the junction of its north and south branches, about 15 miles below Cumberland, Md., from which point it flows in a southeasterly direction into Chesapeake Bay. For its entire length it forms the southern boundary of the State of Maryland

and the northern boundary of the States of West Virginia and Virginia. It drains a total area of about 14,500 square miles.

North Branch of Potomac River rises in the Allegheny Mountains near the west corner of Maryland, and South Branch in the Alleghenies in Virginia and West Virginia. These branches, with their tributaries and the tributaries of the main stream as far down as the Shenandoah, drain a series of narrow and generally fertile valleys lying between the parallel ranges which make up the system of the Alleghenies in this region. Their slopes are not, as a rule, very great, and their beds are of gravel and sand. The slopes of their drainage basins are, however, usually very steep, and after a rain the water collects quickly in the rivers. There are few lowlands to be overflowed, and no lakes whatever in the region. Consequently these streams, and with them Potomac River, are subject to very sudden and heavy freshets in wet seasons, while in dry seasons their discharge becomes small. The record of gage height at Point of Rocks, Md., covering a period of nearly twelve years, shows a maximum range of 29 feet, and for several years the range has been more than 20 feet each year. The corresponding maximum and minimum discharges have been 219,000 and 900 second-feet, respectively.

The slopes of the tributary basin of Shenandoah River are in many instances steep, but the valley through which the Shenandoah flows is generally broader and more lands are subject to overflow. The slope of the river itself is usually greater than the slope of the tributaries above mentioned. As a result the fluctuations of this stream are not so great, having a maximum range of about 19 feet at Millville in twelve years, while the average annual fluctuation is 10 feet or less. The discharge in this period has ranged between 140,000 and 480 second-feet.

From the junction of its north and south branches below Cumberland, Md., the Potomac cuts through the mountains at nearly right angle. Its valley is narrow, its slope in many places great. The bed is generally gravel and bowlders, with ledge rock at small depth, which often appears at the surface. The banks are usually high and are not subject to overflow. It crosses the fall line a few miles above Washington and reaches tide water at Georgetown.

The Baltimore and Ohio Railroad follows the river for its entire length, and the Shenandoah Valley and the Cumberland Valley railroads cross the stream. The Chesapeake and Ohio Canal follows it from Cumberland to Georgetown.

As a water-power stream the principal disadvantage of the Potomac is the great variability of its flow. Good rock foundations for dams can generally be found at small depth, the banks are, as a rule, favorable, and there are several sites where large falls could be rendered available. A very insignificant amount of power has been developed.

The Great Falls of the Potomac, located about 15 miles above Washington (as shown in Pl. IV), offers one of the best undeveloped power sites along Potomac River.

The surface water resources of the Potomac River basin have been discussed in detail in Water-Supply Paper No. 192.

NORTH BRANCH OF POTOMAC RIVER AT PIEDMONT, W. VA.

This station was established June 27, 1899, and was discontinued July 15, 1906. It is located at the iron highway bridge connecting Luke, Md., with Piedmont, W. Va. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 53, and in Water-Supply Paper No. 192, where are given also the data for previous years.

Discharge measurements of North Branch of Potomac River at Piedmont, W. Va., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 16	Bolster and Padgett	146	243	3.51	412
March 30	Robert Follansbee	291	1,220	7.15	5,820
April 11	R. H. Bolster	284	787	5.64	2,590
May 28	Robert Follansbee	147	243	3.49	391

Daily gage height, in feet, of North Branch of Potomac River at Piedmont, W. Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	3.55	3.65	2.75	6.05	4.0	3.25	3.0
2	3.35	3.55	3.1	5.55	3.9	3.45	2.9
3	3.65	3.2	3.3	5.7	4.0	3.3	2.8
4	5.65	3.4	5.15	6.0	3.8	3.1	2.8
5	5.3	3.5	4.35	6.15	3.7	3.3	3.1
6	4.6	3.0	3.95	6.8	3.6	4.6	2.85
7	3.9	3.1	3.8	5.7	3.7	5.25	2.75
8	4.05	3.1	3.8	5.05	3.6	4.7	2.6
9	3.65	3.1	3.7	5.15	3.5	4.1	2.6
10	3.55	2.9	3.6	6.45	3.5	3.65	2.6
11	3.55	2.75	3.4	5.5	3.4	3.35	2.5
12	3.7	2.85	3.6	5.45	3.4	3.1	2.65
13	3.95	3.0	3.5	4.55	3.3	3.25	2.6
14	3.8	3.05	3.5	4.45	3.2	3.1	2.6
15	3.8	3.0	3.5	6.15	3.2	3.0	2.55
16	3.95	2.75	3.5	5.45	3.1	3.0	.....
17	4.15	2.8	3.4	4.85	3.1	2.9	.....
18	4.1	2.9	3.15	4.45	3.0	2.9	.....
19	4.7	2.8	3.4	4.25	3.0	2.9	.....
20	4.35	2.95	4.05	4.1	2.9	2.95	.....
21	4.5	3.0	3.8	3.95	2.9	3.1	.....
22	4.85	3.2	3.7	4.0	2.8	3.3	.....
23	8.2	3.1	3.7	4.0	2.8	3.2	.....
24	6.4	3.05	3.75	4.0	2.7	3.1	.....
25	5.1	3.1	3.55	4.1	2.7	3.0	.....
26	4.6	3.1	3.6	6.5	2.7	3.0	.....
27	4.35	3.05	5.05	5.4	2.7	3.6	.....
28	4.3	2.6	7.3	4.65	3.35	3.35	.....
29	4.15	.....	6.25	4.35	3.45	3.25	.....
30	3.95	.....	7.4	4.15	3.2	3.0	.....
31	3.8	.....	7.4	.....	3.0	.....	.....

NOTE.—Discharge probably unaffected by ice during 1906.

GREAT FALLS OF THE POTOMAC.

Rating table for North Branch of Potomac River at Piedmont, W. Va., 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.*
2.50	70	3.70	519	4.90	1,655	6.20	3,450
2.60	88	3.80	587	5.00	1,770	6.40	3,785
2.70	109	3.90	661	5.10	1,890	6.60	4,140
2.80	133	4.00	740	5.20	2,015	6.80	4,515
2.90	160	4.10	825	5.30	2,140	7.00	4,900
3.00	190	4.20	915	5.40	2,270	7.20	5,300
3.10	224	4.30	1,010	5.50	2,400	7.40	5,710
3.20	262	4.40	1,110	5.60	2,535	7.60	6,130
3.30	304	4.50	1,215	5.70	2,675	7.80	6,570
3.40	350	4.60	1,320	5.80	2,820	8.00	7,030
3.50	401	4.70	1,430	5.90	2,970	8.20	7,500
3.60	457	4.80	1,540	6.00	3,125		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1906, and on the form of previous curves. It is well defined between gage heights 3.5 feet and 5.5 feet.

Monthly discharge of North Branch of Potomac River at Piedmont, W. Va., for 1906.

[Drainage area, 410 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	7,500	327	1,260	3.06	3.53
February	488	88	220	.537	.56
March	5,710	121	1,160	2.83	3.26
April	4,520	700	2,010	4.91	5.48
May	740	109	323	.788	.91
June	2,080	160	413	1.01	1.13
July 1-15	224	70	120	.293	.16

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

POTOMAC RIVER AT POINT OF ROCKS, MD.

This station was established February 17, 1895. It is located at the steel highway bridge at Point of Rocks, Md. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 55, and in Water-Supply Paper No. 192, where are given also the data for previous years.

Discharge measurements of Potomac River at Point of Rocks, Md., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 30	Robert Follansbee	987	3,350	1.70	3,890
December 7[a]	Bolster and Padgett	990	3,180	1.76	4,450

[a] Results not reliable, owing to heavy gale blowing downstream.

Daily gage height, in feet, of Potomac River at Point of Rocks, Md., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	3.6	3.0	1.9	11.1	3.3	1.8	2.2	1.6	3.7	1.2	2.6	1.9
2	3.4	2.9	1.8	9.6	3.1	1.7	1.9	1.5	3.1	1.2	2.5	1.8
3	3.3	2.7	1.8	7.7	2.8	1.7	2.0	1.5	2.8	1.4	2.3	1.9
4	3.7	2.5	2.0	6.5	2.8	1.6	2.9	4.3	2.6	1.5	2.3	1.7
5	8.0	2.4	4.0	5.5	2.6	1.5	2.6	3.6	2.3	2.2	2.1	1.8
6	8.6	2.2	5.45	5.1	2.5	1.7	2.4	2.8	2.1	2.5	2.1	1.8
7	7.0	2.2	4.5	4.8	2.6	1.9	2.2	2.4	1.9	2.7	2.1	1.85
8	4.8	2.0	3.6	4.8	2.5	1.7	2.0	2.6	1.8	2.6	2.0	1.7
9	4.0	1.9	3.0	4.3	2.4	2.4	1.9	2.8	1.8	2.5	2.0	1.75
10	3.5	1.8	2.7	4.2	2.4	3.0	1.7	3.2	1.7	2.2	1.9	1.8
11	3.1	1.8	2.6	5.5	2.4	2.5	1.5	7.6	1.7	2.0	1.8	2.0
12	2.9	1.9	2.5	5.6	2.2	2.2	1.4	5.7	1.6	1.9	1.8	2.2
13	2.8	1.8	2.3	4.9	2.3	1.8	1.3	4.3	1.6	1.6	1.8	3.5
14	3.0	1.8	2.3	4.0	2.2	1.6	1.2	3.7	1.5	1.5	1.7	3.1
15	3.3	1.9	2.3	5.75	2.0	1.6	1.3	3.0	1.5	1.6	1.8	2.65
16	3.6	1.8	2.4	8.45	2.1	1.6	1.2	5.1	1.4	1.4	1.7	2.7
17	3.7	1.7	2.5	7.5	2.0	1.6	1.2	4.8	1.6	1.4	1.8	2.8
18	4.1	1.6	2.5	6.3	1.8	2.5	1.5	4.2	1.5	1.5	1.8	4.7
19	3.9	1.6	2.6	5.1	1.9	3.2	1.8	3.5	1.4	1.7	1.9	10.0
20	3.5	1.6	2.9	4.5	1.8	2.9	1.7	4.4	1.4	12.5	1.9	7.2
21	3.4	1.7	2.9	4.1	1.6	3.1	1.5	4.0	1.4	16.1	3.0	5.6
22	3.3	1.8	3.1	3.6	1.6	5.0	1.4	5.3	1.3	11.65	4.2	5.2
23	3.2	1.9	3.4	3.3	1.6	4.3	1.5	4.8	1.3	8.5	4.0	4.6
24	3.1	2.0	3.9	3.1	1.4	3.6	2.0	3.7	1.3	6.6	3.3	3.8
25	6.35	2.0	3.9	2.9	1.5	3.1	2.1	4.1	1.3	5.4	3.0	3.2
26	5.1	1.9	3.9	2.9	1.4	2.6	1.9	4.8	1.3	4.5	2.7	2.8
27	4.2	1.8	3.7	2.8	1.3	2.4	1.7	4.6	1.2	4.1	2.6	2.85
28	3.6	2.0	7.8	5.1	1.9	2.3	1.8	6.7	1.2	3.6	2.2	2.9
29	3.4	.....	12.9	5.0	1.9	3.1	1.9	6.0	1.2	3.3	2.1	3.0
30	3.2	.....	10.5	4.3	1.7	3.0	2.0	5.3	1.2	3.1	2.1	3.1
31	3.1	.....	10.9	.....	1.7	.....	1.7	4.4	.....	2.8	.....	3.2

NOTE.—Practically no ice conditions.

Rating table for Potomac River at Point of Rocks, Md., for 1902–1906.

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	2,530	2.60	7,330	4.00	14,070	6.80	31,460
1.30	2,810	2.70	7,750	4.20	15,150	7.00	32,820
1.40	3,100	2.80	8,180	4.40	16,270	8.00	39,980
1.50	3,400	2.90	8,620	4.60	17,430	9.00	47,600
1.60	3,700	3.00	9,070	4.80	18,610	10.00	55,600
1.70	4,010	3.10	9,530	5.00	19,820	11.00	63,900
1.80	4,330	3.20	10,000	5.20	21,060	12.00	72,200
1.90	4,670	3.30	10,480	5.40	22,300	13.00	80,500
2.00	5,020	3.40	10,970	5.60	23,560	14.00	88,800
2.10	5,380	3.50	11,470	5.80	24,840	15.00	97,100
2.20	5,750	3.60	11,980	6.00	26,140	16.00	105,400
2.30	6,130	3.70	12,490	6.20	27,460	17.00	113,700
2.40	6,520	3.80	13,010	6.40	28,780		
2.50	6,920	3.90	13,530	6.60	30,100		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1906, inclusive. It is well defined between gage heights 1 foot and 14 feet. Above gage height 10 feet the rating curve is a tangent, the difference being 830 per tenth. The above table supersedes previous tables. from April 1, 1902. to December 31, 1906.

Monthly discharge of Potomac River at Point of Rocks, Md., for 1906.

[Drainage area, 9,650 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	44,500	8,180	15,000	1.55	1.79
February	9,070	3,700	5,120	.530	.55
March	79,700	4,330	15,900	1.65	1.90
April	64,700	8,180	22,400	2.33	2.60
May	10,500	2,810	5,540	.574	.66
June	19,800	3,400	7,010	.726	.81
July	8,620	2,530	4,380	.454	.52
August	37,100	3,400	15,200	1.58	1.82
September	12,500	2,530	4,280	.444	.50
October	106,000	2,530	16,300	1.69	1.95
November	15,200	4,010	6,340	.657	.73
December	55,600	4,010	11,000	1.14	1.31
The year	106,000	2,530	10,700	1.11	15.14

NOTE.—Values for entire year are excellent

The following table gives the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge, and shows the number of days on which the flow and the corresponding horsepower were, respectively, less than the amounts given in the columns for "discharge" and "horsepower."

Discharge and horsepower table for Potomac River at Point of Rocks, Md., from 1895 to 1906.

Discharge in second-feet.	Horsepower (80 per cent efficiency), per foot fall.	Number of days of deficient flow.											
		1895.[a]	1896.[b]	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
990	90	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	.....	.....
1,100	100	5	.....	.....	.....	.....	3	.....	.....	.....	23	.....	.....
1,320	120	40	14	.....	.....	.....	39	.....	12	.....	58	.....	.....
1,540	140	79	28	3	.....	.....	78	.....	25	.....	86	.....	.....
1,760	160	107	43	9	6	23	101	.....	51	.....	107	14	.....
1,960	180	124	60	29	8	50	110	2	51	.....	107	14	.....
2,200	200	128	72	56	29	82	115	5	83	22	126	32	.....
2,750	250	150	101	98	59	133	140	49	109	59	140	46	9
3,300	300	162	130	107	71	152	152	60	142	74	161	90	28
3,850	350	182	162	137	95	172	173	88	162	103	196	130	59
4,400	400	190	187	162	106	176	193	101	175	128	207	149	106
4,950	450	201	222	186	128	188	223	126	185	139	210	162	128
5,500	500	208	238	195	136	197	233	133	195	161	233	195	151

[a] February 17 to December 31.
[b] Flow for missing days estimated from Millville records.

NOTE.—During the period covered by this table the minimum flow was 900 second-feet, giving 82 horsepower per foot of fall, on 6 days (two 3-day periods) in October, 1904.

SOUTH BRANCH OF POTOMAC RIVER NEAR SPRINGFIELD, W. VA.

A gaging station was established at the Baltimore and Ohio Railroad bridge, 3 miles southwest of Springfield, in April, 1894. This station was discontinued in 1896 for want of an observer. On June 26, 1899, a station was established at the highway bridge 1.5 miles

below the original station, near Grace station. This bridge was carried away by flood in February, 1902. The present station was established August 28, 1903, and was discontinued July 14, 1906. It is located at the steel highway bridge, 2.5 miles east of Springfield, W. Va. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 60, and in Water-Supply Paper No. 192, where are given also the data for previous years.

Discharge measurements of South Branch of Potomac River near Springfield, W. Va., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq.-ft.*	*Feet.*	*Sec.-ft.*
March 17[a]	Bolster and Padgett	146	620	4.50	1,960
May 26	Robert Follansbee	146	346	2.63	455

[a] Measurement may have been affected by ice about the pivot point of the meter.

Daily gage height, in feet, of South Branch of Potomac River near Springfield, W. Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	4.0	4.05	2.6	9.65	4.85	2.8	3.0
2	3.95	3.85	2.7	8.75	4.55	2.7	2.8
3	3.85	3.55	2.8	7.85	4.35	2.7	2.68
4	6.75	3.4	7.05	6.25	4.2	2.8	2.7
5	8.65	3.4	6.65	5.3	4.0	2.7	3.15
6	6.7	3.2	5.65	5.4	4.15	2.7	2.9
7	5.3	3.05	4.8	5.15	3.9	2.85	2.85
8	4.6	3.0	4.35	4.95	4.0	2.85	2.55
9	4.15	3.0	4.05	4.65	3.85	2.85	2.4
10	3.75	3.1	3.85	5.35	3.7	2.85	2.48
11	3.6	2.9	3.65	5.45	3.65	2.65	2.3
12	3.9	2.9	3.5	5.15	3.4	2.5	2.25
13	4.3	2.85	3.35	4.75	3.3	2.58	2.3
14	4.5	2.7	3.3	4.4	3.25	2.4	2.1
15	4.55	2.7	3.65	5.4	3.2	2.5	.....
16	5.15	2.7	4.25	6.6	3.4	2.7	.....
17	5.2	2.6	4.45	5.9	3.3	2.7	.....
18	4.75	2.5	4.4	5.5	3.2	2.75	.....
19	4.45	2.4	4.4	4.85	3.1	2.9	.....
20	4.05	2.4	4.8	4.45	3.0	3.0	.....
21	3.85	2.6	5.15	4.0	3.05	3.85	.....
22	3.75	2.65	5.65	3.85	2.85	4.0	.....
23	5.15	2.7	6.1	3.75	2.75	3.65	.....
24	9.5	2.6	5.95	3.65	2.7	3.35	.....
25	7.2	2.6	5.35	3.6	2.6	3.5	.....
26	5.25	2.6	5.6	6.35	2.6	4.2	.....
27	4.85	2.6	8.65	9.85	2.5	4.1	.....
28	4.65	2.6	13.55	7.3	2.6	3.45	.....
29	4.75	.....	10.85	5.75	2.7	3.05	.....
30	4.45	.....	10.65	5.05	2.65	3.0	.....
31	4.25	.....	10.95	.....	2.7	.....	.....

NOTE.—Discharge probably not materially affected by ice during 1906.

Rating table for South Branch of Potomac River near Springfield, W. Va., for 1903 to 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	163	3.30	947	4.50	2,302	6.40	5,540
2.20	210	3.40	1,039	4.60	2,440	6.60	5,970
2.30	261	3.50	1,135	4.70	2,582	6.80	6,420
2.40	315	3.60	1,235	4.80	2,728	7.00	6,890
2.50	372	3.70	1,339	4.90	2,879	7.20	7,370
2.60	432	3.80	1,447	5.00	3,035	7.40	7,870
2.70	495	3.90	1,558	5.20	3,355	7.60	8,370
2.80	561	4.00	1,672	5.40	3,690	7.80	8,870
2.90	630	4.10	1,790	5.60	4,030	8.00	9,370
3.00	702	4.20	1,912	5.80	4,380	9.00	12,000
3.10	778	4.30	2,038	6.00	4,745	10.00	15,000
3.20	860	4.40	2,168	6.20	5,130		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1903–1906. It is well defined between gage heights 2 feet and 4.5 feet. Above 10 feet gage height the discharge is approximate.

Monthly discharge of South Branch of Potomac River near Springfield, W. Va., 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	13,500	1,240	3,320	2.26	2.61
February	1,730	315	664	.452	.47
March	25,600	432	5,080	3.45	3.98
April	14,600	1,240	4,540	3.09	3.45
May	2,800	372	1,080	.738	.85
June	1,910	315	770	.524	.58
July 1–14	819	163	449	.305	.16

NOTE.—Values for January, March, and April are good; those for February, May, June, and July are excellent.

SAVAGE RIVER AT BLOOMINGTON, MD.

This station was established May 3, 1905, and was discontinued July 15, 1906. It is located at a highway bridge about 800 feet above the junction of Savage River with North Branch of Potomac. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 63, and in Water-Supply Paper No. 192, where are given also the data for previous years.

Discharge measurements of Savage River at Bloomington, Md., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 16	Bolster and Padgett	35	68	2.95	87
April 10	R. H. Bolster	46	185	5.60	1,139
Do	do	46	175	5.40	1,027
April 11	do	46	148	4.79	685
May 28	Robert Follansbee	43	89	3.25	141

Daily gage height, in feet, of Savage River at Bloomington, Md., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	2.8	2.75	2.53	5.32	3.22	3.35	2.48
2	2.75	2.55	2.43	4.82	3.18	3.28	2.38
3	3.05	2.65	2.73	4.98	3.32	2.95	2.28
4	4.28	3.03	4.45	5.22	3.22	2.75	2.2
5	4.52	2.75	3.83	5.88	3.0	2.75	2.12
6	4.15	2.6	3.5	5.92	3.0	3.35	1.98
7	3.85	2.67	3.37	4.88	2.92	4.62	1.88
8	3.6	2.6	3.25	4.48	2.82	5.15	1.88
9	3.3	2.53	3.17	4.42	2.82	4.05	1.98
10	3.12	2.6	3.15	5.95	2.8	3.6	1.88
11	3.18	2.37	2.97	4.9	2.72	3.32	1.92
12	3.2	2.47	3.05	4.35	2.68	3.05	1.88
13	2.75	2.5	2.87	3.95	2.58	2.88	1.88
14	3.18	2.47	2.93	3.8	2.52	3.05	1.92
15	3.02	2.37	3.2	4.78	2.52	2.85	1.78
16	3.25	2.4	2.93	4.6	2.48	2.65	.....
17	3.52	2.47	2.88	4.3	2.38	2.55	.....
18	3.68	2.27	2.74	4.05	2.32	2.38	.....
19	4.02	2.33	2.78	3.75	2.42	2.3	.....
20	4.0	2.33	2.95	3.55	2.32	2.52	.....
21	4.15	2.47	2.9	3.52	2.3	2.98	.....
22	4.32	2.63	2.98	3.4	2.3	2.82	.....
23	7.08	2.63	2.75	3.48	2.25	2.78	.....
24	5.5	2.35	3.18	3.4	2.2	2.78	.....
25	4.55	2.47	3.05	3.52	2.2	2.62	.....
26	4.1	2.37	3.05	3.62	2.2	2.65	.....
27	3.6	2.23	4.85	3.65	2.42	2.78	.....
28	3.52	2.25	6.5	3.58	3.4	2.75	.....
29	3.48	.....	6.0	3.48	3.35	2.55	.....
30	3.2	.....	7.15	3.35	2.95	2.42	.....
31	3.18	.....	6.05	.....	2.82	.....	.....

NOTE.—No ice conditions during 1906.

Rating table for Savage River at Bloomington, Md., 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.*
1.70	8	3.00	98	4.30	458	5.60	1,150
1.80	10	3.10	114	4.40	500	5.70	1,215
1.90	12	3.20	132	4.50	544	5.80	1,280
2.00	15	3.30	152	4.60	591	5.90	1,345
2.10	19	3.40	174	4.70	640	6.00	1,415
2.20	23	3.50	197	4.80	691	6.20	1,555
2.30	28	3.60	222	4.90	744	6.40	1,695
2.40	34	3.70	249	5.00	799	6.60	1,840
2.50	41	3.80	278	5.10	855	6.80	1,990
2.60	50	3.90	310	5.20	912	7.00	2,140
2.70	60	4.00	344	5.30	970		
2.80	71	4.10	380	5.40	1,030		
2.90	84	4.20	418	5.50	1,090		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1905 and 1906. It is well defined between gage heights 2.4 feet and 5.6 feet.

Monthly discharge of Savage River at Bloomington, Md., for 1905–6.

[Drainage area, 120 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
May	399	34	97.8	0.815	0.88
June	568	29	118	.983	1.10
July	466	12	85.0	.708	.82
August	210	10	34.0	.283	.33
September	535	8	56.0	.467	.52
October	509	10	82.1	.684	.79
November	418	13	51.1	.426	.48
December	924	21	220	1.83	2.11

Monthly discharge of Savage River at Bloomington, Md., for 1905–6—Continued.

Month.	Discharge second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1906.					
January	2,204	66	330	2.75	3.17
February	103	24	43.8	.365	.38
March	2,260	36	348	2.90	3.34
April	1,380	163	521	4.34	4.84
May	174	23	69.9	.582	.67
June	884	28	138	1.15	1.28
July 1–15	40	10	17.8	.148	.08

NOTE.—Values for 1905 and 1906 are excellent, except July, 1906, which is good.

GEORGES CREEK AT WESTERNPORT, MD.

This station was established May 4, 1905, and was discontinued July 15, 1906. It is located at the highway bridge in Westernport, Md., about one-half mile above the mouth of the creek. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 64, and in Water-Supply Paper No. 192, where are given also the data for previous years.

Discharge measurements of Georges Creek at Westernport, Md., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 16	Bolster and Padgett	41	27	1.49	65
March 30	Robert Follansbee	95	180	3.38	1,230
April 10	R. H. Bolster	93	98	2.50	476
May 28	Robert Follansbee	93	70	2.25	353

Daily gage height, in feet, of Georges Creek at Westernport, Md., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	1.68	1.8	1.6	3.18	1.68	1.65	1.18
2	1.55	1.8	1.78	2.98	1.72	1.55	1.15
3	2.3	1.75	2.05	2.88	1.62	1.55	1.15
4	2.58	1.72	2.1	2.92	1.52	1.32	1.1
5	2.45	1.68	2.02	2.85	1.5	1.6	1.1
6	2.38	1.65	1.98	2.52	1.55	1.68	1.1
7	2.2	1.6	1.8	2.32	1.5	2.22	1.05
8	2.2	1.55	1.75	2.32	1.5	2.25	1.05
9	1.88	1.52	1.68	2.55	1.45	1.95	1 05
10	1.95	1.5	1.6	2.58	1.4	1.8	1.1
11	1.95	1.45	1.55	2.32	1.4	1.72	1.1
12	2.0	1.45	1.52	2.32	1.4	1.75	1.1
13	1.95	1.42	1.5	2.22	1.4	1.75	1.1
14	1.88	1.4	1.5	2.22	1.42	1.7	1.05
15	1.78	1.4	1.5	2.2	1.4	1.62	1.02
16	1.82	1.4	1.45	2.22	1.3	1.55	.....
17	2.0	1.4	1.32	2.12	1.32	1.25	.....
18	2.05	1.4	1.32	2.12	1.32	1.2	.....
19	2.12	1.4	1.38	2.22	1.25	1.2	.....
20	2.15	1.45	1.5	2.0	1.22	1.35	.....
21	2.18	1.45	1.55	2.05	1.2	1.35	.....
22	2.22	1.4	1.58	1.9	1.2	1.35	.....
23	3.28	1.35	1.55	1.88	1.15	1.38	.....
24	3.08	1.32	1.58	1.88	1.15	1.4	.....
25	2.68	1.3	1.6	1.82	1.1	1.3	.....
26	2.2	1.3	1.68	1.9	1.1	1.32	.....
27	2.12	1.38	2.62	1.85	2.02	1.38	.....
28	2.1	1.42	3.2	1.75	2.08	1.25	.....
29	2.05	.....	3.2	1.7	2.2	1.2	.....
30	1.98	.....	3.42	1.72	1.95	1.2	.....
31	1.9	.....	3.45	.....	1.88	.....	.....

NOTE.—Discharge probably unaffected by ice.

Rating tables for Georges Creek at Westernport, Md.

MAY 4 TO JUNE 6, 1905.[a]

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	22	1.40	38	1.60	66	1.80	112
1.30	29	1.50	50	1.70	87		

JUNE 7 TO SEPTEMBER 10, 1905.[b]

1.00	8	1.70	64	2.40	301	3.10	780
1.10	11	1.80	84	2.50	355	3.20	865
1.20	15	1.90	108	2.60	415	3.30	955
1.30	20	2.00	137	2.70	480	3.40	1,045
1.40	27	2.10	170	2.80	550	3.50	1,140
1.50	36	2.20	208	2.90	625		
1.60	48	2.30	252	3.00	700		

SEPTEMBER 11, 1905, TO JULY 15, 1906.[c]

0.90	10	1.70	115	2.50	495	3.30	1,150
1.00	15	1.80	145	2.60	560	3.40	1,250
1.10	21	1.90	180	2.70	630	3.50	1,350
1.20	29	2.00	220	2.80	705	3.60	1,455
1.30	39	2.10	265	2.90	785	3.70	1,560
1.40	52	2.20	315	3.00	870	3.80	1,670
1.50	69	2.30	370	3.10	960	3.90	1,780
1.60	90	2.40	430	3.20	1,055	4.00	1,895

[a] This table is based on one discharge measurement made during 1905 and on the form of the 1906 curve. It is not well defined

[b] This table is based on three discharge measurements made during 1905 and on the form of the 1906 curve. It is fairly well defined between gage heights 1.5 feet and 2 feet.

[c] This table is applicable only for open-channel conditions It is based on five discharge measurements made during 1905 and 1906. It is well defined between gage heights 1.3 feet and 3.5 feet.

Monthly discharge of Georges Creek at Westernport, Md., for 1905–6.

[Drainage area, 76 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
May 4–31	92	26	44.8	0.589	0.61
June	154	15	45.7	.601	.67
July	1,090	13	127	1.67	1.92
August	68	6	15.1	.199	.229
September	528	8	46.4	.611	.68
October	370	12	65.8	.866	1.00
November	102	12	33.8	.445	.50
December	1,250	39	267	3.51	4.05
1906.					
January	1,130	80	320	4.21	4.85
February	145	39	71.2	.937	.98
March	1,300	42	260	3.42	3.94
April	1,040	115	378	4.97	5.54
May	315	21	83.0	1.09	1.26
June	342	29	91.4	1.20	1.34
July 1–14	27	16	20.8	.274	.15

NOTE.—Values given above are rated as follows: May, 1905, fair; August to October, 1905, approximate; remainder of 1905 and 1906, good.

WILLS CREEK AT CUMBERLAND, MD.

This station was established May 5, 1905, and was discontinued July 14, 1906. It is located at the highway bridge at the upper end of "The Narrows," Cumberland, Md. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 65, and in Water-Supply Paper No. 192, where are given also the data for previous years.

Discharge measurements of Wills Creek at Cumberland, Md., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 17	Bolster and Padgett	77	213	4.01	175
April 2	Robert Follansbee	115	467	6.32	1,490
April 10	R. H. Bolster	110	429	6.05	1,200
April 11	....do	106	404	5.88	1,070
May 26	Robert Follansbee	69	169	3.27	55

Daily gage height, in feet, of Wills Creek at Cumberland, Md., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	4.45	4.25	3.5	6.7	4.02	3.5	3.35
2	4.25	4.05	3.5	6.3	4.25	3.48	3.3
3	4.45	3.7	4.15	6.3	4.18	3.38	3.25
4	5.95	4.02	5.25	6.2	4.08	3.3	3.25
5	5.78	4.02	4.6	6.32	4.0	3.5	3.2
6	5.5	3.7	4.25	6.32	4.0	3.65	3.18
7	5.12	3.6	4.25	5.45	3.9	6.6	3.15
8	4.95	3.68	4.3	5.3	3.88	5.5	3.1
9	4.65	3.75	4.22	5.6	3.8	4.75	3.05
10	4.38	3.75	4.18	6.0	3.8	4.3	3.05
11	4.32	3.7	4.12	5.9	3.8	4.0	3.05
12	4.45	3.7	4.08	5.6	3.75	3.8	3.18
13	4.42	3.6	4.02	5.42	3.7	3.78	3.08
14	4.4	3.68	4.05	5.1	3.65	3.72	3.02
15	4.45	3.65	4.05	6.3	3.6	3.68	.....
16	4.7	3.6	4.1	5.92	3.55	3.6	.....
17	5.0	3.55	4.1	5.58	3.6	3.55	.....
18	4.88	3.5	4.1	5.32	3.52	3.62	.....
19	5.1	3.5	4.1	5.02	3.48	3.85	.....
20	5.02	3.5	4.18	4.88	3.45	3.9	.....
21	5.12	3.7	4.2	4.72	3.45	3.88	.....
22	5.25	3.68	4.2	4.68	3.4	3.78	.....
23	7.3	3.58	4.2	4.62	3.4	3.78	.....
24	6.95	3.55	4.2	4.52	3.35	3.7	.....
25	5.88	3.65	4.2	4.5	3.3	3.58	.....
26	5.48	3.5	4.2	4.45	3.3	3.52	.....
27	5.08	3.5	6.1	4.4	3.5	3.5	.....
28	4.9	3.5	7.7	4.32	3.9	3.55	.....
29	4.75	.....	7.2	4.22	3.65	3.5	.....
30	4.55	.....	7.05	4.12	3.55	3.38	.....
31	4.42	.....	7.9	.....	3.4	.....	.....

NOTE.—Discharge probably not affected by ice.

Rating table for Wills Creek at Cumberland, Md., 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.*
3.00	30	3.90	164	4.80	442	6.40	1,560
3.10	38	4.00	188	4.90	482	6.60	1,785
3.20	48	4.10	214	5.00	525	6.80	2,030
3.30	60	4.20	241	5.20	620	7.00	2,295
3.40	73	4.30	270	5.40	735	7.20	2,575
3.50	88	4.40	301	5.60	860	7.40	2,870
3.60	104	4.50	334	5.80	1,005	7.60	3,170
3.70	122	4.60	368	6.00	1,170	7.80	3,480
3.80	142	4.70	404	6.20	1,355		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 9 discharge measurements made during 1905 and 1906. It is well defined between gage heights 3 feet and 6.5 feet.

Monthly discharge of Wills Creek at Cumberland, Md., for 1905–6.

[Drainage area, 240 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
May 6-31	747	91	221	0.921	0.89
June	1,350	104	272	1.13	1.26
July	1,900	96	353	1.47	1.70
August	1,040	36	174	.725	.84
September	647	34	128	.533	.60
October	595	30	149	.621	.72
November	570	48	115	.479	.53
December	2,410	63	529	2.20	2.54
1906.					
January	2,720	256	637	2.65	3.06
February	256	88	122	.508	.53
March	3,640	88	626	2.61	3.01
April	1,900	219	806	3.36	3.75
May	256	60	126	.525	.60
June	1,780	60	207	.862	.96
July 1-14	66	32	44.6	.186	.10

NOTE.—All the above values are excellent.

OPEQUON CREEK NEAR MARTINSBURG, W. VA.

This station was established May 8, 1905, and was discontinued July 15, 1906. It is located at the highway bridge known as Rileys Ford Bridge, about 4 miles southeast of Martinsburg, W. Va. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 67, and in Water-Supply Paper No. 192, where are given also the data for previous years.

Discharge measurements of Opequon Creek near Martinsburg, W. Va., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 18	Bolster and Padgett	75	59	1.51	137
April 2	Robert Follansbee	80	213	3.32	600
April 12	R. H. Bolster	78	134	2.57	338
Do	do	78	132	2.56	332
May 29	Robert Follansbee	75	66	1.57	152

Daily gage height, in feet, of Opequon Creek near Martinsburg, W. Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	1.73	1.6	1.26	4.72	1.92	1.5	1.7
2	1.65	1.6	1.4	3.48	1.9	1.48	1.55
3	1.77	1.55	1.56	3.0	1.88	1.45	1.9
4	8.73	1.48	3.24	2.72	1.85	1.42	7.9
5	4.2	1.45	2.4	2.55	1.82	1.4	2.88
6	3.12	1.4	1.9	2.45	1.8	2.92	2.4
7	2.68	1.37	1.84	2.32	1.78	2.18	2.4
8	2.27	1.33	1.8	2.22	1.75	1.58	1.88
9	2.15	1.32	1.72	2.48	1.72	1.58	1.78
10	1.98	1.37	1.6	4.02	1.68	1.62	1.72
11	1.92	1.4	1.52	3.02	1.65	1.48	1.68
12	1.9	1.4	1.48	2.48	1.65	1.42	1.62
13	1.98	1.4	1.48	2.25	1.62	1.48	1.6
14	2.17	1.45	1.5	2.18	1.6	1.58	1.58
15	2.7	1.48	1.52	8.5	1.58	1.52	1.52
16	2.58	1.42	1.52	5.0	1.55	1.48	.....
17	2.25	1.4	1.52	3.28	1.52	5.38	.....
18	2.32	1.4	1.58	2.9	1.5	3.0	.....
19	1.98	1.4	1.72	2.62	1.5	2.75	.....
20	1.85	1.38	1.83	2.45	1.5	2.48	.....
21	1.78	1.37	1.82	2.35	1.48	5.18	.....
22	1.72	1.48	1.92	2.28	1.45	5.0	.....
23	1.75	1.42	2.28	2.22	1.45	2.58	.....
24	1.93	1.38	2.3	2.15	1.42	2.35	.....
25	1.85	1.35	2.35	2.1	1.4	2.18	.....
26	1.8	1.32	2.78	2.3	1.4	2.05	.....
27	1.75	1.3	4.0	2.25	1.42	1.88	.....
28	1.7	1.28	7.52	2.0	1.52	1.82	.....
29	1.67	.....	5.45	1.98	1.52	2.08	.....
30	1.65	.....	5.78	1.95	1.48	1.85	.....
31	1.63	.....	7.2	.....	1.4	.....	.....

NOTE.—Discharge probably not affected by ice.

Rating tables for Opequon Creek near Martinsburg, W. Va.

MAY 9 TO JUNE 4, 1905.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.15	116	1.40	152	1.70	200	2.00	257
1.20	123	1.50	167	1.80	218		
1.30	137	1.60	183	1.90	237		

OCTOBER 8 TO DECEMBER 20, 1905.[b]

1.10	50	1.50	88	1.90	140	2.30	205
1.20	58	1.60	100	2.00	155	2.40	223
1.30	67	1.70	113	2.10	171	2.50	242
1.40	77	1.80	126	2.20	188		

DECEMBER 21, 1905, TO JULY 15, 1906.[c]

1.20	97	2.60	343	4.00	897	5.80	1,825
1.30	109	2.70	371	4.10	945	6.00	1,935
1.40	122	2.80	402	4.20	993	6.20	2,045
1.50	135	2.90	436	4.30	1,042	6.40	2,155
1.60	149	3.00	472	4.40	1,092	6.60	2,265
1.70	164	3.10	510	4.50	1,142	6.80	2,375
1.80	180	3.20	549	4.60	1,193	7.00	2,485
1.90	197	3.30	589	4.70	1,244	7.20	2,595
2.00	214	3.40	630	4.80	1,295	7.40	2,705
2.10	232	3.50	672	4.90	1,347	7.60	2,815
2.20	251	3.60	715	5.00	1,399	7.80	2,925
2.30	271	3.70	759	5.20	1,504	8.00	3,035
2.40	293	3.80	804	5.40	1,610		
2.50	317	3.90	850	5.60	1,717		

[a] This curve has been drawn through one measurement and parallel to the other curves at this station.

[b] This rating curve has been drawn through one measurement and parallel to the other curves at this station.

[c] This table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1906. Above gage height 6 feet the rating curve is a tangent, the difference being 55 per tenth.

Monthly discharge of Opequon Creek near Martinsburg, W. Va., for 1905–6.

[Drainage area, 275 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
May 9–31	253	116	144	0.524	0.45
June 1–4	140	123	131	.476	.07
October 8–31	155	50	67.4	.245	.22
November	90	50	61.1	.222	.25
December	2,830	54	337	1.23	1.42
1906.					
January	3,440	153	352	1.28	1.48
February	149	107	123	.447	.47
March	2,770	104	480	1.75	2.02
April	3,310	205	509	1.85	2.06
May	200	122	151	.549	.63
June	1,600	122	338	1.23	1.37
July 1–15	2,980	138	387	1.41	.79

NOTE.—Values are rated as follows: 1905, approximate; January and February, 1906, approximate; March to July, 1906, good; daily discharge above 1,500 second-feet, approximate.

SHENANDOAH RIVER AT MILLVILLE, W. VA.

This station was established April 15, 1895. It is located about one-fourth mile above the Baltimore and Ohio Railroad station at Millville, W. Va. The highway runs within a few rods of the stream at the gaging station. The station is best reached by driving from Harpers Ferry, W. Va. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 71, and in Water-Supply Paper No. 192, where are given also the data for previous years.

The following discharge measurement was made May 29, 1906:

Width, 488 feet; area, 1,720 square feet; gage height, 1.58 feet; discharge, 1,790 second-feet.

Daily gage height, in feet, of Shenandoah River at Millville, W. Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.7	2.3	1.1	4.75	2.3	1.5	2.0	1.3	3.55	1.45	2.7	1.85
2	2.45	2.2	1.1	4.2	2.2	1.5	1.8	1.4	3.8	1.45	2.5	1.8
3	2.25	2.0	1.2	3.8	2.1	1.4	1.6	1.8	2.7	1.4	2.4	1.75
4	3.4	2.4[a]	2.2	3.4	2.0	1.3	1.3	1.4	2.2	1.7	2.3	1.7
5	5.3	2.0	2.5	3.1	1.95	1.2	2.15	2.5	2.2	2.5	2.2	1.65
6	4.5	1.95	3.5	2.9	1.9	2.1	1.7	2.3	2.0	3.5	2.1	1.7
7	3.6	1.9	2.9	2.7	1.85	1.3	1.55	2.1	1.9	3.1	2.05	1.65
8	3.0	1.8	2.5	2.6	1.8	1.2	1.6	2.0	1.8	2.6	2.0	1.6
9	2.7	1.6	2.3	2.4	2.1	1.2	1.5	2.2	1.65	2.3	1.9	1.55
10	2.45	1.6	2.1	2.45	2.05	1.65	1.35	2.3	1.6	2.05	1.85	1.5
11	2.3	1.75	2.0	2.6	1.9	1.9	1.3	2.0	1.5	1.8	1.8	1.6
12	2.15	1.5	1.9	2.6	1.85	1.5	1.3	2.0	1.5	1.8	1.8	1.65
13	2.0	1.45	1.75	2.45	1.8	1.2	1.3	3.0	1.45	1.65	1.75	1.55
14	2.0	1.3	1.7	2.3	1.7	1.2	1.3	3.4	1.9	1.5	1.75	1.5
15	2.0	1.35	1.7	3.2	1.6	1.2	1.4	3.8	1.6	1.4	1.75	1.4
16	2.2	1.3	1.8	4.7	1.55	2.0	1.3	3.9	1.5	1.4	1.7	1.45
17	2.3	1.3	1.9	4.2	1.4	2.6	1.3	3.2	1.35	1.4	1.65	1.7
18	2.25	1.2	2.6	3.6	1.35	2.1	1.3	4.1	1.3	1.5	1.6	4.2
19	2.2	1.2	2.7	3.2	1.45	3.8	1.4	3.35	1.35	4.1	1.8	4.5
20	2.1	1.2	2.7	2.95	1.4	2.4	1.5	4.2	1.3	11.3	2.25	4.0

[a] Backwater from ice, February 4.

Daily gage height, in feet, of Shenandoah River at Millville, W. Va., for 1906—Continued.

Date.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	2.0	1.2	2.7	2.7	1.3	2.7	1.4	3.9	1.25	12.8	4.3	3.5
22	1.9	1.2	2.9	2.5	1.25	4.8	1.3	3.4	1.2	8.3	3.8	3.6
23	1.8	1.2	3.15	2.4	1.2	3.7	1.2	3.3	1.2	6.5	3.85	3.4
24	1.8	1.2	3.1	2.25	1.2	2.9	2.0	4.0	1.2	5.7	2.9	3.0
25	3.8	1.15	2.9	2.1	1.15	2.5	1.6	4.5	1 1	4.9	2.7	2.6
26	3.2	1.1	2.9	2.0	1.1	2.15	1.5	4.5	1.25	4.2	2.7	2.2
27	2.7	1.1	3.0	2.0	1.2	2.4	1.4	3.8	1.25	3 8	2.25	2.0
28	2.5	1.1	4.8	3.4	1.3	3.5	1.4	5.4	1.25	3.5	2.15	2.4
29	2.4	.....	4.9	2.9	1.5	3.25	1.4	4.7	1.25	3.2	2.1	2.4
30	2.4	.....	4.6	2.5	1.4	2.4	1.5	5.0	1.35	3.0	2.0	2.25
31	2.5	.....	4.6	.....	1.4	.....	1.3	4.2	.....	2.8	.....	2.2

Rating table for Shenandoah River at Millville, W. Va., 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.*
1.10	1,090	2.40	3,130	3.70	6,100	6.00	14,240
1.20	1,200	2.50	3,330	3.80	6,380	6.20	15,120
1.30	1,320	2.60	3,530	3.90	6,670	6.40	16,000
1.40	1,450	2.70	3,730	4.00	6,960	6.60	16,920
1.50	1,580	2.80	3,940	4.20	7,560	6.80	17,840
1.60	1,720	2.90	4,150	4.40	8,200	7.00	18,800
1.70	1,870	3.00	4,370	4.60	8,860	8.00	24,020
1.80	2,030	3.10	4,600	4.80	9,540	9.00	30,400
1.90	2,200	3.20	4,840	5.00	10,260	10.00	37,500
2.00	2,380	3.30	5,080	5.20	11,020	11.00	45,100
2.10	2,560	3.40	5,320	5.40	11,780	12.00	53,500
2.20	2,750	3.50	5,570	5.60	12,580	13.00	62,700
2.30	2,940	3.60	5,830	5.80	13,400		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1895 and 1904–1906. It is well defined between gage heights 0.4 foot and 5.2 feet. Values above 5 feet are based on a discharge curve, which is the product of a well-defined area curve and a fairly accurate extension of the velocity curve.

Monthly discharge of Shenandoah River at Millville, W. Va., for 1906.

[Drainage area, 3,000 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	11,400	2,030	3,720	1.24	1.43
February	2,940	1,090	1,640	.548	.57
March	9,900	1,090	3,890	1.30	1.50
April	9,370	2,380	4,460	1.49	1.66
May	2,940	1,090	1,800	.601	.69
June	9,540	1,200	2,900	.965	1.08
July	2,660	1,200	1,580	.527	.61
August	11,800	1,320	5,220	1.74	2.01
September	6,380	1,090	1,980	.660	.74
October	60,800	1,450	8,250	2.75	3.17
November	7,880	1,720	3,020	1.01	1.13
December	8,520	1,450	3,050	1.02	1.18
The year	60,800	1,090	3,460	1.15	15.77

NOTE.—The discharge for February 4 was corrected for backwater. Values are rated as follows: 1906, excellent; discharge above 25,000 second-feet, fair.

The following table gives the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge, and shows the number of days on which the flow and the corresponding horsepower were respectively less than the amounts given in the columns for "discharge" and "horsepower:"

Discharge and horsepower table for Shenandoah River at Millville, W. Va., from 1895 to 1906.

Discharge in second-feet.	Horsepower (80 per cent efficiency) per foot fall.	Number of days of deficient flow.											
		1895.[a]	1896.	1897.	1898.	1899.[b]	1900.	1901.	1902.	1903.	1904.	1905.	1906.
485	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	15	.....	.....
550	50	33	4	.....	.....	.....	.....	.....	.....	.....	73	9	.....
660	60	98	24	50	.....	3	20	.....	5	1	106	60	.....
770	70	118	26	67	.....	29	54	1	26	8	114	73	.....
880	80	125	34	85	7	70	89	11	63	19	122	101	.....
990	90	154	75	107	11	112	109	38	97	37	133	137	.....
1,100	100	160	82	146	32	141	128	55	112	59	147	155	7
1,320	120	166	89	179	91	167	161	78	145	82	180	180	36
1,540	140	185	130	210	116	184	202	104	167	118	215	208	85
1,760	160	192	192	220	143	194	219	120	174	129	234	238	116

[a] April 15 to December 31.
[b] Missing days estimated from Point of Rocks records.

NOTE.—From April 15, 1895, to December 31, 1906, the minimum flow was 480 second-feet, giving 44 horsepower per foot of fall on 5 consecutive days in October, 1895, and on 15 days (5 consecutive) in October and November, 1904.

SOUTH FORK OF SHENANDOAH RIVER NEAR FRONT ROYAL, VA.

This station was established June 26, 1899, and was discontinued July 16, 1906. It is located about 1 mile above the bridge, which is near the Norfolk and Western Railway station. The conditions at this station and the bench marks are described in Water Supply Paper No. 167, page 74, and in Water Supply Paper No. 192, where are given also the data for previous years.

The following discharge measurement was made June 16, 1906:

Width, 300 feet; area, 906 square feet; gage height, 4.70 feet; discharge, 1,070 second-feet.

Daily gage height, in feet, of South Fork of Shenandoah River near Front Royal, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	5.65	5.43	4.2	7.05	5.22	4.7	5.45
2	5.45	5.3	4.17	6.8	5.1	4.62	5.28
3	5.25	5.2	4.23	6.45	5.0	4.5	5.25
4	6.13	5.1	5.05	6.25	4.95	4.42	5.25
5	8.47	4.85	7.02	5.85	4.9	4.38	4.9
6	7.22	4.82	6.33	5.68	4.85	4.3	4.45
7	6.4	4.9	5.8	5.52	4.88	4.22	4.65
8	6.0	4.73	5.47	5.4	5.0	4.2	4.62
9	5.65	4.65	5.15	5.32	5.1	4.18	4.4
10	5.38	4.5	5.15	5.3	5.05	4.1	4.28
11	5.17	4.52	5.05	5.4	5.0	4.1	4.3
12	5.0	4.45	4.9	5.35	4.9	4.15	4.38
13	5.0	4.4	4.83	5.28	4.8	4.22	5.32
14	5.0	4.4	4.7	5.2	4.78	4.2	4.65
15	5.05	4.43	4.8	6.35	4.6	4.4	4.4

Daily gage height, in feet, of South Fork of Shenandoah River near Front Royal, Va., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
16	5.3	4.32	5.25	7.75	4.62	4.65	4.25
17	5.3	4.4	5.95	6.8	4.52	5.45	.....
18	5.3	4.33	5.77	6.38	4.55	5.75	.....
19	5.2	4.3	5.8	6.08	4.45	5.35	.....
20	5.12	4.3	5.75	5.8	4.4	5.35	.....
21	5.0	4.3	5.8	5.55	4.35	6.2	.....
22	4.9	4.25	6.1	5.45	4.3	6.9	.....
23	4.93	4.22	5.9	5.35	4.28	6.05	.....
24	6.8	4.28	5.8	5.25	4.2	5.5	.....
25	6.85	4.25	5.6	5.05	4.2	5.35	.....
26	6.22	4.25	5.58	5.1	4.2	5.28	.....
27	5.75	4.12	5.77	5.35	4.22	5.72	.....
28	5.63	4.25	6.75	5.45	4.3	6.15	.....
29	5.6	.....	7.35	5.4	4.65	5.5	.....
30	5.55	.....	7.1	5.3	4.4	5.35	.....
31	5.55	.....	6.9	.....	4.72	.....	.....

NOTE.—Discharge probably unaffected by ice.

Rating table for South Fork of Shenandoah River near Front Royal, Va., for 1904–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.10	610	5.10	1,460	6.10	2,790	7.20	4,680
4.20	670	5.20	1,570	6.20	2,940	7.40	5,080
4.30	740	5.30	1,690	6.30	3,100	7.60	5,480
4.40	810	5.40	1,810	6.40	3,260	7.80	5,900
4.50	890	5.50	1,940	6.50	3,430	8.00	6,320
4.60	970	5.60	2,070	6.60	3,600	8.20	6,760
4.70	1,060	5.70	2,210	6.70	3,770	8.40	7,200
4.80	1,150	5.80	2,350	6.80	3,940		
4.90	1,250	5.90	2,490	6.90	4,120		
5.00	1,350	6.00	2,640	7.00	4,300		

NOTE.—The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1904–1906. It is well defined between gage heights 3.4 feet and 5.3 feet.

Monthly discharge of South Fork of Shenandoah River near Front Royal, Va., for 1906.

[Drainage area, 1,570 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	7,350	1,250	2,280	1.45	1.67
February	1,850	622	957	.610	.64
March	4,980	652	2,230	1.42	1.64
April	5,800	1,400	2,390	1.52	1.70
May	1,590	670	1,050	.668	.77
June	4,120	610	1,460	.932	1.04
July 1–16	1,880	705	1,140	.725	.43

NOTE.—Values for 1906 are excellent.

SOUTH RIVER AT BASIC CITY, VA.

This station was established June 29, 1905, in connection with the investigation of stream pollution in the Shenandoah Valley, and was discontinued July 15, 1906. It is located at the highway bridge one-half mile below the Chesapeake and Ohio Railway bridge at

Basic City, Va. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 76, and in Water-Supply Paper No. 192, where are given also references to publications that contain data for previous years.

Discharge measurements of South River at Basic City, Va., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 11	Robert Follansbee	72	206	3.25	221
June 14	Follansbee and Padgett	70	158	2.69	86

Daily gage height, in feet, of South River at Basic City, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	3.0	3.4	2.8	3.6	2.9	2.75	2.6
2	2.9	3.3	2.8	3.6	2.9	2.7	2.6
3	3.2	3.2	5.3	3.5	2.8	2.6	2.6
4	4.4	3.2	4.9	3.4	2.9	2.6	2.7
5	3.7	3.2	4.0	3.2	2.9	2.5	2.6
6	3.4	3.1	3.8	3.3	2.8	2.4	2.65
7	3.2	3.1	3.5	3.2	3.0	2.6	2.45
8	3.0	3.0	3.5	3.1	3.0	2.6	2.55
9	2.9	2.9	3.3	3.1	2.8	2.5	2.65
10	2.8	2.9	3.0	3.2	2.85	2.5	2.6
11	2.7	2.9	3.1	3.25	2.85	2.4	2.3
12	2.8	2.9	3.1	3.2	2.7	2.5	2.4
13	3.1	2.9	3.1	3.15	2.8	2.6	2.55
14	3.1	2.9	3.0	3.1	2.8	2.7	2.35
15	3.1	2.9	3.1	4.5	2.7	2.6	2.4
16	3.0	2.8	3.2	4.1	2.75	2.6	.....
17	3.0	2.7	3.3	3.75	2.8	3.2	.....
18	3.1	2.7	3.3	3.55	2.65	2.5	.....
19	3.2	2.7	3.3	3.4	2.7	2.8	.....
20	3.2	2.7	3.2	3.25	2.7	5.45	.....
21	3.1	2.7	3.3	3.25	2.6	4.9	.....
22	3.1	2.8	3.2	3.2	2.6	3.45	.....
23	4.9	2.8	3.2	3.2	2.6	3.2	.....
24	4.4	2.8	3.2	3.1	2.5	3.0	.....
25	3.9	2.8	3.1	3.0	2.6	2.9	.....
26	3.6	2.8	3.2	3.1	2.6	3.2	.....
27	3.6	2.8	3.5	3.05	2.65	2.95	.....
28	3.7	2.8	3.7	3.0	2.75	2.85	.....
29	3.7	.....	3.7	3.0	3.0	2.8	.....
30	3.6	.....	3.5	2.9	2.7	2.7	.....
31	3.5	.....	3.8	.....	2.75	.....	.....

NOTE.—Discharge probably unaffected by ice.

Rating table for South River at Basic City, Va., 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.*
2.00	7	2.90	135	3.80	377	4.70	678
2.10	12	3.00	159	3.90	407	4.80	714
2.20	19	3.10	183	4.00	438	4.90	750
2.30	29	3.20	208	4.10	470	5.00	786
2.40	41	3.30	234	4.20	503	5.10	823
2.50	55	3.40	261	4.30	537	5.20	860
2.60	72	3.50	289	4.40	572	5.30	897
2.70	91	3.60	318	4.50	607	5.40	934
2.80	112	3.70	347	4.60	642	5.50	972

NOTE.—The above table is applicable only for open-channel conditions. It is based on 6 discharge measurements made during 1905 and 1906. It is fairly well defined between gage heights 2.5 feet and 4.1 feet.

Monthly discharge of South River at Basic City, Va., for 1905–6.

[Drainage area, 142 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
July	786	41	159	1.12	1.29
August	135	29	70.9	.499	.58
September	208	19	58.2	.410	.46
October	91	12	42.2	.297	.34
November	41	7	23.4	.165	.18
December	972	19	160	1.13	1.30
1906.					
January	750	91	258	1.82	2.10
February	261	91	141	.993	1.03
March	897	112	276	1.94	2.24
April	607	135	241	1.70	1.90
May	159	55	106	.746	.86
June	953	41	154	1.08	1.20
July 1–15	91	29	62.5	.440	.24

NOTE.—Values are rated as follows: July, August, and December, 1905, and all of 1906, excellent; September, 1905, good; October, 1905, fair; November, 1905, approximate; discharge below 25 second-feet, approximate.

LEWIS CREEK NEAR STAUNTON, VA.

This station was established June 30, 1905, in connection with the investigation of stream pollution in the Shenandoah Valley, and was discontinued July 15, 1906. It is located at the private bridge across Lewis Creek, on the property of William Glenn, 2 miles from Staunton. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 77, and in Water-Supply Paper No. 192, where are given also references to publications that contain data for previous years.

Discharge measurements of Lewis Creek near Staunton, Va., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 10	Robert Follansbee	16	13.9	0.83	12.5
June 14	Follansbee & Padgett	15	9.7	.55	6.6

Daily gage height, in feet, of Lewis Creek near Staunton, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	0.54	0.49	0.74	0.74	0.48	0.54	0.64
2	.43	.53	.70	.70	.53	.53	.53
3	.54	.60	.71	.64	.60	.54	.54
4	1.43	.53	.53	.49	.49	.58	.53
5	.94	.54	.64	.54	.53	.59	.49
6	.83	.53	.59	.48	.54	.48	.53
7	.64	.49	.54	.44	.53	.54	.64
8	.53	.53	.53	.57	.54	.53	.53
9	.49	.44	.71	.44	.43	.49	.54
10	.43	.48	.53	.83	.49	.53	.48
11	.59	.44	.54	.84	.48	.44	.44
12	.48	.53	.59	.73	.49	.53	.48
13	.69	.49	.74	.79	.43	.54	.53
14	.53	.59	.63	.63	.44	.53	.64
15	.59	.54	1.04	.74	.48	.49	.43

Daily gage height, in feet, of Lewis Creek near Staunton, Va., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
16	0.53	0.48	0.83	0.63	0.49	0.63	.....
17	.44	.54	.84	.74	.33	.49	.....
18	.48	.53	.83	.53	.34	.43	.....
19	.59	.49	.84	.49	.48	.49	.....
20	.53	.43	.78	.53	.44	.53	.....
21	.74	.49	.74	.49	.43	.49	.....
22	.63	.53	.70	.53	.49	.43	.....
23	.74	.54	.64	.64	.38	.44	.....
24	.63	.43	.63	.63	.34	.93	.....
25	.54	.54	.64	.54	.33	1.94	.....
26	.48	.53	.59	.54	.94	1.83	.....
27	.54	.49	.54	.59	1.18	.94	.....
28	.63	.43	1.13	.49	1.64	.73	.....
29	.54	.....	.84	.63	1.13	.54	.....
30	.48	.....	.93	.64	.64	.53	.....
31	.44	.....	1.24	.....	.58	.....	.....

NOTE.—Discharge probably unaffected by ice.

Rating tables for Lewis Creek near Staunton, Va.

JULY 1, 1905, TO MAY 27, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.30	1.0	0.60	5.5	0.90	14.9	1.20	29.0
.35	1.4	.65	6.8	.95	16.8	1.25	32.0
.40	1.9	.70	8.2	1.00	18.9	1.30	35.5
.45	2.6	.75	9.7	1.05	21.0	1.35	39.0
.50	3.4	.80	11.3	1.10	23.5	1.40	42.5
.55	4.4	.85	13.0	1.15	26.0	1.45	46.5

MAY 28 TO JULY 15, 1906.[b]

0.25	1.3	0.60	7.9	0.95	20.5	1.60	63
.30	1.8	.65	9.4	1.00	23.0	1.70	71
.35	2.5	.70	11.0	1.10	28.5	1.80	79
.40	3.3	.75	12.7	1.20	34.5	1.90	88
.45	4.2	.80	14.5	1.30	41	2.00	97
.50	5.3	.85	16.3	1.40	48		
.55	6.5	.90	18.3	1.50	55		

[a] This table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1905 and 1906. It is fairly well defined between gage heights 0.5 foot and 0.8 foot.

[b] This table is based on 1 discharge measurement made during 1906 and on the form of the preceding curve.

Monthly discharge of Lewis Creek near Staunton, Va., for 1905–6.

[Drainage area, 20 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
July	24.	1.9	6.0	0.299	0.34
August	5.5	1.4	3.2	.158	.18
September	5.5	1.9	2.8	.138	.15
October	19.	1.4	4.6	.229	.26
November	9.7	1.4	3.5	.173	.19
December	6.8	1.9	3.3	.167	.19
1906.					
January	45.	2.3	6.6	.329	.38
February	5.5	2.3	3.6	.180	.19
March	31.	4.0	9.7	.485	.56
April	13.	2.3	6.1	.303	.34
May	66.	1.2	7.4	.370	.43
June	92.	3.8	12.3	.615	.69
July 1–15	9.1	3.8	6.2	.308	.17

NOTE.—Values are rated as follows: July and October, 1905, and January, March, April, and May, 1906, good; remainder of the period fair, except June, which is approximate; discharge below 2 second-feet and above 30 second-feet, approximate.

COOKS CREEK NEAR MOUNT CRAWFORD, VA.

This station was established July 1, 1905, in connection with the investigation of stream pollution in the Shenandoah Valley, and was discontinued July 15, 1906. It is located at the upper highway bridge across Cooks Creek, three-fourths of a mile from Mount Crawford, Va. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 78, and in Water-Supply Paper No. 192, where are given also the data for previous years.

The following measurement was made April 10, 1906:

Width, 31 feet; area, 78 square feet; gage height, 2.32 feet; discharge, 32.4 second-feet.

Daily gage height, in feet, of Cooks Creek at Mount Crawford, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	2.05	2.0	2.0	2.5	2.1	2.0	2.1
2	2.05	2.0	2.0	2.4	2.1	2.0	2.1
3	2.05	1.8	2.0	2.3	2.1	2.0	2.1
4	3.0	2.0	2.4	2.3	2.1	2.0	2.1
5	2.5	2.0	2.2	2.2	2.1	2.0	2.0
6	2.3	2.1	2.1	2.3	2.1	1.9	2.0
7	2.3	2.0	2.1	2.2	2.2	1.9	2.0
8	2.2	2.0	2.1	2.2	2.2	1.9	2.0
9	2.2	2.0	2.1	2.3	2.1	1.9	2.0
10	2.1	2.0	2.1	2.3	2.1	1.9	2.0
11	2.1	2.1	2.1	2.2	2.1	1.9	3.0
12	2.1	2.0	2.1	2.2	2.0	1.9	2.1
13	2.1	2.0	2.05	2.2	2.1	1.8	2.0
14	2.3	2.0	2.4	2.2	2.1	1.8	2.0
15	2.3	2.0	2.6	2.5	2.0	1.8	2.0
16	2.2	1.9	2.5	2.4	2.0	1.8	.....
17	2.2	2.0	2.4	2.3	2.0	2.0	.....
18	2.2	2.0	2.3	2.2	2.0	2.0	.....
19	2.1	1.9	2.4	2.2	2.0	2.0	.....
20	2.1	1.9	2.3	2.2	2.0	2.5	.....
21	2.1	2.0	2.3	2.2	1.9	2.1	.....
22	2.1	2.0	2.3	2.2	1.9	2.2	.....
23	2.3	2.0	2.3	2.2	1.9	2.1	.....
24	2.3	1.8	2.3	2.1	2.0	2.0	.....
25	2.2	2.0	2.3	2.1	2.0	2.0	.....
26	2.1	2.0	2.3	2.2	2.0	2.1	.....
27	2.1	2.0	2.6	2.2	2.0	3.0	.....
28	2.2	2.0	2.5	2.1	2.0	2.0	.....
29	2.2	.....	2.5	2.1	2.0	2.2	.....
30	2.1	.....	2.4	2.1	2.0	2.1	.....
31	2.1	.....	2.5	.....	2.0	.....	.....

NOTE.—Discharge probably unaffected by ice.

Monthly discharge of Cooks Creek near Mount Crawford, Va., for 1905–6.

[Drainage area, 41 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
July	346	19	43.8	1.07	1.23
August	27	13	19.7	.480	.55
September	16	10	12.7	.310	.35
October	19	10	11.4	.278	.32
November	13	10	11.4	.278	.31
December	64	10	18.7	.456	.53

Monthly discharge of Cooks Creek near Mount Crawford, Va., for 1905–6—Continued.

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1906.					
January	71	21	27.5	.671	.77
February	23	13	18.5	.451	.47
March	46	19	30.6	.746	.86
April	41	23	28.7	.700	.78
May	27	16	20.6	.502	.58
June	71	13	21.0	.512	.57
July 1–15	71	19	23.8	.580	.32

NOTE.—Values rated as follows: July, 1905, fair; August and December, 1905, good; September to November, 1905, approximate; 1906, good. Discharge determinations below 15 second-feet and above 60 second-feet, approximate. The rating used to determine the above values is virtually based on two measurements and hence is very uncertain.

ELK RUN AT ELKTON, VA.

This station was established June 28, 1905, in connection with the investigation of stream pollution in the Shenandoah Valley and was discontinued July 15, 1906. It was located at the highway bridge 500 feet south of the railroad station at Elkton, Va. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 80, and in Water-Supply Paper No. 192, where are given also the data for previous years.

Discharge measurements of Elk Run at Elkton, Va., in 1906.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
April 11	Robert Follansbee	2.78	15.7
June 14	Follansbee and Padgett	2.57	6.5

Daily gage height, in feet, of Elk Run at Elkton, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	2.85	2.9	2.7	3.1	2.9	2.67	2.5
2	2.8	2.95	2.7	3.8	2.88	2.5	2.5
3	2.75	2.9	3.35	3.0	2.75	2.6	2.5
4	3.25	2.9	3.3	2.95	2.8	2.65	2.6
5	3.1	2.9	2.9	2.85	2.8	2.51	2.5
6	3.0	2.85	2.85	2.9	2.9	2.6	3.5
7	2.91	2.85	2.8	2.85	2.95	2.59	2.8
8	2.8	2.8	2.8	2.8	2.9	2.5	2.78
9	2.96	2.8	2.81	2.95	2.8	2.6	2.7
10	2.91	2.8	2.7	2.8	2.87	2.58	2.72
11	2.9	2.8	2.8	2.85	2.85	2.53	2.7
12	2.8	2.78	2.75	2.8	2.7	2.6	2.72
13	2.8	2.77	2.85	2.8	2.75	2.58	2.7
14	2.8	2.75	2.95	2.85	2.7	2.47	2.7
15	3.0	2.7	3.0	4.5	2.55	2.58	2.75
16	2.9	2.77	3.1	3.5	2.64	2.6	.....
17	2.85	2.7	3.0	3.2	2.6	2.6	.....
18	2.8	2.7	2.95	3.0	2.6	2.65	.....
19	2.8	2.8	2.9	2.95	2.6	2.7	.....
20	2.75	2.72	2.85	2.85	2.6	3.65	.....

Daily gage height, in feet, of Elk Run at Elkton, Va., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
21	2.75	2.7	2.9	2.9	2.55	2.9	.....
22	2.8	2.78	2.9	2.9	2.62	3.2	.....
23	3.0	2.77	2.85	2.85	2.6	2.9	.....
24	3.1	2.8	2.8	2.8	2.5	2.87	.....
25	3.0	2.75	2.7	2.8	2.6	2.82	.....
26	2.95	2.78	2.9	2.95	2.62	2.72	.....
27	3.0	2.75	2.85	3.0	2.5	2.63	.....
28	3.15	2.75	2.9	2.95	2.72	2.6	.....
29	2.95	.....	3.0	2.95	2.7	2.6	.....
30	3.0	.....	2.9	2.85	2.65	2.55	.....
31	2.9	.....	3.1	.....	2.7	.....	.....

NOTE.—Discharge affected only slightly by ice.

Daily discharge, in second-feet, of Elk Run at Elkton, Va., for 1905–6.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.							1905.						
1	14	8.5	8.5	6.5	9.5	9.5	17	9.5	10.5	5.5	10	9.5	7.5
2	14	8	7	6.5	9.5	9.5	18	9.5	8.5	5.5	9	9.5	7.5
3	11	8	7	6.5	9.5	9.5	19	8.5	9.5	5.5	9	9.5	9.5
4	11	7	7	6	9.5	9.5	20	8	8.5	15	9	10.5	32
5	11	7	8.5	6	9.5	9.5	21	8	8.5	8.5	10	9.5	46
6	11	7	7	6.5	9.5	9.5	22	10.5	9.5	7	10	8.5	11.5
7	11	7	5.5	6.5	9.5	9.5	23	7	8.5	7	10	8.5	9.5
8	11	9.5	5.5	6.5	12	8.5	24	7	23	7	10	8.5	9.5
9	9	8.5	5.5	8	9.5	8.5	25	7	28	6.5	12	8.5	11.5
10	9	7	5.5	8	9.5	9.5	26	7	19	6.5	12	8.5	9.5
11	9	10.5	6	27	9.5	9.5	27	7	19	6.5	9.5	8.5	11.5
12	57	10.5	5.5	14.5	9.5	8.5	28	8.5	12.5	6.5	9.5	8.5	11.5
13	28	29	6	10	9.5	8.5	29	8.5	10	6.5	9.5	8.5	17
14	19	85	6	8	12	8.5	30	8.5	10	6.5	9.5	8.5	15.5
15	12.5	19.5	6	8	9.5	7.5	31	8.5	8.5	.....	9.5	.....	14
16	9.5	13	5.5	8	9.5	7.5							

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1906.							
1	13	15.5	11.5	29	17.5	9	6
2	11.5	18	11.5	89	17	6.5	6
3	10.5	16.5	42.5	24	13	8	6
4	29	16.5	38.5	21.5	14.5	8	7
5	21.5	16.5	17.5	17.5	14.5	6	6
6	17.5	15	15.5	19.5	17.5	7	44
7	14.5	15	14	17.5	19.5	7	11
8	11.5	13.5	15	16	16.5	6	11
9	16	13.5	15	21.5	13.5	7	9
10	14.5	13.5	12	16	15.5	7	9
11	14	13.5	15	17.5	15	6	9
12	11.5	13	13.5	16	13	7	9
13	11.5	12.5	16.5	16	12	7	9
14	11.5	12	20.5	17.5	13	5.5	9
15	17.5	11	22.5	132	8	6.5	10
16	15.5	12.5	27.5	58.5	9.5	7	.....
17	14	11	22.5	35.5	8.5	7	.....
18	12.5	11	20.5	24	8.5	7.5	.....
19	12.5	14	18.5	21.5	8.5	8.5	.....
20	11	12	16.5	16.5	8.5	54	.....
21	11	11.5	18.5	18.5	7.5	13	.....
22	12.5	13.5	18.5	18.5	9	24	.....
23	19	13	16.5	16.5	8.5	13	.....
24	23	14	15	15	7	12	.....
25	19	12.5	13	15	8.5	11	.....
26	17	13.5	19.5	20.5	8	9	.....
27	19	12.5	17.5	23	6.5	7.5	.....
28	25.5	12.5	19.5	20.5	10	7	.....
29	17	.....	24	19.5	9.5	7	.....
30	19	.....	19.5	16	8	6.5	.....
31	15.5	.....	29	.....	9.5	.....	.....

NOTE.—Discharge obtained by indirect method for shifting channel.

Monthly discharge of Elk Run at Elkton, Va., for 1905–6.

[Drainage area, 15.8 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
July	57	7.0	11.9	0.753	0.87
August	85	7.0	14.1	.892	1.03
September	15	5.5	6.7	.426	.48
October	27	6.0	9.4	.594	.68
November	12	8.5	9.4	.595	.66
December	46	7.5	11.8	.747	.86
1906.					
January	29	10	15.8	1.00	1.15
February	18	11	13.5	.854	.89
March	42	11	19.3	1.22	1.41
April	132	15	27.0	1.71	1.91
May	20	6.5	11.5	.728	.84
June	54	5.5	9.9	.627	.70
July 1–15	44	6.0	10.7	.677	.38

NOTE.—Values for 1905 and 1906 are approximate, owing to shifting channel and insufficient discharge measurements.

HAWKSBILL CREEK NEAR LURAY, VA.

This station was established June 27, 1905, in connection with the investigation of stream pollution in the Shenandoah River Valley, and was discontinued July 15, 1906. It is located a short distance above the mouth of Dry Run, 1½ miles north of Luray, Va. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 81, and in Water-Supply Paper No. 192, where are given also references to publications that contain data for previous years.

Discharge measurements of Hawksbill Creek near Luray, Va., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 12	Robert Follansbee	39	46	1.86	75
June 15 [a]	Follansbee and Padgett	20	17	1.50	36

[a] Wading below foot bridge.

Daily gage height, in feet, of Hawksbill Creek near Luray, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	2.0	1.9	1.55	2.3	1.9	1.6	1.6
2	1.9	1.9	1.55	2.2	1.85	1.6	1.55
3	3.3	1.9	1.8	2.1	1.85	1.55	1.55
4	2.7	1.85	2.0	2.05	1.85	1.55	1.55
5	2.45	1.85	1.95	2.0	1.8	1.5	1.55
6	2.25	1.75	1.85	1.95	1.75	1.5	1.5
7	2.2	1.7	1.85	1.95	1.75	1.5	1.5
8	2.1	1.7	1.85	1.9	1.75	1.5	1.5
9	2.0	1.7	1.8	1.9	1.75	1.5	1.5
10	2.05	1.65	1.8	1.95	1.75	2.0	1.5
11	2.0	1.65	1.75	1.9	1.75	1.8	1.8
12	1.9	1.65	1.7	1.9	1.7	1.6	1.6
13	1.8	1.65	1.7	1.8	1.7	1.55	1.55
14	1.8	1.7	1.7	1.8	1.65	1.55	1.55
15	1.8	1.65	1.75	3.35	1.65	2.65	1.55

Daily gage height, in feet, of Hawksbill Creek near Luray, Va., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
16	1.8	1.6	1.8	3.05	1.65	1.95	.....
17	1.75	1.6	1.75	2.55	1.65	2.5	.....
18	1.75	1.6	1.75	2.35	1.6	1.8	.....
19	1.75	1.55	1.85	2.25	1.6	1.6	.....
20	1.75	1.55	1.9	2.2	1.6	1.6	.....
21	1.7	1.6	1.9	2.1	1.6	2.45	.....
22	1.65	1.55	1.9	2.0	1.55	1.75	.....
23	1.75	1.55	1.9	1.85	1.5	1.7	.....
24	1.75	1.5	1.9	1.85	1.5	1.7	.....
25	1.8	1.55	1.9	1.85	1.5	1.7	.....
26	1.8	1.55	1.9	2.1	1.5	1.8	.....
27	1.9	1.55	2.15	2.05	1.5	1.8	.....
28	1.9	1.55	2.4	2.0	1.6	1.75	.....
29	1.9	.....	2.35	1.9	1.6	1.7	.....
30	1.9	.....	2.3	1.9	1.55	1.65	.....
31	1.9	.....	2.4	.....	1.5	.....	.....

NOTE.—Discharge probably unaffected by ice.

Rating table for Hawksbill Creek near Luray, Va., 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.*
1.30	24	1.90	83	2.50	196	3.10	355
1.40	30	2.00	98	2.60	220	3.20	384
1.50	37	2.10	115	2.70	245	3.30	414
1.60	46	2.20	133	2.80	271	3.40	445
1.70	57	2.30	152	2.90	298		
1.80	69	2.40	173	3.00	326		

NOTE.—The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905 and 1906. It is fairly well defined between gage heights 1.4 feet and 2 feet.

Monthly discharge of Hawksbill Creek near Luray, Va., for 1905–6.

[Drainage area, 52 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
June 27–31	63	46	54.5	1.05	0.16
July	46	30	36.1	.694	.80
August	63	27	32.6	.627	.72
September	37	24	27.5	.529	.59
October	46	27	30.0	.577	.66
November	34	27	30.0	.577	.64
December	298	30	81.7	1.57	1.81
1906.					
January	414	52	100	1.92	2.21
February	83	37	53.9	1.04	1.08
March	173	42	85.2	1.64	1.89
April	430	69	123	2.37	2.64
May	83	37	53.6	1.03	1.19
June	232	37	68.8	1.32	1.47
July 1–15	69	37	42.7	.821	.458

NOTE.—Values rated as follows: June to August, 1905, February, March, May to July, 1906, excellent; remainder of 1905 and 1906, good.

NORTH FORK OF SHENANDOAH RIVER NEAR RIVERTON, VA.

This station was established June 26, 1899, and was discontinued July 14, 1906. It is located about 2 miles above Riverton, Va., on the farm owned by L. W. Burke. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 83, and in Water-Supply Paper No. 192, where are given also the data for previous years.

The following discharge measurement was made April 13, 1906:

Width, 230 feet; area, 638 square feet; gage height, 5.60 feet; discharge, 969 second-feet.

Daily gage height, in feet, of North Fork of Shenandoah River near Riverton, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	5.7	5.3	4.55	7.9	5.65	4.62	5.05
2	5.45	5.2	4.5	7.1	5.5	4.7	4.88
3	5.4	5.1	4.75	6.7	5.4	4.58	4.85
4	8.6	5.5	6.45	6.32	5.35	4.52	6.12
5	7.75	5.0	6.55	6.1	5.25	4.65	5.52
6	6.83	4.98	5.9	5.92	5.32	4.62	5.2
7	6.2	5.15	5.55	5.75	5.32	4.55	4.95
8	5.85	5.6	5.45	5.6	5.48	4.75	4.82
9	5.58	5.5	5.35	5.52	5.45	4.62	4.7
10	5.35	5.25	5.25	6.1	5.3	4.6	4.6
11	5.37	5.45	5.15	5.95	5.22	4.85	4.6
12	5.27	4.9	5.0	5.75	5.2	4.78	4.6
13	5.25	4.68	5.0	5.62	5.05	4.65	4.65
14	5.3	4.6	5.0	5.28	5.0	4.58	4.62
15	5.4	4.68	5.05	6.4	4.9	5.05	.....
16	5.48	4.65	5.2	6.98	4.88	5.25	.....
17	5.4	4.8	5.45	6.4	4.82	5.5	.....
18	5.38	4.55	5.58	6.05	4.8	5.85	.....
19	5.33	4.52	5.8	5.88	4.8	5.9	.....
20	5.27	4.6	5.9	5.7	4.72	5.65	.....
21	5.2	4.6	5.95	5.58	4.62	6.85	.....
22	5.1	4.6	6.2	5.48	4.6	7.25	.....
23	5.05	4.6	6.55	5.4	4.6	6.6	.....
24	5.7	4.6	6.45	5.28	4.55	5.8	.....
25	5.9	4.53	6.2	5.2	4.55	5.55	.....
26	5.55	4.55	6.1	5.2	4.52	5.3	.....
27	5.33	4.52	7.5	7.48	4.52	6.1	.....
28	5.3	4.58	9.4	6.7	5.08	6.2	.....
29	5.37	.....	8.45	6.15	4.9	5.7	.....
30	5.43	.....	8.35	5.85	4.75	5.35	.....
31	5.35	.....	8.1	.....	4.65	.....	.....

NOTE.—Backwater due to ice conditions February 4, 7–11, 17.

Rating table for North Fork of Shenandoah River, near Riverton, Va., from August 16, 1904, to July 14, 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.*
4.50	275	5.60	925	6.70	1,870	7.80	3,080
4.60	325	5.70	1,000	6.80	1,970	7.90	3,210
4.70	375	5.80	1,075	6.90	2,070	8.00	3,340
4.80	425	5.90	1,155	7.00	2,170	8.20	3,600
4.90	480	6.00	1,235	7.10	2,270	8.40	3,880
5.00	535	6.10	1,320	7.20	2,380	8.60	4,160
5.10	595	6.20	1,405	7.30	2,490	8.80	4,450
5.20	655	6.30	1,495	7.40	2,600	9.00	4,750
5.30	720	6.40	1,585	7.50	2,720		
5.40	785	6.50	1,680	7.60	2,840		
5.50	855	6.60	1,775	7.70	2,960		

NOTE.—The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1904–1906 after dam at Riverton was raised 2 feet. It is well defined between gage heights 4 feet and 5.5 feet. During August, 1904, the dam was raised 2 feet. The exact date is uncertain, but the table is assumed to apply from August 16, 1904.

Monthly discharge of North Fork of Shenandoah River near Riverton, Va., for 1906.

[Drainage area, 1,040 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	4,160	565	1,040	0.996	1.15
February	720	285	418	.402	.42
March	5,350	275	1,420	1.37	1.58
April	3,210	655	1,320	1.27	1.42
May	962	285	545	.524	.60
June	2,440	285	787	.757	.84
July 1-14	1,340	325	523	.503	.26

NOTE.—The discharge was estimated for February 4, 7-11, 17, when the gage was affected by backwater. Values are rated as follows: January to March, good; April to July, excellent.

PASSAGE CREEK AT BUCKTON, VA.

This station was established October 26, 1905, and was discontinued July 15, 1906. It is located about 700 feet above the mouth of the creek, at the trestle of the Southern Railway at Buckton, which is a siding 1 mile east of Waterlick, Va. Passage Creek is a tributary of North Fork of Shenandoah River. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 85, and in Water-Supply Paper No. 192, where are given also the data for previous years.

Discharge measurements of Passage Creek at Buckton, Va., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 13	Robert Follansbee	47	51	1.40	91
June 16	do	48	66	1.72	132

Daily gage height, in feet, of Passage Creek at Buckton, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	1.4	1.2	1.1	2.6	1.3	0.85	1.3
2	1.35	1.25	1.0	2.2	1.3	.95	1.2
3	1.3	1.3	1.1	1.9	1.3	.9	1.2
4	3.4	1.3	3.1	1.8	1.25	.85	1.2
5	2.0	1.3	2.2	1.7	1.25	.9	1.1
6	1.8	1.4	1.6	1.6	1.25	1.1	1.0
7	1.5	1.4	1.5	1.6	1.25	1.0	.9
8	1.5	1.6	1.5	1.5	1.3	.9	.9
9	1.5	1.7	1.5	1.3	1.25	.85	.85
10	1.55	1.6	1.4	1.9	1.2	.85	.85
11	1.55	1.5	1.3	1.6	1.2	.85	.85
12	1.5	1.5	1.3	1.5	1.2	1.1	.8
13	1.4	1.2	1.3	1.4	1.2	1.0	1.0
14	1.4	1.1	1.3	1.4	1.2	.9	.85
15	1.5	1.1	1.4	2.5	1.1	.9	.85
16	1.45	1.2	1.4	2.4	1.1	1.6	.....
17	1.4	1.15	1.35	2.0	1.0	2.55	.....
18	1.3	1.15	1.4	1.85	1.0	3.2	.....
19	1.3	1.1	1.6	1.7	1.0	2.2	.....
20	1.3	1.1	1.5	1.6	1.0	2.1	.....

Daily gage height, in feet, of Passage Creek at Buckton, Va., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
21	1.2	1.0	1.6	1.55	1.0	2.4	.....
22	1.2	1.0	1.8	1.5	.95	2.52	.....
23	1.2	1.0	2.2	1.4	.9	2.1	.....
24	1.25	1.0	2.1	1.4	.9	1.95	.....
25	1.2	1.0	2.1	1.4	.8	1.9	.....
26	1.2	1.0	2.1	1.4	.75	1.7	.....
27	1.2	1.0	2.6	1.65	.8	2.6	.....
28	1.25	1.1	3.4	1.5	.95	1.7	.....
29	1.2	.....	3.4	1.4	1.0	1.6	.....
30	1.2	.....	3.3	1.35	.9	1.4	.....
31	1.2	.....	2.6	.....	.85	.....	.....

NOTE.—Ice conditions February 4–13.

MONOCACY RIVER NEAR FREDERICK, MD.

This station was established August 4, 1896. It is located at the county bridge on the toll road leading from Frederick to Mount Pleasant, Md. It is 4 miles northeast of Frederick, about 2,000 feet above the mouth of Israel Creek, and 3,000 feet below the mouth of Tuscarora Creek. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 86, and in Water-Supply Paper No. 192, where are given also the data for previous years.

The following discharge measurement was made May 31, 1906:

Area, 324 square feet; gage height, 4.70 feet; discharge, 328 second-feet.

Daily gage height, in feet, of Monocacy River near Frederick, Md., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.2	4.9	5.3	9.7	5.4	4.7	4.5	4.5	5.5	4.3	5.6	4.5
2	5.7	4.8	5.5	7.8	5.4	4.7	4.5	9.1	5.2	4.3	5.5	4.5
3	7.5	4.5	9.1	7.4	5.3	4.6	4.5	16.1	5.1	4.3	5.3	4.5
4	18.35	4.5	16.65	6.9	5.3	4.5	5.3	10.1	4.9	4.8	5.2	4.5
5	12.6	5.1	9.1	6.5	5.2	4.4	5.1	5.5	4.9	7.1	5.1	4.5
6	7.6	5.0	6.9	6.3	5.3	4.4	4.6	5.3	4.8	6.1	5.0	4.7
7	6.7	4.9	6.5	6.2	5.3	4.4	4.6	5.1	4.7	5.8	4.9	4.8
8	6.6	4.8	6.4	6.1	5.3	4.4	4.5	4.9	4.6	4.9	4.8	4.8
9	6.2	5.2	6.3	7.5	5.2	4.4	4.5	4.8	4.6	4.7	4.8	4.7
10	5.9	5.1	6.1	16.8	5.0	5.5	4.4	4.8	4.5	4.6	4.8	5.9
11	5.7	5.0	5.9	9.1	5.0	5.1	4.4	6.1	4.4	4.5	4.8	6.8
12	6.9	4.9	5.8	8.5	4.9	4.5	4.9	5.1	4.4	4.4	4.7	6.4
13	6.7	4.8	5.8	7.1	4.9	4.5	4.5	6.1	4.4	4.3	4.7	5.3
14	6.2	5.9	5.8	6.9	4.9	4.4	4.4	4.8	4.4	4.3	4.7	5.2
15	6.5	8.1	5.8	21.8	4.7	4.4	4.4	4.7	4.4	4.3	4.8	5.2
16	7.1	5.4	5.8	15.5	4.8	4.5	4.4	4.6	4.4	4.3	4.8	7.6
17	6.9	4.9	5.7	10.2	4.8	4.6	4.5	4.6	4.4	4.3	4.8	9.8
18	6.2	4.8	5.7	8.1	4.7	7.1	4.5	4.5	4.4	4.3	4.9	12.1
19	5.9	5.0	5.6	7.5	4.7	9.7	4.4	8.5	4.4	9.5	5.2	8.5
20	5.7	5.0	5.6	7.1	4.5	9.5	4.4	7.5	4.4	13.2	5.5	6.5
21	5.7	5.4	5.5	6.7	4.5	10.5	4.3	6.5	4.8	9.5	5.1	9.5
22	5.7	9.4	5.5	6.4	4.5	10.7	4.4	5.4	4.6	11.5	5.0	7.5
23	5.6	6.5	5.5	6.3	4.5	6.7	4.8	7.35	4.4	8.5	4.9	6.9
24	5.6	6.1	5.6	6.1	4.5	6.1	5.1	6.5	4.4	7.5	4.8	5.8
25	5.6	6.7	5.6	5.9	4.4	5.9	4.8	7.5	4.4	8.5	4.7	5.7
26	5.5	6.9	5.5	5.8	4.5	5.8	4.6	7.8	4.3	8.1	4.6	5.6
27	5.5	5.9	9.0	5.7	4.5	5.1	4.4	11.0	4.3	7.5	4.6	7.8
28	5.55	6.1	17.45	5.5	5.6	4.9	4.35	9.8	4.3	6.7	4.6	6.9
29	5.3	.....	12.5	5.4	5.1	4.8	4.5	7.5	4.3	6.2	4.5	5.8
30	5.2	.....	10.5	5.4	4.8	4.7	4.3	6.1	4.3	5.8	4.5	5.7
31	5.1	.....	9.6	.....	4.7	.....	4.3	5.8	.....	5.7	.....	8.4

NOTE.—Ice conditions February 6, 7, and 9.

Rating table for Monocacy River near Frederick, Md., 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.*
3.80	80	5.20	538	6.60	1,390	9.00	3,525
3.90	99	5.30	584	6.70	1,465	9.20	3,715
4.00	120	5.40	632	6.80	1,545	9.40	3,905
4.10	144	5.50	682	6.90	1,625	9.60	4,100
4.20	170	5.60	734	7.00	1,705	9.80	4,300
4.30	198	5.70	789	7.20	1,875	10.00	4,500
4.40	228	5.80	846	7.40	2,045	11.00	5,500
4.50	260	5.90	906	7.60	2,220	12.00	6,500
4.60	294	6.00	969	7.80	2,400	13.00	7,550
4.70	330	6.10	1,034	8.00	2,580	14.00	8,600
4.80	368	6.20	1,102	8.20	2,765		
4.90	408	6.30	1,172	8.40	2,955		
5.00	450	6.40	1,242	8.60	3,145		
5.10	493	6.50	1,315	8.80	3,335		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1900 to 1906. It is fairly well defined between gage heights 4 feet and 10 feet. Above 12 feet gage height the rating curve is a tangent, the difference being 105 per tenth.

Monthly discharge of Monocacy River near Frederick, Md., for 1906.

[Drainage area, 660 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	13,200	493	1,660	2.51	2.89
February	3,900	260	824	1.25	1.30
March	12,200	584	2,280	3.45	3.98
April	16,800	632	2,880	4.36	4.86
May	734	228	422	.639	.74
June	5,200	228	1,040	1.57	1.75
July	584	198	284	.430	.50
August	10,800	260	1,780	2.70	3.11
September	682	198	290	.439	.49
October	7,760	198	1,490	2.25	2.59
November	734	260	418	.633	.71
December	6,600	260	1,430	2.17	2.50
The year	16,800	198	1,230	1.87	25.42

NOTE.—Values for entire year are excellent.

The following table gives the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge, and shows the number of days on which the flow and the corresponding horsepower were, respectively, less than the amounts given in the columns for "discharge" and "horsepower."

Discharge and horsepower table for Monocacy River at Frederick, Md., from 1896 to 1906.

Discharge in second-feet.	Horsepower (80 per cent efficiency), per foot fall.	Number of days of deficient flow.										
		1896.[a]	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
55	5	.....	.....	.....	.....	4	.....	.....	.....	.....	.....	.....
66	6	.....	.....	.....	.....	16	.....	10	.....	.....	.....	.....
88	8	16	.....	.....	4	63	.....	22	.....	21	.....	.....
110	10	32	6	22	29	89	.....	29	.....	27	.....	.....
132	12	74	19	37	56	119	.....	38	.....	78	.....	.....
154	14	98	45	48	75	142	1	48	.....	85	2	.....
176	16	114	56	58	100	163	25	72	4	123	17	.....
198	18	115	63	59	100	165	25	72	4	123	17	.....
220	20	128	86	68	118	174	74	94	15	129	36	18
275	25	136	115	99	149	196	131	115	56	152	78	82
330	30	142	130	116	163	213	155	147	78	187	106	96
385	35	142	149	123	169	224	165	152	94	216	151	138
440	40	145	171	138	187	244	204	170	128	240	169	154
495	45	147	192	157	206	254	216	176	130	259	195	175
550	50	147	199	169	213	265	229	185	138	269	205	184
660	60	148	222	206	231	275	243	207	154	285	220	202
770	70	149	243	234	243	299	264	217	173	297	237	226

[a] August 4 to December 31.

NOTE.—During the period covered by the above table the minimum flow was 49 second-feet, giving 4.5 horsepower per foot of fall for four consecutive days.

JAMES RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The headwaters of the James lie in the high mountains in the extreme western part of Virginia. The river is formed by the confluence of Jackson and Cowpasture rivers in the northern part of Botetourt County, Va.; thence it flows eastward across the State and empties into Chesapeake Bay through Hampton Roads. The total length of the river is about 335 miles and its drainage area is about 9,700 square miles. The river and all its tributaries lie wholly within the State of Virginia.

The topography of the basin is varied in character, changing from the mountainous section in the upper part to low, flat, and often swampy areas as tide water is approached. Jackson and Cowpasture rivers flow in narrow valleys between steep hills, over beds of sand and gravel, with rock ledges in places, and are bordered with fertile bottom lands. In this portion of the basin the water collects quickly, causing rapid rises in the river below.

Near Clifton Forge and again near Balcony Falls the James flows through ridges of the Alleghenies, with sharp falls over beds of solid rock. At other points similar though less pronounced falls and rapids occur as the river cuts through the lesser foothills. Between these mountainous or hilly sections the stream winds through broad and fertile valleys over beds of sand and gravel, with gentle slope. The fall line is crossed at Richmond.

Many dams have been built in the James, generally for diverting water into the old James and Kanawha Canal, which followed the river from Richmond to Buchanan and was at one time utilized throughout that entire distance. It has now been abandoned, however, and its right of way is owned and for considerable distances occupied by the Chesapeake and Ohio Railway. The use of the dams was abandoned with the canal, and though many of them are in good repair they have not been improved for power purposes. The principal utilized power is at Richmond. On October 19, 1904, a measurement of the James and Kanawha Canal was made about 5 miles above Richmond, Va., at a bridge opposite the 5-mile post of the Chesapeake and Ohio Railway. Area, 318 square feet; discharge, 556 second-feet.

The fluctuations in stage are great. The records of the Cartersville station, which extend over a period of eight years, show a range in gage height of nearly 25 feet. The discharge has varied between 97,800 and 600 second-feet.

In 1897 a reconnaissance survey of James River was made under the direction of D. C. Humphreys, professor of civil engineering of Washington and Lee University. This survey covered the portion of the river between Clifton Forge and Richmond and a part of North River, and consisted in determining the profile, which was done by using the profile of the Chesapeake and Ohio Railway as a base and tying on to the water surface at each dam and at intermediate points not more than 5 miles apart. Notes were made in regard to the condition of the dams and measurements of flow were made on all of the more important tributaries. The results of this reconnaissance were published in the Nineteenth Annual Report of the United States Geological Survey, Part IV, pages 162–173, and in Bulletin No. 3 of the Geological Survey of Virginia, Thomas L. Watson, geologist in charge, Blacksburg, Va.

Gages were established on James River in 1893 by F. B. Isaacs, engineer for water power of the Chesapeake and Ohio Railway Company, at Ninemile Locks, Columbia, Scottsville, Lynchburg, Balcony Falls, Buchanan, Eagle Mountain, and Clifton Forge. Records of heights of water at these points were made twice daily from 1893 to 1897 and freshet reports were obtained for these years. The gages were not referred to any fixed datum, but the zero of each gage was set at what was considered ordinary low water in the river. During the latter part of 1899 records were resumed, except at Scottsville, Balcony Falls, and Eagle Mountain, where the gages have been abandoned.

At Boshers dam, 9 miles above Richmond, is a gage where the height of water is recorded twice daily, showing the supposed head on the crest of the dam. The crest, however, is so irregular that

the coefficient of discharge has not been ascertained. Another complication exists in the fact that water is deflected into a canal, the quantity not being known.

The United States Weather Bureau maintains river stations on the James at Lynchburg, Columbia, and Richmond, Va.

JAMES RIVER AT BUCHANAN, VA.

This station was established August 18, 1895, and was discontinued July 15, 1906. It is located at the iron highway bridge near the Chesapeake and Ohio Railway station and one-half mile from the Norfolk and Western Railway station. It is about 20 miles from the mouth of North River and one-half mile above the mouth of Purgatory Creek. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 91, where are given also references to publications that contain data for previous years.

The following discharge measurement was made June 12, 1906:

Width, 319 feet; area, 1,010 square feet; gage height, 2.31 feet; discharge, 727 second-feet.

Daily gage height, in feet, of James River at Buchanan, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	3.64	4.13	2.45	6.24	3.2	2.7	2.25
3	3.42	3.88	2.35	5.42	3.1	2.61	2.21
3	3.39	3.56	2.55	4.95	3.14	2.59	2.25
4	7.9	3.42	4.21	4.42	2.96	2.4	4.22
5	7.08	3.34	5.39	4.35	3.02	2.31	2.96
6	5.49	3.2	4.22	4.0	3.45	2.72	2.72
7	4.72	3.19	3.91	4.05	3.55	2.64	2.45
8	4.18	3.09	3.55	3.84	3.4	2.52	2.3
9	3.93	2.9	3.52	3.8	3.36	2.51	2.26
10	3.55	2.94	3.28	4.28	3.12	2.34	2.2
11	3.39	2.93	3.24	4.92	3.1	2.3	2.19
12	3.33	2.7	3.01	4.46	2.94	2.34	2.12
13	3.39	2.77	3.01	4.25	2.91	2.3	2.22
14	3.55	2.75	2.85	3.9	2.7	2.45	2.31
15	3.55	2.65	3.38	4.48	2.78	2.4	2.32
16	3.81	2.72	7.00	5.5	2.65	2.4	.....
17	3.86	2.66	5.9	5.01	2.8	2.35	.....
18	3.79	2.49	4.83	4.4	2.9	2.55	.....
19	3.62	2.5	4.59	4.25	2.96	2.5	.....
20	3.41	2.5	4.67	3.92	2.76	4.12	.....
21	3.35	2.4	4.89	3.85	2.78	4.75	.....
22	3.46	2.5	4.63	3.6	2.6	3.96	.....
23	9.41	2.52	4.65	3.59	2.66	3.58	.....
24	9.16	2.45	4.28	3.4	2.49	3.16	.....
25	6.34	2.55	4.23	3.38	2.5	2.92	.....
26	5.4	2.53	3.88	3.12	2.36	2.79	.....
27	4.86	2.43	5.4	3.22	2.68	2.6	.....
28	4.83	2.5	7.88	3.1	2.75	2.6	.....
29	5.0	.....	7.14	3.2	2.8	2.59	.....
30	4.6	.....	6.16	3.1	2.9	2.51	.....
31	4.37	.....	6.46	.....	2.94	.....	.....

NOTE.—Discharge probably unaffected by ice.

Rating table for James River at Buchanan, Va., for 1898–1906.

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	505	3.30	1,815	4.50	4,025	6.40	8,495
2.20	575	3.40	1,965	4.60	4,235	6.60	9,030
2.30	655	3.50	2,125	4.70	4,450	6.80	9,575
2.40	740	3.60	2,290	4.80	4,665	7.00	10,130
2.50	835	3.70	2,460	4.90	4,885	7.20	10,700
2.60	935	3.80	2,640	5.00	5,105	7.40	11,290
2.70	1,040	3.90	2,825	5.20	5,555	7.60	11,900
2.80	1,155	4.00	3,015	5.40	6,015	7.80	12,520
2.90	1,275	4.10	3,210	5.60	6,485	8.00	13,140
3.00	1,400	4.20	3,410	5.80	6,965	9.00	16,470
3.10	1,530	4.30	3,610	6.00	7,460	10.00	20,300
3.20	1,670	4.40	3,815	6.20	7,970		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 17 discharge measurements made during 1901–1906. It is well defined between gage heights 1.8 feet and 4.5 feet. From 4.5 to 8.5 feet it is determined by two measurements made in 1901. Above gage height 8.5 feet it is determined by the product of the area and velocity curves, but these are somewhat uncertain. A rock control below the station causes the discharge measurements to plot on a fairly permanent curve.

Monthly discharge of James River at Buchanan, Va., for 1906.

[Drainage area, 2,060 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	18,000	1,860	4,750	2.31	2.66
February	3,270	740	1,300	.631	.66
March	12,800	698	4,250	2.06	2.38
April	8,070	1,530	3,390	1.65	1.84
May	2,210	706	1,310	.636	.73
June	4,560	655	1,180	.573	.64
July 1–15	3,450	519	888	.431	.24

NOTE.—Values for 1906 are excellent.

The following table gives the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge and shows the number of days on which the flow and the corresponding horsepower were respectively less than the amounts given in the columns for "discharge" and "horsepower."

Discharge and horsepower table for James River at Buchanan, Va., from 1895 to 1906.

Discharge in second-feet.	Horsepower (80 per cent efficiency) per foot fall.	Number of days of deficient flow.											
		1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
275	25	.....	a 2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
330	30	.....	a 8	25	6	71	16	.....	.....	.....	16	.....	.....
385	35	11	a 13	44	9	112	30	.....	18	.....	71	8	.....
440	40	59	a 13	67	9	112	31	.....	18	.....	105	19	.....
495	45	65	35	84	12	134	46	9	50	.....	126	70	.....
550	50	81	54	101	22	153	72	20	84	40	136	86	1
660	60	119	81	119	45	171	107	42	119	95	160	120	11
770	70	.....	105	146	52	178	125	52	139	115	181	146	24
880	80	.....	142	182	88	184	144	70	154	128	199	166	41
990	90	.....	165	191	102	194	163	89	166	138	213	187	52
1,100	100	.....	205	209	136	196	176	103	176	154	220	200	63
1,320	120	.....	235	238	175	202	207	132	205	172	234	222	80
1,540	140	.....	262	256	195	214	234	154	224	187	242	236	92

a In 1896 a discharge of less than 495 second-feet occurred only in April and May. As the determination for these months are known to be of doubtful value, they should be disregarded altogether in any power estimates.

NOTE.—The minimum discharge from 1895 to 1906 was 275 second-feet, giving 25 horsepower per foot of fall, on eleven consecutive days in October, 1899, and on three consecutive days in August and in September, 1900.

JAMES RIVER AT HOLCOMB ROCK, VA.

This station was established by the Willson Aluminum Company, of Holcomb Rock, Va., in 1899, in connection with measurements to determine the horsepower available at that point. During 1899 the records were fragmentary, but at the beginning of 1900 daily records were taken, which have been furnished to the United States Geological Survey through the courtesy of the general manager of the company. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 93, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of James River, at Holcomb Rock, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.9	2.9	1.3	5.75	1.75	1.6	1.4	1.5	3.8	3.45	2.25	1.85
2	3.75	2.75	1.3	4.9	1.8	1.7	1.5	1.4	2.65	3.8	2.2	1.8
3	3.0	2.45	1.7	4.05	1.75	1.35	1.05	1.3	2.45	5.85	2.1	1.7
4	2.5	2.0	4.2	3.6	1.7	1.3	2.05	1.3	2.25	9.55	1.95	1.7
5	2.4	2.1	4.8	3.15	1.7	1.3	1.85	1.0	2.05	9.65	1.85	1.65
6	2.55	2.1	3.7	2.95	1.55	1.5	1.55	1.5	1.9	6.6	1.7	1.7
7	3.0	2.0	2.9	2.75	2.25	1.55	1.45	2.0	1.8	5.65	1.7	1.65
8	3.3	1.75	2.55	2.55	2.1	1.35	1.1	2.35	1.7	4.65	1.7	1.6
9	2.95	1.7	2.35	2.6	2.05	1.3	1.15	2.1	1.6	3.85	1.7	1.45
10	2.55	1.7	2.3	3.15	2.0	1.15	1.2	2.05	1.55	3.2	1.65	1.5
11	2.2	1.7	2.0	3.75	1.85	1.25	1.2	1.7	1.5	2.7	1.55	1.6
12	2.1	1.55	2.0	3.4	1.8	1.3	1.2	1.6	1.55	2.45	1.65	1.55
13	2.1	1.6	1.9	3.1	1.55	1.3	1.1	1.7	1.85	2.15	1.7	1.5
14	2.4	1.55	1.85	2.7	1.6	1.4	1.2	2.15	2.25	2.0	1.65	1.4
15	2.4	1.55	2.25	3.3	1.55	1.3	1.1	3.45	1.8	1.95	1.6	1.4
16	2.55	1.5	5.4	4.6	1.5	1.3	1.35	4.2	1.5	1.85	1.6	1.45
17	2.55	1.5	5.15	4.4	1.5	1.1	1.3	4.05	1.35	1.8	1.6	1.6
18	2.5	1.25	3.7	3.65	1.6	1.4	1.2	3.6	1.35	3.4	1.55	4.7
19	2.5	1.5	3.6	3.2	1.65	1.5	1.25	3.0	1.4	13.4	3.95	6.8
20	2.3	1.45	3.85	2.9	1.6	4.75	1.3	3.2	1.4	19.0	9.85	4.35
21	2.0	1.35	3.9	2.65	1.5	4.5	1.1	3.2	1.3	12.3	7.85	3.7
22	2.05	1.4	3.85	2.55	1.4	3.55	1.2	2.9	1.4	8.1	5.3	3.55
23	5.85	1.3	3.4	2.4	1.3	2.65	1.7	2.75	1.6	6.3	4.2	3.35
24	9.85	1.4	3.3	2.25	1.3	2.05	1.4	2.8	1.9	5.45	3.35	2.8
25	6.3	1.1	2.95	2.1	1.3	1.95	1.3	2.9	1.65	4.4	2.85	2.55
26	4.7	1.35	2.9	2.1	1.3	1.7	1.3	2.8	1.55	3.8	2.65	2.35
27	4.0	1.35	3.65	2.0	1.3	2.1	1.3	2.75	1.4	3.4	2.45	2.2
28	3.75	1.3	7.1	2.0	1.5	1.65	1.3	4.75	1.6	3.2	2.25	2.2
29	4.1	.....	6.5	1.85	1.6	1.85	1.5	5.9	2.15	2.85	2.05	2.2
30	3.8	.....	5.8	1.75	1.8	1.6	2.05	4.6	2.25	2.5	1.85	2.1
31	3.35	.....	5.85	.....	1.7	.....	1.7	3.85	.....	2.35	.....	3.1

JAMES RIVER AT CARTERSVILLE, VA.

This station was established January 1, 1899. It is located at the highway bridge crossing the James between Pemberton and Cartersville, 300 yards from the railroad station, and 50 miles above Richmond, Va. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 94, where are given also references to publications that contain data for previous years.

The following discharge measurement was made June 7, 1906:

Width, 690 feet; area, 2,100 square feet; gage height, 2.22 feet; discharge, 3,400 second-feet.

Daily gage height, in feet, of James River at Cartersville, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.98	5.37	2.22	8.62	2.9	2.6	3.0	2.98	6.03	4.88	3.95	3.1
2	4.38	4.3	2.4	8.2	2.88	4.85	2.15	3.75	5.38	3.50	3.65	2.95
3	3.85	4.2	2.52	6.95	2.8	3.62	1.9	3.6	4.55	5.15	3.45	2.8
4	17.0	3.38	10.1	6.05	2.8	2.59	1.85	2.78	3.97	12.4	3.22	2.7
5	12.2	3.6	8.25	5.32	2.7	2.1	2.5	2.55	3.52	15.2	3.1	2.7
6	11.2	3.5	7.05	4.9	2.78	2.05	2.38	2.2	3.15	11.9	3.0	2.62
7	7.9	3.3	5.85	4.6	2.75	2.08	2.42	1.7	2.92	9.4	2.9	2.5
8	6.15	3.15	4.9	4.25	3.8	2.05	2.15	2.92	2.7	7.2	2.8	2.48
9	5.35	3.08	4.38	4.15	3.3	2.08	1.85	2.98	2.5	6.65	2.72	2.45
10	4.7	3.45	3.95	5.45	2.9	1.97	1.6	4.0	2.4	5.52	2.65	2.35
11	4.1	3.0	3.5	5.02	2.9	1.8	1.6	3.72	2.05	4.82	2.75	2.35
12	3.85	2.82	3.3	5.2	2.72	1.7	1.6	3.65	2.2	4.12	2.85	2.5
13	3.8	2.65	3.15	5.15	2.6	1.6	1.68	4.82	2.5	3.62	2.85	2.38
14	3.9	2.8	3.02	4.7	2.55	1.65	1.55	3.72	3.15	3.25	2.68	2.3
15	4.12	2.65	3.3	10.0	2.25	1.85	1.42	2.95	2.55	3.12	2.55	2.25
16	4.1	2.5	8.65	9.4	2.35	1.75	1.3	4.32	2.4	2.9	2.65	2.2
17	4.0	2.4	6.45	7.25	2.28	2.0	1.6	5.58	2.25	2.82	2.58	2.2
18	3.95	2.32	6.95	6.82	2.2	2.4	1.7	9.32	2.08	3.1	2.48	3.8
19	3.9	2.38	5.98	5.9	2.15	1.88	1.6	6.75	2.15	7.8	8.9	3.75
20	3.7	2.1	8.7	5.15	2.12	1.98	1.58	5.32	2.38	21.8	9.95	8.2
21	3.55	2.3	6.95	4.75	2.2	5.2	2.72	5.65	2.11	23.3	10.8	7.48
22	3.32	2.38	6.58	4.47	2.0	7.05	2.3	4.82	2.02	18.7	10.2	6.0
23	3.28	2.45	5.62	4.15	2.8	6.85	2.88	6.55	2.0	12.2	7.3	5.25
24	3.95	2.3	5.0	3.95	1.9	4.47	3.3	4.6	2.2	9.55	5.95	4.72
25	11.3	2.2	4.92	3.58	1.78	3.68	2.5	7.0	2.3	8.05	4.85	4.15
26	7.82	2.15	4.71	3.49	1.75	3.08	1.9	5.35	2.32	7.08	4.45	3.62
27	6.22	2.0	5.3	3.48	2.72	5.3	1.65	6.28	2.25	6.2	4.18	3.3
28	9.0	2.2	5.71	3.5	2.85	3.65	1.95	9.05	2.05	5.9	3.82	3.5
29	7.6	.....	8.2	3.15	4.75	3.6	2.75	7.45	2.02	5.0	3.45	3.42
30	6.3	.....	9.05	2.95	3.48	3.45	5.4	9.1	2.35	4.55	3.22	3.3
31	5.85	.....	10.5	.....	3.28	.....	4.35	7.55	.....	4.2	.....	3.35

NOTE.—Discharge probably unaffected by ice.

Rating table for James River at Cartersville, Va., for 1899–1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	2,170	3.00	5,550	4.70	9,530	7.80	18,330
1.40	2,350	3.10	5,770	4.80	9,780	8.00	18,970
1.50	2,530	3.20	5,990	4.90	10,040	9.00	22,300
1.60	2,710	3.30	6,210	5.00	10,300	10.00	25,750
1.70	2,900	3.40	6.440	5.20	10,820	11.00	29,260
1.80	3,090	3.50	6,670	5.40	11,350	12.00	32,930
1.90	3,280	3.60	6,900	5.60	11,890	13.00	36,670
2.00	3,480	3.70	7,130	5.80	12,430	14.00	40,520
2.10	3,680	3.80	7,360	6.00	12,980	15.00	44,500
2.20	3,880	3.90	7,590	6.20	13,540	16.00	48,600
2.30	4,080	4.00	7,830	6.40	14,100	17.00	52,820
2.40	4,280	4.10	8,070	6.60	14,680	18.00	57,200
2.50	4,490	4.20	8,310	6.80	15,260	19.00	61,700
2.60	4,700	4.30	8,550	7.00	15,860	20.00	66,300
2.70	4,910	4.40	8,790	7.20	16,460	21.00	71,300
2.80	5,120	4.50	9,030	7.40	17,080	22.00	76,900
2.90	5,330	4.60	9,280	7.60	17,700	23.00	82,900

NOTE.—The above table is applicable only for open-channel conditions. It is based on 25 discharge measurements made during 1897–1906. It is well defined between gage heights 0.7 foot and 10 feet. Between gage heights 10 feet and 20 feet the table is the product of the area curve by the extension of the velocity curve. Above 20 feet estimates are obtained in the same way, with the addition of a small overflow discharge.

Monthly discharge of James River at Cartersville, Va., for 1906.

[Drainage area, 6,230 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	52,800	6,170	13,800	2.22	2.56
February	11,300	3,480	5,380	.863	.90
March	25,500	3,920	12,700	2.04	2.35
April	25,800	5,440	11,600	1.86	2.08
May	9,660	3,000	4,910	.789	.91
June	16,000	2,710	5,850	.939	1.05
July	11,400	2,170	4,020	.645	.74
August	23,400	2,900	10,600	1.70	1.96
September	13,100	3,480	5,110	.820	.91
October	84,800	5,160	20,800	3.34	3.85
November	28,600	4,450	9,230	1.48	1.65
December	19,600	3,880	6,750	1.08	1.24
The year	84,800	2,170	9,230	1.48	20.20

NOTE.—Values for entire year are excellent.

The following table gives the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge, and shows the number of days on which the flow and the corresponding horsepower were respectively less than the amounts given in the columns for "discharge" and "horsepower:"

Discharge and horsepower table for James River at Cartersville, Va., from 1899 to 1906.

Discharge in second-feet.	Horsepower (80 per cent efficiency) per foot fall.	Number of days of deficient flow.							
		1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
880	80	.....	3	.....	.....	.....	.....	.....	.....
990	90	.....	3	.....	8	.....	11	.....	.....
1,100	100	.....	12	.....	13	.....	15	.....	.....
1,320	120	4	19	.....	22	.....	40	.....	.....
1,540	140	14	31	.....	34	.....	75	.....	.....
1,760	160	42	59	.....	48	.....	95	13	.....
1,980	180	66	75	.....	52	1	100	32	.....
2,200	200	109	92	2	78	23	115	59	1
2,750	250	140	112	48	113	78	154	92	10
3,300	300	158	123	70	138	111	186	132	27
3,850	350	176	152	100	158	128	213	155	52
4,400	400	191	180	124	173	149	234	182	91
4,950	450	198	200	145	179	162	245	200	116
5,500	500	209	216	159	189	178	254	227	151

NOTE.—The ice conditions at this station during some of the winter months did not materially affect the results given in the above table.

Minimum flow from 1899 to 1906 was 842 second-feet, giving 77 horsepower on 3 days in September, 1900.

ROANOKE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Dan River joins the Roanoke at Clarksville, Mecklenburg County, Va., 185 miles above its mouth, and is its largest tributary. The Roanoke drains a total area of 9,200 square miles, and empties into Albemarle Sound a short distance below Plymouth, N. C. It is navigable at all stages for 120 miles, to Weldon, N. C., where it crosses the

fall line. The Dan and the Roanoke above their junction drain, respectively, 3,800 and 3,550 square miles. The Roanoke is the more northerly of the two, and its drainage basin lies entirely in Virginia. It rises among the eastern foothills of the Blue Ridge, southwest of Roanoke and Salem, and flows at first northeast, then southeast to its junction with the Dan. The Dan rises in Surry County, N. C., and Patrick County, Va., and flows at first southeast, then northeast to its junction with the Roanoke. A large part of the drainage area of the Dan lies in North Carolina.

During 1905 a survey of Roanoke River was made in order to determine a plan and profile and other information which would be of use in hydraulic developments. For description, plan, and profile of this survey see Bulletin No. 3 of the Geological Survey of Virginia.

The rainfall on the basin of the Roanoke above the fall line is about 48 inches per annum, and is evenly distributed throughout the year. The average amount probably increases slightly as the stream is ascended, though the records of rainfall over the basin are too incomplete to decide this matter. The slopes in the headwaters and in the upper tributaries are steep, freshets on the river are violent, and the fluctuations of height occur with great rapidity. Rises of 50 feet and over have been noted at Weldon, and freshets in which the rate of rise is 10 feet a day or more are frequent.

The United States Weather Bureau maintains gages at Clarksville, Va., at the junction of the Dan and Roanoke; on Dan River at Danville, Va., and on Roanoke River at Weldon, N. C.

ROANOKE RIVER AT ROANOKE, VA.

This station was established July 10, 1896, and was discontinued July 15, 1906. The gage is located at the Walnut Street Bridge, Roanoke, but the measuring section is at the Jefferson Street Bridge. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 102, where are given also references to publications that contain data for previous years.

The following discharge measurement was made June 10, 1906:

Width, 112 feet; area, 124 square feet; gage height, .76 feet; discharge, 119 second-feet.

Daily gage height, in feet, of Roanoke River at Roanoke, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	1.35	1.8	1.0	2.3	1.35	1.1	0.8
2	1.3	1.7	1.1	2.05	1.3	1.0	.8
3	4.8	1.6	1.15	1.75	1.3	.9	.75
4	3.6	1.5	1.7	1.65	1.2	.7	.75
5	2.8	1.5	1.5	1.55	1.1	.8	.7
6	2.15	1.5	1.4	1.5	1.2	.8	.7
7	1.85	1.4	1.3	1.45	1.3	.8	.7
8	1.75	1.4	1.3	1.4	1.3	.8	.7
9	1.65	1.35	1.3	1.4	1.3	.7	.7
10	1.5	1.3	1.2	1.7	1.1	.8	.7

Daily gage height, in feet, of Roanoke River at Roanoke, Va., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
11	1.5	1.2	1.2	1.6	1.1	.8	.7
12	1.5	1.2	1.2	1.55	1.1	.8	.65
13	1.4	1.2	1.2	1.4	1.0	1.4	.65
14	1.4	1.2	1.15	1.4	1.0	1.3	.65
15	1.5	1.2	1.4	1.8	.9	1.2	.7
16	1.5	1.2	1.5	2.0	1.0	1.1	.....
17	1.5	1.2	2.0	1.85	1.0	1.0	.....
18	1.45	1.1	2.1	1.7	1.0	1.0	.....
19	1.4	1.1	2.2	1.6	1.0	.9	.....
20	1.35	1.1	2.2	1.5	.9	.8	.....
21	1.3	1.1	2.2	1.4	1.4	1.1	.....
22	1.3	1.05	2.1	1.6	1.3	1.0	.....
23	4.05	1.05	2.0	1.5	1.4	.9	.....
24	2.7	1.05	1.8	1.4	1.4	.8	.....
25	2.2	1.05	1.7	1.3	1.2	.8	.....
26	2.05	1.05	1.6	1.3	1.1	.8	.....
27	1.85	1.1	2.15	1.2	1.0	.8	.....
28	1.3	1.0	2.2	1.15	1.0	.8	.....
29	2.2	.....	2.1	1.5	1.0	.8	.....
30	2.0	.....	2.05	1.4	.9	.8	.....
31	1.9	.....	2.0	.....	1.1	.....	.....

NOTE.—Discharge probably unaffected by ice.

Rating table for Roanoke River at Roanoke, Va., 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.*
0.60	74	1.60	470	2.60	1,240	3.60	2,390
.70	96	1.70	530	2.70	1,340	3.70	2,515
.80	122	1.80	590	2.80	1,440	3.80	2,645
.90	152	1.90	655	2.90	1,550	3.90	2,775
1.00	186	2.00	725	3.00	1,660	4.00	2,905
1.10	224	2.10	800	3.10	1,780	4.20	3,175
1.20	264	2.20	880	3.20	1,900	4.40	3,445
1.30	310	2.30	960	3.30	2,020	4.60	3,715
1.40	360	2.40	1,050	3.40	2,140	4.80	3,985
1.50	415	2.50	1,140	3.50	2,265		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1896–1906. It is fairly well defined.

Monthly discharge of Roanoke River at Roanoke, Va., for 1906.

[Drainage area, 388 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	3,980	310	808	2.08	2.40
February	590	186	299	.771	.80
March	880	186	524	1.35	1.56
April	960	244	459	1.18	1.32
May	360	152	243	.626	.72
June	360	96	161	.415	.46
July 1–15	122	85	99	.255	.14

NOTE.—Values for entire year are good.

The following table gives the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge, and shows the number of days on which the flow and the corresponding horsepower were, respectively, less than the amounts given in the columns for "discharge" and "horsepower."

Discharge and horsepower table for Roanoke River at Roanoke, Va., from 1896 to 1906.

Discharge in second-feet.	Horsepower (80 per cent efficiency) per foot fall.	Number of days of deficient flow.										
		1896.[a]	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.[b]
66	6	.....	8	.....	.....	1	.....	.....	.....	.....	.....	.....
88	8	36	101	21	43	43	.....	70	6	7	2	3
110	10	111	142	39	125	66	.....	108	17	78	7	15
132	12	120	156	48	140	80	1	121	31	132	55	32
154	14	126	182	83	167	107	9	144	87	164	101	38
176	16	127	182	95	179	127	29	154	103	181	115	38
198	18	129	194	110	185	150	51	162	124	217	135	53
220	20	129	195	122	194	165	70	174	136	238	139	58
275	25	134	206	137	205	190	112	198	173	287	188	92
330	30	139	216	155	218	215	145	220	195	302	227	109

[a] July to December, 1896. [b] January to July 15, 1906.

NOTE.—The minimum flow during the period covered by the above table was 58 second-feet, giving 5.3 horsepower per foot of fall on one day in February, 1900.

ROANOKE RIVER[a] AT RANDOLPH, VA.

This station was originally established August 27, 1900. It is located on the railroad bridge about five-eighths mile southwest of the Southern Railway station at Randolph. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 104, where are given also references to publications that contain data for previous years.

The following discharge measurement was made June 8, 1906:

Width, 237 feet; area, 735 square feet; gage height, 4.20 feet; discharge, 1,440 second-feet.

Daily gage height, in feet, of Roanoke River at Randolph, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	10.3	11.5	5.75	9.85	4.65	5.6	5.95	8.5
2	8.65	10.1	5.75	7.95	4.8	5.4	5.65	6.55
3	6.6	7.5	5.6	7.15	4.9	5.4	5.3	6.4
4	12.9	6.2	5.75	6.75	4.8	5.4	5.05	6.85
5	23.6	6.2	5.85	6.45	4.65	5.6	4.85	7.1
6	19.8	6.35	5.9	6.4	4.85	5.5	4.75	7.3
7	7.65	6.3	6.15	6.15	5.15	5.45	4.75	7.1
8	6.7	6.25	6.0	5.95	5.7	5.15	4.55	6.9
9	6.75	6.25	5.85	6.35	6.05	5.25	4.55	6.7
10	6.9	7.05	5.75	7.5	5.9	5.35	4.85	7.4
11	6.85	6.85	5.85	8.95	5.55	5.1	5.25	7.5
12	6.95	6.65	5.85	9.15	5.5	5.15	5.8	.....
13	7.15	6.25	5.85	8.65	5.0	5.05	5.9	.....
14	7.25	5.7	5.75	7.3	5.05	4.95	5.65	.....
15	6.75	6.05	5.65	8.25	4.9	5.2	5.45	.....

[a] Called Staunton River in reports prior to 1905.

Daily gage height, in feet, of Roanoke River at Randolph, Va., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
16	6.55	5.85	5.65	8.2	4.85	5.2	5.25	.....
17	6.35	5.65	5.85	7.5	4.65	5.25	4.75	.....
18	6.3	5.45	8.85	7.35	4.75	5.35	4.45	.....
19	5.85	5.35	7.7	7.35	4.65	5.65	4.25	.....
20	5.4	5.35	13.0	7.4	4.65	5.15	4.4	.....
21	5.85	5.25	11.0	7.0	4.45	7.2	5.05	.....
22	5.85	5.35	9.1	6.75	4.45	9.35	5.55	.....
23	5.65	5.15	7.75	6.45	4.2	6.95	6.5	.....
24	5.75	4.95	7.05	6.45	4.1	5.1	6.15	.....
25	5.6	4.95	6.8	6.3	3.9	7.75	5.3	.....
26	5.8	4.85	6.75	5.95	4.1	7.4	4.6	.....
27	6.05	5.15	6.75	5.65	4.45	6.65	4.55	.....
28	10.6	5.35	7.15	5.6	5.75	6.35	4.25	.....
29	11.55	.....	7.35	5.25	8.9	6.65	4.5	.....
30	12.4	.....	8.75	5.0	8.3	6.25	7.45	.....
31	12.5	.....	15.6	.....	6.55	.....	7.75	.....

NOTE.—Discharge probably unaffected by ice.

DAN RIVER AT MADISON, N. C.

This station was established May 14, 1903. It is located at the Southern Railway bridge about one-fourth mile from Madison and one-half mile above the mouth of Mayo River. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 107, where are given also references to publications that contain data for previous years.

The following discharge measurement was made June 21, 1906:

Width, 142 feet; area, 374 square feet; gage height, 2.37 feet; discharge, 729 second-feet.

Daily gage height, in feet, of Dan River at Madison, N. C., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.4	3.0	2.25	3.4	1.75	1.3	1.7	3.3	3.9	2.9	2.35	2.05
2	2.15	2.6	2.0	2.75	1.85	1.2	1.65	4.0	3.1	2.7	2.3	2.0
3	2.0	2.25	1.7	2.4	1.95	1.2	2.0	4.3	2.9	2.5	2.2	2.0
4	17.9	2.0	5.4	2.4	2.0	1.15	1.85	2.6	3.1	5.9	2.15	1.95
5	5.4	2.1	3.1	2.3	2.05	1.1	1.7	2.15	2.85	3.6	2.15	1.95
6	3.7	2.3	2.65	2.25	1.7	6.1	1.6	2.15	2.5	2.9	2.15	1.9
7	2.9	2.2	2.3	2.25	2.4	1.9	1.8	1.9	2.3	3.2	2.1	1.9
8	2.75	2.1	2.1	2.05	2.15	2.0	1.5	1.9	2.2	2.9	2.1	1.85
9	2.55	2.0	2.1	2.1	1.85	1.9	4.8	1.8	2.1	2.45	2.1	1.8
10	2.35	2.2	2.0	2.7	1.5	1.8	2.9	1.8	2.05	3.1	2.05	1.8
11	2.2	2.1	1.8	2.45	1.5	2.5	1.8	1.8	1.9	2.6	2.05	2.6
12	2.25	2.0	1.75	2.1	1.5	1.85	1.45	1.6	1.8	2.1	2.15	2.2
13	4.2	2.0	1.75	2.05	1.5	2.0	1.5	5.2	5.4	2.0	2.1	1.9
14	4.8	2.0	1.7	2.0	1.45	3.6	1.5	3.1	3.5	2.0	2.1	1.9
15	3.4	1.9	2.15	3.1	1.45	3.1	1.4	5.0	2.4	1.95	2.05	1.9
16	3.0	1.8	5.3	2.8	1.4	3.5	5.0	14.9	2.1	1.9	2.15	1.85
17	2.75	1.7	3.2	2.45	1.3	4.0	2.4	15.5	2.1	2.0	2.1	1.85
18	2.4	1.8	2.6	2.25	1.3	3.2	4.5	14.3	2.1	2.3	2.0	4.4
19	2.3	1.75	2.15	2.15	1.3	2.5	2.3	5.9	2.0	9.3	2.5	3.9
20	2.2	1.7	7.4	2.1	1.25	3.9	2.3	7.6	3.5	7.5	4.6	4.2
21	2.15	1.65	4.0	2.05	1.25	2.5	6.3	4.2	2.65	5.0	3.2	4.6
22	2.0	3.2	2.8	1.95	1.25	3.3	6.5	3.2	2.4	4.2	2.8	2.9
23	10.1	2.8	2.6	1.95	1.25	2.35	6.3	2.9	3.0	3.6	2.5	2.6
24	6.6	2.25	2.45	1.9	1.2	1.8	2.4	2.7	2.85	3.2	2.3	2.2
25	4.4	2.0	2.15	1.8	1.2	3.3	4.4	2.5	2.75	3.0	2.2	2.0
26	3.2	1.9	2.7	1.75	1.15	6.2	2.1	2.65	2.4	2.9	2.2	1.85
27	6.1	1.75	2.6	1.7	2.2	2.7	1.8	3.2	2.2	2.8	2.15	1.8
28	6.4	2.65	2.5	1.7	2.0	2.0	4.2	6.1	2.0	2.7	2.1	2.0
29	4.6	.....	2.55	1.65	1.6	1.9	2.4	8.6	2.0	2.5	2.1	2.4
30	3.9	.....	2.9	1.7	1.5	1.8	7.7	7.5	2.1	2.5	2.05	2.25
31	3.4	.....	5.0	.....	1.4	.....	6.8	5.8	.....	2.4	.....	4.2

NOTE.—Discharge probably unaffected by ice.

DAN RIVER AT SOUTH BOSTON, VA.

This station was established August 27, 1900. It is located in South Boston, on the Norfolk and Western Railway bridge, which crosses the river at that place. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 109, where are given also references to publications that contain data for previous years.

The following discharge measurement was made June 9, 1906:

Width, 252 feet; area, 1,310 square feet; gage height, 213 feet; discharge, 1,850 second-feet.

Daily gage height, in feet, of Dan River at South Boston, Va., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.25	2.9	4.28	8.75	2.6	1.68	2.6	3.35	4.18	2.55	3.0	1.98
2	3.95	2.25	4.12	5.75	2.3	1.38	2.28	4.2	4.25	5.85	3.1	2.08
3	4.55	2.25	4.35	4.5	2.4	1.45	2.0	3.4	4.05	3.95	2.85	2.02
4	16.1	2.05	5.0	4.4	2.55	1.58	2.05	3.65	5.95	4.15	2.55	2.05
5	19.7	3.75	5.65	3.8	2.18	1.55	2.18	3.25	4.6	8.75	2.35	2.15
6	18.0	4.3	4.8	3.52	2.3	1.4	3.7	3.75	3.88	7.32	2.3	2.35
7	9.6	3.02	3.82	2.7	3.48	1.6	3.95	3.3	3.28	4.95	2.08	2.4
8	6.6	3.85	3.45	3.08	3.95	1.65	4.0	3.08	2.85	3.6	2.18	2.22
9	5.62	4.65	3.42	3.7	3.02	1.75	3.5	3.32	2.62	2.5	2.22	2.28
10	3.75	4.5	3.1	5.25	2.2	3.65	3.45	3.2	2.15	1.25	2.4	2.42
11	3.35	3.8	2.75	5.1	2.25	4.82	3.05	4.08	1.82	1.1	2.35	2.52
12	4.2	3.6	2.3	4.08	2.35	3.58	2.75	4.4	1.9	1.18	2.6	2.55
13	3.4	3.18	2.58	3.45	2.5	2.7	2.22	4.75	1.85	.95	2.55	2.62
14	5.0	3.18	2.9	3.88	2.18	2.12	2.28	5.45	2.15	.....	2.3	2.72
15	6.35	2.9	3.65	4.8	1.78	1.78	2.95	6.48	2.02	.....	2.52	2.6
16	4.3	2.6	5.15	5.7	1.85	1.8	3.08	7.72	2.3	.....	2.42	2.65
17	5.35	2.95	4.65	4.5	1.82	3.1	3.18	10.8	2.3	2.75	2.55	2.75
18	4.45	2.9	3.5	3.58	1.92	3.92	3.7	15.6	2.2	2.8	2.75	2.8
19	4.1	2.7	4.05	3.18	2.05	3.42	4.05	18.5	2.25	4.65	2.8	2.62
20	3.65	2.55	4.0	2.88	1.92	5.78	4.95	17.0	2.48	7.12	3.05	2.52
21	3.05	2.65	5.95	2.68	1.85	4.7	6.75	13.7	3.85	12.75	3.18	2.42
22	3.85	3.5	5.9	2.58	1.98	3.6	10.0	8.9	4.42	8.4	3.2	2.35
23	7.9	2.32	4.05	2.7	1.85	3.9	12.5	7.68	3.9	6.5	2.55	2.22
24	12.3	2.35	3.25	2.58	1.42	3.65	10.3	6.08	3.38	5.05	2.55	2.3
25	8.35	2.5	4.3	2.52	1.8	3.42	8.0	4.85	3.22	4.6	2.35	2.18
26	6.9	2.55	3.8	2.55	2.35	3.35	7.75	4.08	3.15	4.12	2.22	2.12
27	6.0	2.75	4.25	2.42	3.0	6.6	6.65	4.18	2.5	3.9	2.15	2.02
28	8.85	4.12	4.9	2.32	3.5	3.5	7.48	4.18	1.9	3.8	2.1	2.02
29	9.4	.....	4.6	2.88	3.45	2.55	5.35	4.65	2.12	3.85	2.05	2.12
30	7.68	.....	8.3	2.85	1.7	2.42	3.7	4.95	1.98	3.92	1.92	4.75
31	6.3	.....	11.3	.....	1.55	.....	3.4	4.02	.....	3.75	.....	10.7

NOTE.—Discharge probably unaffected by ice.

Rating table for Dan River at South Boston, Va., for 1903–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	1,014	2.40	2,186	3.90	3,400	6.80	6,034
1.00	1,091	2.50	2,265	4.00	3,484	7.00	6,234
1.10	1,168	2.60	2,345	4.20	3,653	8.00	7,275
1.20	1,245	2.70	2,425	4.40	3,824	9.00	8,415
1.30	1,323	2.80	2,505	4.60	3,997	10.00	9,700
1.40	1,401	2.90	2,585	4.80	4,172	11.00	11,100
1.50	1,479	3.00	2,665	5.00	4,349	12.00	12,540
1.60	1,557	3.10	2,746	5.20	4,528	13.00	14,000
1.70	1,635	3.20	2,827	5.40	4,709	14.00	15,500
1.80	1,713	3.30	2,908	5.60	4,892	15.00	17,180
1.90	1,791	3.40	2,989	5.80	5,077	16.00	19,100
2.00	1,870	3.50	3,070	6.00	5,264	17.00	21,650
2.10	1,949	3.60	3,152	6.20	5,453	18.00	24,600
2.20	2,028	3.70	3,234	6.40	5,644	19.00	27,800
2.30	2,107	3.80	3,317	6.60	5,838	20.00	31,200

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1906 and is fairly well defined. Below gage height 10.4 feet the table is the same as that published for 1904.

Monthly discharge of Dan River at South Boston, Va., for 1906.

[Drainage area, 2,750 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	30,200	2,700	7,160	2.60	3.00
February	4,040	1,910	2,750	.999	1.04
March	11,500	2,110	3,960	1.44	1.66
April	8,120	2,120	3,320	1.21	1.35
May	3,440	1,420	2,130	.774	.89
June	5,840	1,380	2,650	.963	1.07
July	13,300	1,870	4,250	1.55	1.79
August	26,200	2,730	6,410	2.33	2.69
September	5,220	1,730	2,670	.971	1.08
October	13,600	1,050	3,870	1.41	1.63
November	2,830	1,810	2,270	.825	.92
December	10,700	1,850	2,480	.902	1.04
The year	30,200	1,050	3,660	1.33	18.16

NOTE.—Values for entire year are good.

The following table gives the horsepower (80 per cent efficiency) per foot of fall that may be developed at different rates of discharge, and shows the number of days on which the flow and the corresponding horsepower were respectively less than the amounts given in the columns for "discharge" and "horsepower."

Discharge and horsepower table for Dan River at South Boston, Va., from 1900 to 1906.

Discharge in second-feet.	Horsepower, 80 per cent efficiency, per foot fall.	Number of days of deficient flow.						
		1900.[a]	1901.	1902.	1903.	1904.	1905.	1906.
385	35	.....	.....	.....	.....	1	.....	.....
440	40	.....	.....	.....	.....	3	.....	.....
495	45	.....	.....	.....	.....	4	.....	.....
550	50	.....	.....	.....	.....	6	.....	.....
660	60	.....	.....	.....	.....	15	.....	.....
770	70	5	.....	.....	.....	19	.....	.....
880	80	10	.....	.....	.....	36	.....	.....
990	90	11	.....	4	.....	46	4	.....
1,100	100	15	.....	22	.....	57	16	1
1,320	120	27	.....	64	6	89	55	4
1,540	140	47	.....	92	59	165	113	10
1,760	160	64	29	100	112	212	144	29
1,980	180	80	78	112	122	248	172	54
2,200	200	83	129	133	131	275	194	101
2,750	250	111	244	167	161	307	236	175

[a] September 1 to December 31, 1900.

NOTE.—Minimum flow from September 1, 1900, to December 31, 1906, was 375 second-feet, giving 34 horsepower per foot of fall in October, 1904.

CAPE FEAR RIVER DRAINAGE BASIN.

MISCELLANEOUS MEASUREMENT.

The following measurement was made in Cape Fear River drainage basin in 1906:

South Buffalo Creek, near Greensboro, N. C.—A measurement was made June 21, 1906, at the Southern Railway trestle about 2 miles south of Greensboro. The bench mark is the top of the upstream

end of the seventh bent cap from the left end of trestle; elevation, 29.50 feet above datum of the assumed gage.

Width, 16 feet; area, 12 square feet; gage height, 1.22 feet; discharge, 7.6 second-feet.

YADKIN, OR PEDEE, RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Yadkin River, called Pedee River, below the junction with the Uharie, rises on the eastern slope of the Blue Ridge, in Caldwell and Watauga counties, N. C., and flows at first southeastward, then turns abruptly to the northeast, and after flowing in this direction for about 60 miles again bends abruptly and flows southward and southeastward across North Carolina and South Carolina, emptying into Winyah Bay at Georgetown, S. C. The total length of the stream from source to mouth, in its general direction, is from 275 to 300 miles, but with all the windings it is probably 400 miles or more.

The Pedee drains a total area of about 17,000 square miles, of which 9,700 square miles are in North Carolina and 7,300 in South Carolina. It crosses the fall line near Cheraw, S. C., in a series of rapids extending over a number of miles, with no very great fall at any one place or in any short distance.

The upper part of the drainage basin is rough and mountainous and is largely forest covered, and throughout this part of its course the flow of the stream is more constant than would be expected. Below the great bend, where the river turns to the south, the valley averages about 50 miles in width. At many points the river is bordered by wide expanses of bottom lands, which are fertile and very productive, but are at times subject to overflow. At other places the stream is confined between bold and abrupt banks, and in one place it flows for several miles in a narrow channel, parts of which are only 60 feet wide, in a deep ravine between the flanking hills, forming the noted "Narrows." Above the great bend the valley is from 15 to 20 miles wide, and the elevations of the divides which separate the basin of the Yadkin from adjacent drainage basins are much higher, so that the tributary streams have a large fall.

Small amounts of power may be developed on some of the tributaries of this river in South Carolina, but the power possibilities of the basin in this State are unimportant. In North Carolina both the main stream and many of its tributaries can be made to furnish power in large amount at a number of places, and for this reason they are among the most important power streams in the Southern States.

The average rainfall over the part of the basin in North Carolina is probably between 48 and 51 inches, approximating the smaller figure over the lower portions, and possibly exceeding the larger over

the higher and more mountainous portions, the precipitation increasing toward the head of the stream. The total amount is rather evenly distributed among the seasons.

What is said to be the highest flood ever known at Wilkesboro occurred in March, 1899, the stream rising 28 feet above low water. The greatest flood recorded at the gaging station at Salisbury occurred in December, 1901, the stream reaching an extreme height on the gage of 19.7 feet and having a probable discharge of about 130,000 second-feet, or about 38 second-feet per square mile. The flood of March, 1899, produced a rise of about 1 foot less than this flood of December, 1901. The most destructive flood ever experienced on the river occurred in May, 1901, but the recorded gage height at the Salisbury station was less for this flood than for either of the others mentioned, and the general testimony of those living along the banks is to the same effect.

The minimum recorded flow at the Salisbury station occurred in September, October, and November, 1897, when the basin experienced the most severe drought in its history. The flow fell to 900 second-feet several times during this period, i. e., the basin above the station was discharging at an average rate of 0.26 second-foot per square mile. The maximum flow is thus about 144 times the minimum.

The United States Weather Bureau maintains river stations on the Pedee at Cheraw and at Smiths Mills, S. C.

YADKIN RIVER NEAR SALISBURY, N. C.

This station was established September 24, 1895. It is located at the Piedmont toll bridge, about 6 miles east of Salisbury, N. C.

The bridge is a five-span steel structure situated 300 yards above the Southern Railway bridge. The channel curves to the right a short distance below the bridge. The bed is rocky. The discharge is modified considerably at times by drift wood lodging against the piers.

Discharge measurements are made from the bridge to which the gage is attached. The gage was first established on the railroad bridge 300 yards below. In 1899 a gage was put on the toll bridge, and this was used until 1903, when the station was moved back to the railroad bridge. In the latter part of 1905 simultaneous readings of the gages on both bridges were commenced and continued during the greater part of 1906. This was to determine the relation between the two gages, as it was finally decided to continue the gage readings from the toll bridge. All 1906 gage heights refer to the toll-bridge gage.

The gage is of the standard chain type, fastened to the downstream lower chord in the second span from the left end. The chain length

is 26.87 feet. The gage is read once each day by J. V. Yarbrough, the toll collector. The reference point is the top of the downstream end of the first floor beam of the second span from the right bank; elevation, 23.14 feet above the gage zero. The bench mark is a standard copper plug set in a rock on right bank on the upstream side of the road, 5 feet from the tollgate and 6.4 feet upstream from the upstream side of bridge produced; elevation, 31.49 feet above the datum of the toll-bridge gage.

Discharge measurements of Yadkin River near Salisbury, N. C., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 3	F. C. Murphy	462	2,220	2.58	3,430
June 22	W. E. Hall	475	2,380	3.10	5,050
September 11	do	474	2,440	3.04	4,970

Daily gage height, in feet, of Yadkin River near Salisbury, N. C., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.8	3.55	2.6	4.8	2.75	2.2	2.5	3.95	9.8	3.55	2.9	2.85
2	2.65	3.35	2.55	3.9	2.8	2.15	2.55	5.3	6.7	3.2	2.9	2.95
3	2.4	3.2	2.5	3.35	2.85	2.3	2.3	5.7	4.2	3.3	2.85	2.9
4	8.4	3.0	2.7	3.15	2.85	2.35	2.7	4.1	5.0	4.0	2.95	2.8
5	9.1	3.0	4.0	3.0	2.95	2.75	4.2	3.45	4.2	4.8	2.9	2.8
6	5.1	3.0	3.2	2.95	3.0	3.0	2.9	3.15	3.65	4.0	2.8	2.8
7	3.7	2.9	2.9	2.9	2.85	2.75	2.5	2.9	3.4	3.7	2.8	2.75
8	3.2	2.8	2.8	2.9	3.55	2.45	2.8	2.8	3.25	3.5	2.8	2.8
9	3.05	2.8	2.8	2.85	3.05	2.35	3.6	2.75	3.2	3.15	2.75	2.8
10	2.85	2.85	2.8	2.9	2.65	2.7	4.4	2.65	3.1	3.05	2.75	2.8
11	2.7	2.8	2.7	3.0	2.5	4.6	3.3	2.55	2.95	3.1	2.9	3.1
12	3.0	2.7	2.7	2.8	2.4	3.8	2.7	2.55	2.95	2.95	2.85	3.35
13	4.0	2.6	2.5	2.65	2.55	3.0	2.45	2.55	3.15	2.8	2.75	3.1
14	3.85	2.6	2.5	2.65	2.55	3.9	2.35	2.65	4.2	3.0	2.75	2.9
15	3.7	2.65	2.6	2.85	2.35	5.0	2.4	3.6	3.4	2.8	2.75	2.8
16	3.5	2.55	5.4	3.6	2.3	5.9	2.8	5.4	3.1	2.75	2.85	2.85
17	3.2	2.5	4.6	3.5	2.35	5.8	4.6	8.2	2.8	2.75	2.85	2.85
18	3.0	2.6	3.55	3.05	2.25	4.5	3.4	5.6	2.8	2.8	2.85	3.1
19	2.85	2.65	3.15	2.85	2.25	4.0	3.2	4.8	2.95	3.7	3.0	3.4
20	2.75	2.5	5.5	2.7	2.35	3.4	3.05	3.8	3.4	9.4	8.5	3.2
21	2.75	2.45	5.0	2.65	2.4	3.4	3.9	4.0	3.2	7.1	7.2	3.5
22	2.75	2.9	3.8	2.75	2.2	2.95	6.9	4.0	3.0	4.8	4.1	3.4
23	4.8	3.0	3.3	2.75	2.2	3.3	6.4	3.85	3.5	4.1	3.65	3.2
24	9.0	2.9	3.05	2.35	2.2	2.7	5.0	3.55	3.5	3.7	3.35	3.0
25	5.5	2.7	3.1	2.3	2.2	3.1	3.85	3.25	3.5	3.5	3.25	2.8
26	4.3	2.7	3.1	2.25	2.15	3.45	5.7	3.15	3.0	3.35	3.2	2.55
27	4.7	2.5	3.0	2.25	2.35	3.8	4.2	3.25	2.8	3.25	3.05	2.5
28	7.2	2.55	2.95	2.5	2.8	3.0	5.9	3.65	2.85	3.15	3.05	2.9
29	6.4	.....	3.05	2.6	2.7	2.7	3.55	4.8	3.15	3.15	3.0	2.95
30	4.8	.....	3.4	2.65	2.4	2.7	3.35	10.9	3.25	3.0	2.9	3.0
31	4.0	.....	4.4	.....	2.25	.....	4.2	11.9	.....	3.0	.....	3.15

Rating table for Yadkin River near Salisbury, N. C., 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	1,990	3.30	5,860	4.60	10,830	6.80	20,950
2.10	2,220	3.40	6,220	4.70	11,240	7.00	22,060
2.20	2,460	3.50	6,580	4.80	11,650	7.20	23,210
2.30	2,720	3.60	6,950	4.90	12,070	7.40	24,400
2.40	2,990	3.70	7,320	5.00	12,490	7.60	25,600
2.50	3,270	3.80	7,700	5.20	13,340	7.80	26,800
2.60	3,560	3.90	8,080	5.40	14,210	8.00	28,000
2.70	3,860	4.00	8,460	5.60	15,090	9.00	34,000
2.80	4,170	4.10	8,850	5.80	15,990	10.00	40,000
2.90	4,490	4.20	9,240	6.00	16,910	11.00	46,000
3.00	4,820	4.30	9,630	6.20	17,860	12.00	52,000
3.10	5,160	4.40	10,030	6.40	18,850		
3.20	5,510	4.50	10,430	6.60	19,880		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1901–1906. It is well defined between gage heights 2 feet and 11 feet. Above gage height 7.30 feet the rating curve is a tangent, the difference being 60.0 per tenth. Measurements made at the railroad bridge have been referred to the toll bridge gage by means of a series of simultaneous readings. This table refers to the toll bridge gage.

Monthly discharge of Yadkin River near Salisbury, N. C., for 1906.

[Drainage area, 3,400 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
January	34,600	2,990	10,300	3.03	3.49
February	6,760	3,130	4,190	1.23	1.28
March	14,600	3,270	6,020	1.77	2.04
April	11,600	2,590	4,630	1.36	1.52
May	6,760	2,340	3,460	1.02	1.18
June	16,400	2,340	6,230	1.83	2.04
July	21,500	2,720	7,540	2.22	2.56
August	51,400	3,420	10,900	3.21	3.70
September	38,800	4,170	7,630	2.24	2.50
October	36,400	4,010	7,700	2.26	2.61
November	31,000	4,010	6,140	1.81	2.02
December	6,580	3,270	4,720	1.39	1.60
The year	51,400	2,340	6,620	1.95	26.54

NOTE.—Values for 1906 are excellent.

YADKIN RIVER AT NORTH WILKESBORO, N. C.

This station was established April 10, 1903. It is located at the lower highway bridge between Wilkesboro and North Wilkesboro, about one-half mile below North Wilkesboro railroad station and three-fourths mile below the mouth of Reddie River. The conditions at this station and the bench marks are described in Water-Supply Paper No. 167, page 118, where are given also references to publications that contain data for previous years.

Discharge measurements of Yadkin River at North Wilkesboro, N. C., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 19	W. E. Hall	101	629	3.00	2,300
June 19	do	101	619	2.94	2,260

Daily gage height, in feet, of Yadkin River at North Wilkesboro, N. C., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.65	2.35	1.1	2.95	1.15	0.65	1.1	3.7	4.6	3.8	2.45	2.35
2	.65	2.1	1.0	2.35	1.25	1.2	1.0	4.3	3.6	3.7	2.4	2.35
3	4.6	1.75	1.15	2.0	1.15	.75	1.1	3.2	3.1	7.0	2.4	2.3
4	5.8	1.5	4.3	1.8	1.5	.65	2.0	2.6	2.9	7.0	2.35	2.25
5	2.85	1.65	2.5	1.65	1.8	1.4	1.15	2.2	2.9	5.1	2.3	2.2
6	2.0	1.6	1.9	1.6	1.25	3.1	3.0	1.9	2.6	4.3	2.3	2.2
7	1.5	1.45	1.65	1.45	4.8	1.4	1.55	1.9	2.55	3.7	2.2	2.2
8	1.35	1.35	1.6	1.4	1.9	1.05	1.15	1.7	2.4	3.3	2.2	2.1
9	1.2	1.35	1.45	1.35	1.5	1.3	2.4	1.5	2.25	3.0	2.2	2.1
10	.95	1.25	1.3	1.65	1.3	1.4	1.45	1.4	2.1	3.0	2.1	2.1
11	.95	1.2	1.15	1.3	1.2	2.5	1.15	1.5	2.0	2.75	2.1	2.7
12	3.1	1.25	1.15	1.25	1.1	1.2	1.05	1.25	2.0	2.65	2.2	2.2
13	2.2	1.25	1.1	1.2	1.05	2.1	1.05	1.85	2.35	2.6	2.1	2.1
14	3.1	1.2	1.1	1.2	1.0	6.3	.95	2.15	2.15	2.5	2.0	2.1
15	2.6	1.15	2.7	4.2	.9	7.4	2.3	6.2	1.9	2.4	2.15	2.0
16	2.2	1.1	2.8	2.4	.85	5.5	5.0	4.0	1.9	2.4	2.1	2.0
17	1.8	1.0	2.0	1.9	.85	4.7	2.25	3.7	1.85	2.6	2.05	2.1
18	1.6	1.0	1.6	1.65	.8	3.8	2.5	3.7	1.85	2.9	2.85	2.4
19	1.45	1.0	1.65	1.55	.9	3.4	1.9	3.0	3.8	17.9	18.8	2.1
20	1.3	1.0	2.9	1.45	.8	2.6	1.65	2.4	2.9	7.9	7.0	2.5
21	1.2	1.0	2.2	1.4	.75	2.0	1.95	3.5	2.6	4.9	4.6	2.35
22	1.4	1.75	1.9	1.35	.7	2.7	3.0	3.3	2.65	4.1	3.8	2.2
23	12.3	1.15	1.6	1.35	.7	1.7	2.25	3.3	2.9	3.6	3.3	2.15
24	5.0	1.1	1.5	1.2	.7	1.6	2.6	2.4	3.2	3.3	3.0	2.0
25	3.3	1.1	1.5	1.15	.65	2.6	4.4	2.1	2.35	3.15	2.8	1.5
26	2.8	1.1	1.5	1.15	.75	1.7	2.1	2.15	2.15	3.0	2.75	1.7
27	3.3	1.1	1.5	1.15	1.95	1.4	2.6	2.35	2.75	2.9	2.55	1.9
28	4.0	1.15	1.5	1.15	1.3	1.25	2.3	3.4	3.0	2.75	2.65	1.9
29	3.6	.....	1.45	1.05	.9	1.25	1.75	18.0	6.6	2.65	2.45	2.1
30	2.9	.....	4.6	1.6	.75	1.25	2.95	9.2	4.4	2.6	2.35	2.0
31	2.6	.....	4.3	.....	.7	.....	2.35	7.2	.....	2.55	.....	7.6

Rating table for Yadkin River at North Wilkesboro, N. C., 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.*
−0.60	215	0.80	745	2.40	1,725	6.00	5,100
− .50	245	.90	790	2.60	1,880	7.00	6,100
− .40	275	1.00	840	2.80	2,045	8.00	7,100
− .30	305	1.10	890	3.00	2,220	9.00	8,100
− .20	340	1.20	945	3.20	2,400	10.00	9,100
− .10	375	1.30	1,000	3.40	2,580	11.00	10,100
.00	410	1.40	1,055	3.60	2,760	12.00	11,100
.10	450	1.50	1,115	3.80	2,950	13.00	12,100
.20	490	1.60	1,175	4.00	3,140	14.00	13,100
.30	530	1.70	1,240	4.20	3,330	15.00	14,100
.40	570	1.80	1,305	4.40	3,520	16.00	15,100
.50	610	1.90	1,370	4.60	3,710	17.00	16,100
.60	655	2.00	1,440	4.80	3,900	18.00	17,100
.70	700	2.20	1,580	5.00	4,100	19.00	18,100

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1906. Owing to changing conditions of flow, it can not be considered as very well defined. Above gage height 4.8 feet, the rating curve is a tangent, the difference being 100 per tenth.

Monthly discharge of Yadkin River at North Wilkesboro, N. C., for 1905–6.

[Drainage area, 500 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Sec.-ft. per sq. mile.	Depth in inches.
1905.					
January	3,330	215	720	1.44	1.66
February	2,860	340	929	1.86	1.94
March	1,060	570	740	1.48	1.71
April	2,950	530	772	1.54	1.72
May	3,240	510	1,010	2.02	2.33
June	1,720	410	585	1.17	1.30
July	11,600	530	1,680	3.36	3.87
August	3,420	530	1,200	2.40	2.77
September	6,000	490	819	1.64	1.83
October	2,950	490	608	1.22	1.41
November	510	450	485	.970	1.08
December	7,200	470	1,290	2.58	2.97
The year	11,600	215	903	1.81	24.59
1906.					
January	11,400	677	2,160	4.32	4.98
February	1,690	840	1,020	2.04	2.12
March	3,710	840	1,460	2.92	3.37
April	3,330	865	1,230	2.46	2.74
May	3,900	677	986	1.97	2.27
June	6,500	677	1,840	3.68	4.11
July	4,100	815	1,550	3.10	3.57
August	17,100	972	2,900	5.80	6.69
September	5,700	1,340	2,110	4.22	4.71
October	17,000	1,720	3,270	6.54	7.54
November	17,900	1,440	2,520	5.04	5.62
December	6,700	1,120	1,710	3.42	3.94
The year	17,900	677	1,900	3.79	51.66

NOTE.—Values are rated as follows: 1905 and 1906, fair; discharge above 4,000 second-feet, approximate.

MISCELLANEOUS MEASUREMENTS IN YADKIN RIVER DRAINAGE BASIN.

The following miscellaneous discharge measurements were made in Yadkin River drainage basin in North Carolina in 1906:

Date.	Stream.	Locality.	Width.	Area of section.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 19	Reddie	North Wilkesboro	70	134	2.60	270
June 21	Mayo	Madison	80	410	2.82	485

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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 203.]

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 may be obtained, free of charge (except classes 2, 7, and 8), on application.

2. A certain number are delivered to Senators and Representatives in Congress, for distribution.

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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