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SURFACE WATER SUPPLY
OF
LOWER WESTERN MISSISSIPPI RIVER DRAINAGE
1906

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DISTRICT HYDROGRAPHERS

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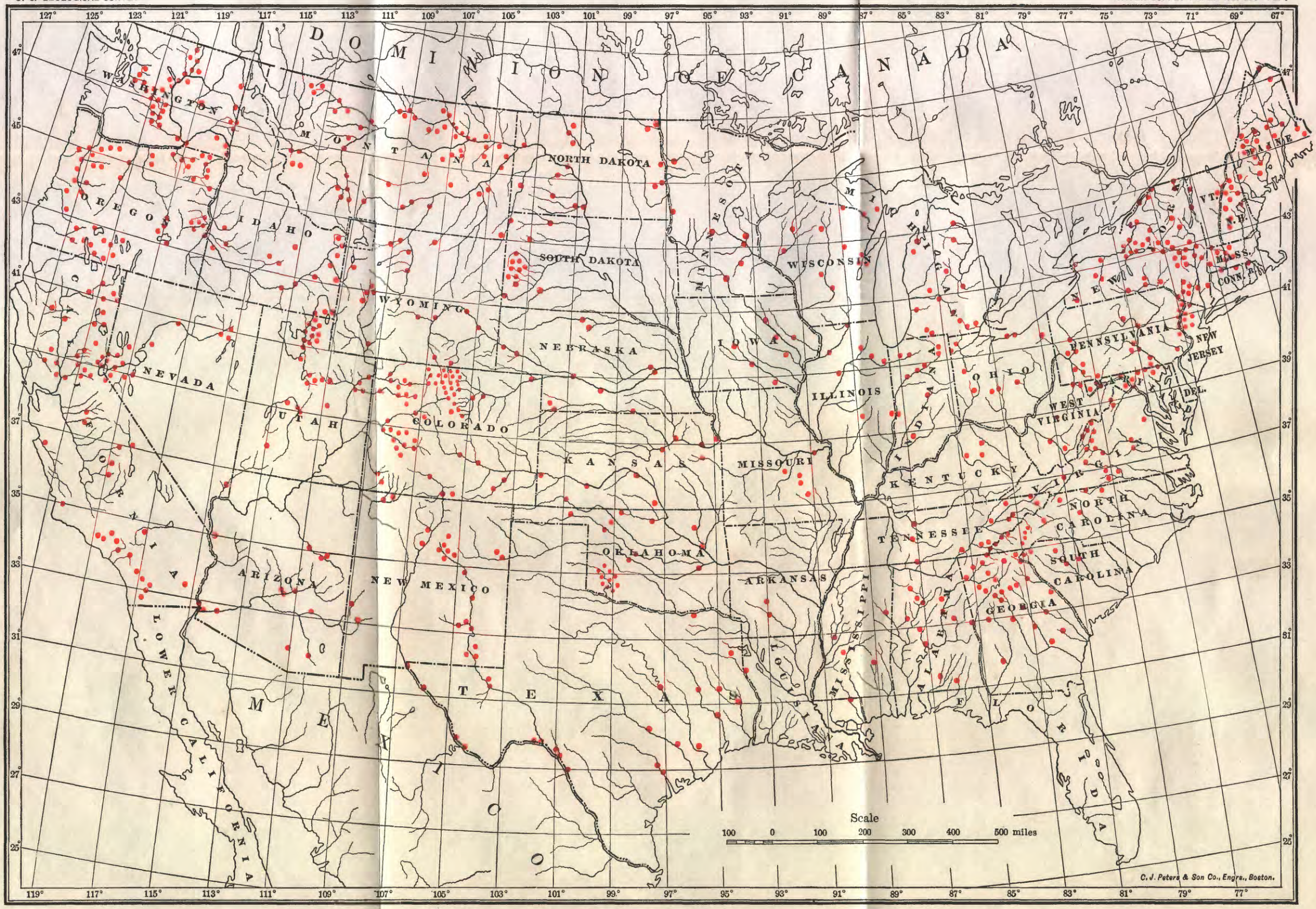

MAP OF UNITED STATES SHOWING LOCATION OF PRINCIPAL RIVER STATIONS MAINTAINED DURING 1906.

SURFACE WATER SUPPLY OF THE LOWER WESTERN MISSISSIPPI RIVER DRAINAGE, 1906.[a]

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District Hydrographers.[b]

INTRODUCTION.

SCOPE OF WORK.

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

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

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

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

In the southern portion of the territory the work was under the direction of J. M. Giles, assisted by W. A. Lamb, E. Patterson, and E. R. Kirby. In the northern and western portions the work was under the direction of M. C. Hinderlider during the first half of the year and under R. I. Meeker during the last half of the year.

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

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

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

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

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

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

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

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

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

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

DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet

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

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

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

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

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

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

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

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

EXPLANATION AND USE OF TABLES.

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

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

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

The discharge-measurement table gives the results of the discharge

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

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

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

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

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

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

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

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

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

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

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

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

CONVENIENT EQUIVALENTS.

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

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

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

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

FIELD METHODS OF MEASURING STREAM FLOW.

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

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

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

Slope method.—Much information has been collected relative to

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

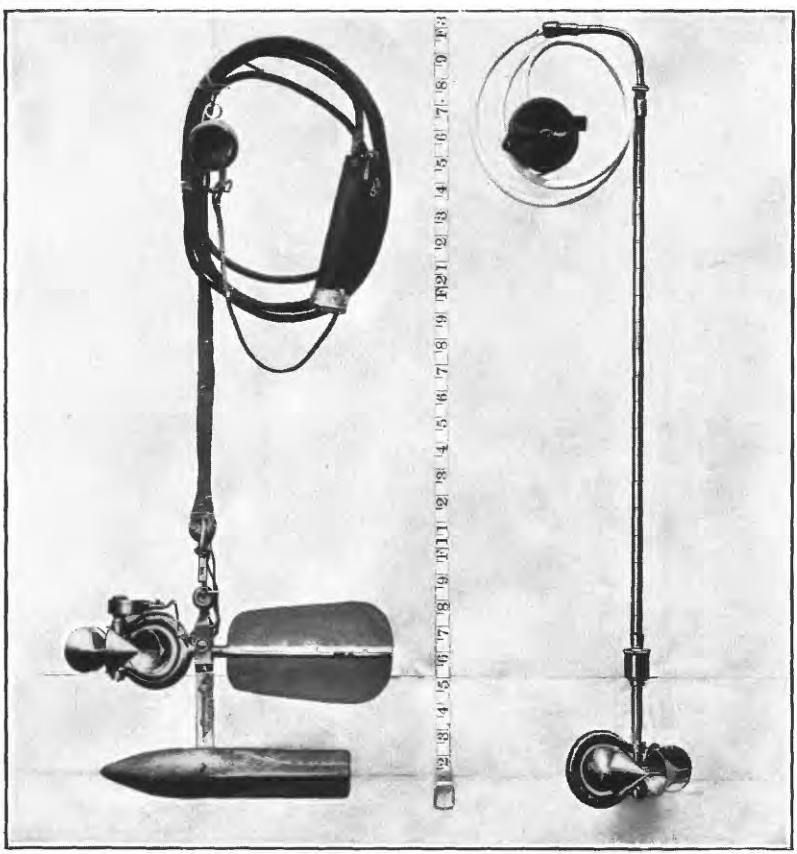
The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is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

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

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

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

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



B. PRICE CURRENT METERS.

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

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

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

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

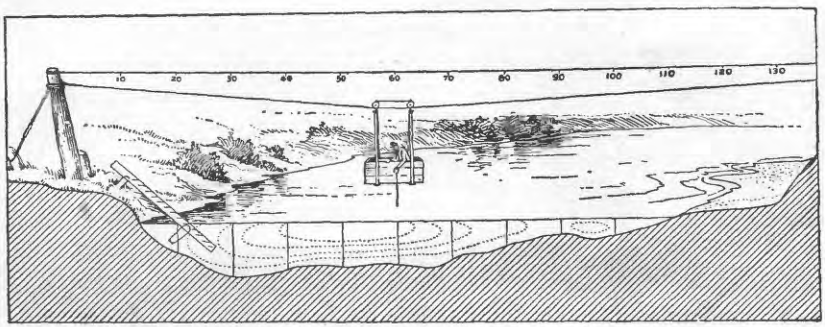


FIG. 1.—Cable station, showing section of river, car, gage, etc.

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

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

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

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

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

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

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

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

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

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

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

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

OFFICE METHODS OF COMPUTING RUN-OFF.

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

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

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

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

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

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

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

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

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

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

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

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

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

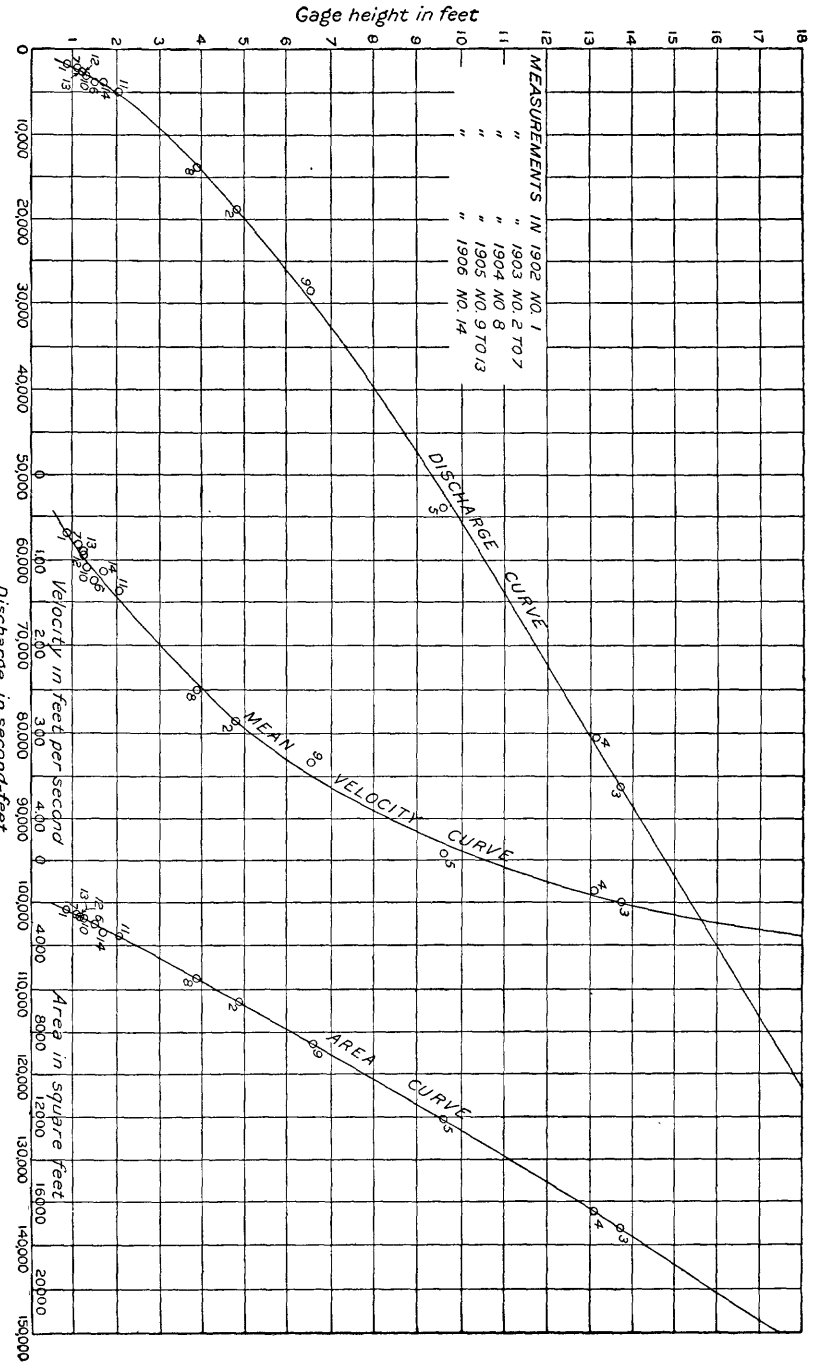


FIG. 2.—Discharge, area, and mean-velocity curves of Potomac River at Point of Rocks, Md.

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

COOPERATION AND ACKNOWLEDGMENTS.

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MERAMEC RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Meramec River rises in Dent County, Mo., flows northeast, and enters the Mississippi near St. Louis. This river drains a rugged, hilly, and comparatively thinly populated country. There are, however, numerous good sites for dams, and the United States Geological Survey is studying the river in connection with the possible water-power developments and for its possible use as a future water supply for the city of St. Louis.

The total drainage area of Meramec River is 3,619 square miles; at Eureka it is 3,500 square miles. The drainage area above Dry Fork is 340 square miles, and that of Dry Fork is 360 square miles.

MERAMEC RIVER NEAR MERAMEC, MO.

This station was established February 28, 1903, and was discontinued July 21, 1906. It was located about 600 feet below the mouth of Spring Branch and about 1 mile from the post road between Meramec and St. James, Mo. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 13, where are given also references to publications that contain data for previous years.

Discharge measurements of Meramec River near Meramec, Mo., in 1904–1906.

Date.	Hydrographer.	Gage height.	Discharge.
1904.		*Feet.*	*Sec.-ft.*
January 27	F. W. Hanna	3.33	390
March 8	do	3.22	322
April 13	do	4.05	585
June 14	Hanna and Murphy	3.10	281
July 27	F. W. Hanna	2.91	193
August 12	do	2.80	150
September 28	Hanna and Johnson	2.90	185
1905.			
June 22	M. S. Brennan	2.79	164
July 26	do	3.60	438
September 8	do	2.79	168
October 12	do	2.92	174
December 20	do	2.96	256
1906.			
March 7	M. S. Brennan	3.70	467
May 12	do	3.02	280

Daily gage height, in feet, of Meramec River near Meramec, Mo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	3.1	4.0	4.3	6.2	3.7	3.7	2.8
2	3.3	3.9	4.2	5.8	3.5	3.5	2.8
3	4.6	3.8	4.1	4.9	3.4	3.2	2.8
4	5.9	3.7	3.9	4.6	3.3	3.1	2.8
5	4.8	3.6	3.7	4.5	3.3	3.0	2.8
6	4.1	3.4	3.7	4.4	3.3	3.0	2.8
7	3.9	3.3	3.9	4.3	3.2	2.9	2.7
8	3.8	3.35	3.8	4.1	3.2	2.9	2.7
9	3.6	3.3	3.7	4.3	3.1	2.8	2.7
10	3.6	3.3	3.7	4.1	3.1	2.8	2.7
11	3.5	3.2	3.6	4.1	3.1	2.8	2.7
12	3.5	3.3	3.6	4.1	3.05	2.8	2.7
13	3.4	4.4	3.5	4.0	3.0	2.75	2.7
14	3.4	4.2	3.7	5.1	3.0	2.7	2.7
15	3.6	4.1	3.7	4.8	2.95	2.7	2.7
16	3.5	3.9	3.7	4.5	2.9	2.7	2.8
17	3.4	3.8	3.7	4.2	2.9	2.7	3.1
18	3.3	3.7	3.6	4.0	2.9	2.7	2.9
19	3.2	3.7	3.6	3.9	2.9	2.7	2.8
20	3.2	3.7	3.5	3.8	2.9	2.8	2.7
21	5.4	3.8	3.5	3.7	2.9	2.8	2.7
22	5.7	3.7	3.8	3.7	2.85	2.8	.....
23	7.6	3.7	4.6	3.6	2.8	2.8	.....
24	7.4	5.2	4.7	3.5	2.8	3.1	.....
25	6.0	4.8	5.0	3.4	2.8	3.2	.....
26	4.8	4.7	7.2	3.3	2.8	3.1	.....
27	4.4	4.5	8.9	3.3	2.8	3.0	.....
28	4.6	4.4	6.7	3.2	2.8	2.9	.....
29	4.6	.....	5.1	3.2	2.8	2.8	.....
30	4.4	.....	4.8	3.2	2.8	2.8	.....
31	4.3	.....	5.5	.....	2.8	.....	.....

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Rating tables for Meramec River near Meramec, Mo.

FEBRUARY, 1903, TO JANUARY 20, 1904.[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.*
2.40	134	2.50	165	3.00	329	4.00	732

JANUARY 21 TO JUNE 30, 1904, AND FROM MARCH 26 TO JULY 21, 1906.[b]

2.60	150	3.50	435	4.40	840	5.60	1,465
2.70	175	3.60	475	4.50	890	5.80	1,580
2.80	200	3.70	515	4.60	940	6.00	1,700
2.90	230	3.80	560	4.70	990	7.00	2,300
3.00	260	3.90	605	4.80	1,040	8.00	2,900
3.10	290	4.00	650	4.90	1,090	9.00	3,500
3.20	325	4.10	695	5.00	1,140		
3.30	360	4.20	740	5.20	1,245		
3.40	395	4.30	790	5.40	1,355		

JULY 1, 1904, TO MARCH 25, 1906.[c]

2.70	135	3.60	430	4.50	840	5.80	1,530
2.80	160	3.70	470	4.60	890	6.00	1,640
2.90	185	3.80	510	4.70	940	6.20	1,750
3.00	215	3.90	555	4.80	990	6.40	1,870
3.10	245	4.00	600	4.90	1,040	6.60	1,990
3.20	280	4.10	645	5.00	1,090	6.80	2,110
3.30	315	4.20	690	5.20	1,200	7.00	2,230
3.40	350	4.30	740	5.40	1,310	8.00	2,830
3.50	390	4.40	790	5.60	1,420		

[a] This table is based on discharge measurements made during 1903 and is well defined.
[b] This table is based on 3 discharge measurements made during 1904, 1 in 1906, and the form of the previous curve. It is not well defined.
[c] This table is based on 8 discharge measurements made during 1904–1906 and the form of previous curves. It is well defined below gage height 3.7 feet.

Monthly discharge of Meramec River near Meramec, Mo., for 1904–1906.

[Drainage area, 340 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1904.						
January	2,180	134	424	26,100	1.25	1.44
February	435	150	229	13,200	.674	.73
March 1–24	695	260	363	17,300	1.07	.96
April 13–30	3,140	260	1,010	36,100	2.97	1.99
May	840	360	549	33,800	1.61	1.86
June	2,300	325	642	38,200	1.89	2.11
July	790	185	319	19,600	.938	1.08
August	430	160	215	13,200	.632	.73
September	185	160	172	10,200	.506	.56
October	390	148	189	11,600	.556	.64
November	160	148	155	9,220	.456	.51
December	148	148	148	9,100	.435	.50
The period				238,000		
1905.						
January	245	148	165	10,100	.485	.56
February	1,580	148	346	19,200	1.02	1.06
March	2,830	315	760	46,700	2.24	2.58
April	790	185	384	22,800	1.13	1.26
May	2,350	245	550	33,800	1.62	1.87
June	245	135	174	10,400	.512	.57
July	2,170	160	453	27,900	1.33	1.53
August	1,310	160	318	19,600	.935	1.08
September[a]	2,950	148	621	37,000	1.83	2.04
October	1,580	185	358	22,000	1.05	1.21

[a] Gage heights for September 14 and 15, 1905, in Water-Supply Paper No. 173, should be 2.8 feet.

Monthly discharge of Meramec River near Meramec, Mo., for 1904–1906—Continued.

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.						
November	1,040	280	500	29,800	1.47	1.64
December	510	185	259	15,900	.762	.88
The year	2,950	135	407	295,000	1.20	16.28
1906.						
January	2,590	245	797	49,000	2.34	2.70
February	1,200	280	557	30,900	1.64	1.71
March	3,440	390	819	50,400	2.41	2.78
April	1,820	325	729	43,400	2.14	2.39
May	515	200	270	16,600	.794	.92
June	515	175	239	14,200	.703	.78
July 1–21	290	175	193	8,040	.568	.44
The period				213,000		

NOTE.—Values 1904 to 1906 are rated as good.

MERAMEC RIVER NEAR EUREKA, MO.

This station was established August 26, 1903, and was discontinued July 21, 1906. It was located at the highway bridge on the road between Crescent and Eureka, Mo., about 1½ miles from Eureka, 2 miles below the mouth of Big River, and 2 miles above the Frisco Railroad bridge. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 14, where are given also references to publications that contain data for previous years.

Discharge measurements of Meramec River near Eureka, Mo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 5	M. S. Brennan	270	1,520	8.48	7,210
May 9	Brennan and Lane	182	692	5.05	2,460

Daily gage height, in feet, of Meramec River near Eureka, Mo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	5.5	8.2	11.3	20.1	4.9	3.9	4.0
2	5.7	7.3	13.2	19.0	4.9	4.3	3.9
3	7.8	6.8	12.1	14.2	4.9	4.7	3.8
4	10.8	6.5	10.1	11.1	4.8	4.9	3.7
5	13.9	6.0	8.6	9.4	5.1	4.6	3.7
6	11.4	5.6	7.5	8.8	5.3	4.5	3.7
7	8.5	5.3	7.0	8.2	5.2	4.4	3.6
8	7.1	5.3	6.8	8.4	5.2	4.3	3.6
9	6.5	5.2	6.8	9.2	5.0	4.5	3.6
10	6.0	5.1	6.7	8.9	4.8	6.9	3.6
11	5.7	4.9	6.5	8.7	4.7	5.9	3.6
12	5.5	4.8	6.1	7.6	4.5	4.7	3.5
13	5.4	5.0	5.8	7.1	4.4	4.3	4.4
14	5.3	6.6	5.7	8.6	4.4	4.1	4.3
15	5.2	9.3	6.1	10.9	4.3	3.9	3.8

Daily gage height, in feet, of Meramec River near Eureka, Mo., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
16	5.2	8.2	6.2	10.5	4.2	3.8	5.8
17	5.2	7.4	6.1	8.5	4.1	3.7	5.2
18	5.1	6.6	5.8	7.5	4.1	4.2	5.0
19	5.0	6.1	5.8	6.9	4.0	7.4	4.2
20	4.9	6.0	5.6	6.5	4.0	5.5	4.0
21	6.9	6.5	5.5	6.3	4.0	4.4	3.8
22	12.6	7.1	7.2	6.0	4.0	4.3	.....
23	17.5	7.4	9.4	5.8	3.9	4.2	.....
24	18.4	11.8	10.0	5.6	3.9	4.1	.....
25	11.0	12.1	10.0	5.5	3.9	6.5	.....
26	9.4	14.0	12.7	5.3	3.8	5.6	.....
27	9.0	11.1	18.2	5.2	3.9	5.0	.....
28	9.3	11.2	21.2	5.1	3.8	4.7	.....
29	9.3	.....	20.4	5.0	3.8	4.5	.....
30	9.5	.....	16.1	5.0	3.7	4.4	.....
31	9.1	.....	19.3	.....	3.8	.....	.....

Rating table for Meramec River near Eureka, Mo., for 1903–1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.60	460	4.20	1,520	5.80	3,150	8.80	6,700
2.70	490	4.30	1,610	5.90	3,260	9.00	6,960
2.80	530	4.40	1,700	6.00	3,370	10.00	8,330
2.90	580	4.50	1,790	6.20	3,590	11.00	9,790
3.00	640	4.60	1,880	6.40	3,810	12.00	11,340
3.10	710	4.70	1,980	6.60	4,030	13.00	13,090
3.20	780	4.80	2,080	6.80	4,250	14.00	15,040
3.30	850	4.90	2,180	7.00	4,470	15.00	17,040
3.40	920	5.00	2,280	7.20	4,710	16.00	19,040
3.50	990	5.10	2,380	7.40	4,950	17.00	21,040
3.60	1,060	5.20	2,490	7.60	5,190	18.00	23,040
3.70	1,130	5.30	2,600	7.80	5,430	19.00	25,040
3.80	1,200	5.40	2,710	8.00	5,670	20.00	27,040
3.90	1,280	5.50	2,820	8.20	5,920	21.00	29,140
4.00	1,360	5.60	2,930	8.40	6,180	22.00	31,240
4.10	1,440	5.70	3,040	8.60	6,440		

NOTE.—The above table is based on 22 discharge measurements made during 1903–1906 and is well defined between gage heights 2.8 feet and 6.2 feet.

Monthly discharge of Meramec River near Eureka, Mo., for 1906.

[Drainage area, 3,500 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	23,800	2,180	6,640	408,000	1.90	2.19
February	15,000	2,080	5,210	289,000	1.49	1.55
March	29,600	2,820	8,890	547,000	2.54	2.93
April	27,200	2,280	6,900	411,000	1.97	2.20
May	2,600	1,130	1,700	105,000	.486	.56
June	4,950	1,130	2,070	123,000	.591	.66
July 1–21	3,150	990	1,430	59,600	.409	.32
The period	.....	.....	.....	1,940,000	.....	.....

NOTE.—Values for 1906 are rated as good.

MERAMEC SPRING NEAR MERAMEC, MO.

This station was established February 28, 1903, and was discontinued July 21, 1906. It was located on Spring Branch, 500 feet from the spring, at a footbridge, about 1 mile from the mouth of Spring Branch and 2 miles above the mouth of Dry Fork. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 17, where are given also references to publications that contain data for previous years.

Discharge measurements of Meramec Spring near Meramec, Mo., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 15	S. K. Clapp	55	75	1.70	488
June 22	M. S. Brennan	27	41	.37	95
July 26	do	29	51	.95	203
September 8	do	27	42	.40	94
October 12	do	27	43	.52	113
December 20	do	27	41	.40	103
1906.					
March 7	M. S. Brennan	27	50	.90	202
May 12	do	27	45.6	.62	156

Daily gage height, in feet, of Meramec Spring near Meramec, Mo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	0.5	1.2	1.2	1.8	0.8	0.8	0.55
2	.5	1.1	1.1	1.8	.8	.6	.5
3	1.4	.95	1.0	1.8	.75	.65	.5
4	1.6	.9	.9	1.3	.75	.65	.5
5	1.8	.9	.9	1.2	.75	.6	.5
6	1.2	.85	.9	1.1	.8	.6	.5
7	1.0	.8	1.1	1.2	.75	.6	.5
8	.9	.75	1.0	1.2	.7	.55	.5
9	.8	.7	.95	1.1	.7	.55	.5
10	.8	.7	.95	1.2	.7	.5	.5
11	.8	.7	.9	1.0	.7	.5	.5
12	.7	.7	.9	1.0	.7	.5	.5
13	.7	1.3	.85	.95	.65	.5	.5
14	.7	1.2	.9	1.4	.6	.5	.5
15	.7	1.1	.9	1.4	.6	.5	.5
16	.7	1.0	.9	1.1	.6	.5	.5
17	.7	.95	.9	1.1	.6	.5	.5
18	.65	.9	.85	1.0	.6	.5	.5
19	.6	.8	.8	1.0	.55	.5	.5
20	.6	.8	.8	.95	.5	.5	.5
21	1.4	.9	.8	.9	.5	.5	.5
22	1.9	.9	.9	.9	.5	.5	.....
23	1.6	.9	1.2	.9	.5	.5	.....
24	1.4	1.4	1.3	.9	.5	.5	.....
25	1.3	1.3	1.3	.9	.5	.6	.....
26	1.1	1.2	1.9	.8	.5	.6	.....
27	1.1	1.3	2.3	.8	.5	.6	.....
28	1.3	1.3	1.9	.8	.5	.6	.....
29	1.3	.....	1.6	.8	.5	.6	.....
30	1.3	.....	1.5	.75	.5	.6	.....
31	1.25	.....	1.5	.....	.5	.....	.....

Rating table for Meramec Spring near Meramec, Mo., 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.*
0.20	66	0.90	202	1.60	445	2.30	795
.30	80	1.00	228	1.70	490	2.40	850
.40	96	1.10	258	1.80	535	2.50	910
.50	114	1.20	290	1.90	580	2.60	970
.60	133	1.30	325	2.00	630	2.70	1,030
.70	154	1.40	360	2.10	685	2.80	1,100
.80	177	1.50	400	2.20	740		

NOTE.—The above table is based on 8 discharge measurements made during 1905–6 and is well defined between gage heights 0.35 foot and 1.7 feet.

Monthly discharge of Meramec Spring near Meramec, Mo., for 1905–6.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.				
January	80	73	74.6	4,590
February	400	73	109	6,050
March	910	114	248	15,200
April	400	96	160	9,520
May	580	154	221	13,600
June	154	96	106	6,310
July	630	96	202	12,400
August	258	96	147	9,040
September	1,170	105	292	17,400
October	1,100	114	224	13,800
November	400	133	211	12,600
December	177	105	125	7,690
The year	1,170	73	177	128,000
1906.				
January	580	114	259	15,900
February	360	154	229	12,700
March	795	177	283	17,400
April	535	165	269	16,000
May	177	114	137	8,420
June	177	114	125	7,440
July 1–21	123	114	114	4,750
The period	.....	.....	.....	82,600

NOTE.—Values for 1905–6 are rated as good.

COURTOIS CREEK AT SCOTIA, MO.

This station was established November 11, 1904, and was discontinued July 22, 1906. It was located at Scotia, a post-office 8 miles south of Leasburg, a small town on the St. Louis and San Francisco Railroad. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 18.

Discharge measurements of Courtois Creek at Scotia, Mo., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1904.					
November 1	F. W. Hanna	.....	.....	[a] 1.05	112
1905.					
April 9	M. S. Brennan	122	167	3.00	340
May 16	Sidney K. Clapp	120	227	4.10	746
June 23	M. S. Brennan	109	81	2.13	180
July 27	.....do	115	138	3.15	426
September 9	.....do	110	99	2.57	252
October 13	.....do	111	85	2.35	199
1906.					
March 8	M. S. Brennan	123	220	3.92	636
May 10	.....do	117	143	3.17	399

[a] Refers to original gage; gage height approximately 1.65 when referred to present gage.

Daily gage height, in feet, of Courtois Creek at Scotia, Mo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	2.25	4.75	4.75	(a)	3.3	2.8	2.6
2	2.25	4.75	2.95	4.9	3.3	2.8	2.6
3	2.25	4.75	2.75	4.8	3.2	2.8	2.5
4	2.25	4.75	3.75	(a)	3.2	4.3	2.5
5	2.25	4.75	3.75	5.9	3.2	3.9	2.5
6	5.95	4.65	3.55	5.9	3.1	3.3	2.5
7	5.95	4.35	3.35	5.7	3.1	3.1	2.9
8	5.35	4.35	3.35	5.4	3.1	2.9	2.9
9	3.95	4.15	3.25	5.3	3.1	2.9	2.7
10	3.15	4.15	3.25	4.6	3.1	2.8	2.7
11	3.25	4.15	3.25	4.5	3.1	2.8	2.7
12	3.25	3.75	3.15	4.3	3.1	2.8	2.6
13	3.35	3.75	3.15	4.3	3.1	2.8	2.6
14	3.45	3.65	3.05	5.7	3.1	2.7	2.6
15	3.45	3.65	2.95	4.9	3.1	2.7	2.5
16	3.45	3.95	2.95	4.8	3.1	2.7	2.5
17	3.35	3.95	2.95	4.7	3.1	2.7	2.5
18	2.95	3.95	3.75	4.7	3.1	2.7	2.5
19	2.95	3.95	3.75	4.7	3.0	2.7	2.4
20	2.95	3.75	3.55	4.6	3.0	2.7	2.4
21	2.95	3.35	3.35	4.6	3.0	2.7	2.4
22	2.95	3.15	3.75	4.5	3.0	2.7	2.4
23	2.95	4.95	3.65	4.4	3.0	2.6	.....
24	3.75	4.95	3.65	4.4	2.9	2.6	.....
25	(a)	4.95	3.55	4.4	2.9	2.6	.....
26	(a)	3.95	4.95	3.7	2.9	2.6	.....
27	4.95	4.75	4.95	3.5	2.9	4.7	.....
28	4.95	4.75	4.75	3.5	2.9	2.9	.....
29	4.95	.....	4.75	3.5	2.8	2.8	.....
30	4.95	.....	(a)	3.3	2.8	2.7	.....
31	4.75	.....	(a)	.....	2.8	.....	.....

a Water over top of gage.

Rating table for Courtois Creek at Scotia, Mo., for 1905–6.

Gage height.	Discharge.	Gage height	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	50	2.10	170	3.20	410	4.60	945
1.10	58	2.20	186	3.30	440	4.80	1,040
1.20	66	2.30	202	3.40	470	5.00	1,140
1.30	75	2.40	218	3.50	500	5.20	1,245
1.40	85	2.50	235	3.60	535	5.40	1,355
1.50	95	2.60	255	3.70	570	5.60	1,465
1.60	105	2.70	275	3.80	610	5.80	1,580
1.70	116	2.80	300	3.90	650	6.00	1,700
1.80	128	2.90	325	4.00	690		
1.90	141	3.00	350	4.20	770		
2.00	155	3.10	380	4.40	855		

NOTE.—The above table is based on 8 discharge measurements made during 1905–6, and is well defined between gage heights 2.1 feet and 4.1 feet. Below gage height 2.0 feet it is very uncertain.

Monthly discharge of Courtois Creek at Scotia, Mo., for 1905—6.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.				
January	535	105	219	13,500
February	1,190	50	302	16,800
March 1–23	2,690	255	806	33,600
April 10–30	1,580	155	487	20,300
May (30 days)	(a)	155	786	46,800
June	1,580	105	328	19,500
July (24 days)	(a)	58	459	21,800
August (29 days)	(a)	155	409	23,500
September (27 days)	(a)	50	386	20,700
October (29 days)	(a)	275	389	22,400
November	1,580	128	453	27,000
December	380	186	262	16,100
The period				282,000
1906.				
January (29 days)	(a)	194	622	35,800
February	1,120	395	802	44,500
March (29 days)	(a)	338	565	32,500
April (28 days)	(a)	440	984	54,600
May	440	300	365	22,400
June	990	255	347	20,600
July 1–22	325	218	250	10,900
The period				221,000

a Maximum discharge occurred on days when water was over gage.

NOTE.—Gage heights as published in Water-Supply Paper No. 173 for January, February, and March are approximately 0.75 foot too high as determined by the plotting of the 1904 discharge measurement. These gage heights were corrected before the application of the rating table. All values for this station are liable to large errors owing to frequent errors in gage readings.

ARKANSAS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The western rim of the Arkansas basin is formed by three of the highest mountain ranges of Colorado—the Saguache, Sangre de Cristo, and Culebra, each having summits of more than 14,000 feet altitude. The melting of the almost perpetual snow which mantles the high peaks near the north end of this rim furnishes water for three small creeks, known, respectively, as East, Lake, and Tennessee forks, and these, uniting near Leadville, form the Arkansas.

From the junction of the forks the river flows a little east of south for about 75 miles, then turns to the east and cuts through a canyon whose perpendicular walls attain elevations of more than 2,000 feet above the water's edge, emerging finally into the plains region near Canyon. From Canyon to the Colorado-Kansas State line its general course is eastward for about 200 miles. Entering Kansas the river runs for 140 miles by general course a little south of east; it then makes a bold curve to the north, forming what is known as the Great Bend, below which it flows southeastward across Indian Territory to its junction with the Mississippi in northeastern Arkansas. The entire length of the stream from source to mouth, measured along the general course, is about 1,100 miles.

In its upper course the Arkansas is fed by numerous small streams, generally short, which lie wholly in or have their sources in the mountains. Those which head in the mountains and flow out onto the prairies are used more or less for irrigation. The most important of these tributaries are Greenhorn, Huerfano, Apishapa, and Purgatory rivers. The plains tributaries include Black Squirrel, Horse, Two Butte, and Big Sandy creeks, Salt Fork, Cimarron, Verdigris, Grand, and Canadian rivers, and scores of smaller streams. The largest of these is Canadian River.

The principal source of the water which the river bears to the plains is the precipitation along the crest of the high ranges. This is mainly in the form of snow and amounts to 20 or 30 inches each year. From the foothills to Arkansas City the precipitation ranges from 12 to 35 inches, being 25 to 35 inches in the last 100 miles below Hutchinson. The natural storage in the basin is limited to a few mountain lakes of gracial origin.

The streams of this drainage area are subject to floods of two kinds—the annual spring floods caused by the melting of the snows in the headwater regions; and floods caused by the violent storms, locally known as cloudbursts, in the foothills and plains regions. Occasionally, too, the river runs dry, and many of the tributaries are intermittent in character.

ARKANSAS RIVER.

ARKANSAS RIVER NEAR CANYON, COLO.

This station was established April 17, 1889, at the suspension footbridge at the Hot Springs Hotel, at Canyon, Colo., about 1 mile above the State penitentiary.

The station is of special importance, being located at the mouth of the canyon, at a point practically above the diversion of all water to the plains region, except the North and South Canyon ditches, both of which head above the station. During the irrigation season each of these ditches carries from 25 to 60 second-feet, according to the needs of the irrigators, and their discharge should be added to the discharge at the station in order to obtain the total run-off at the mouth of the canyon. No accurate records have been kept of the amount of water passing through these canals, although miscellaneous measurements have been made when measurements were made at the regular station. The estimated monthly discharges of Arkansas River at Canyon station do not include the water taken out by these canals. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 21, where are given also references to publications that contain data for previous years. The records cover a period of seventeen years.

Discharge measurements of Arkansas River near Canyon, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 17	R. I. Meeker	61	121	3.32	374
April 4	do	70	115	3.32	429
May 2	do	60	114	3.35	400
May 25	do	105	330	5.15	2,040
June 15	do	105	489	6.25	3,880
July 11	T. E. Brick	102	312	5.00	1,810
October 27	R. I. Meeker	80	178	3.95	697

Daily gage height, in feet, of Arkansas River near Canyon, Colo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3.0	3.3	3.2	3.5	3.45	4.95	4.85	4.4	4.0	4.0	4.0
2	3.0	3.25	3.2	3.4	3.4	5.05	4.9	4.5	4.15	4.0	4.0
3	3.15	3.25	3.2	3.4	3.4	5.0	4.95	4.45	4.3	4.0	4.15
4	3.4	3.25	3.2	3.4	3.4	4.9	4.9	4.4	4.25	4.0	4.0
5	3.2	3.15	3.2	3.3	3.45	5.0	4.95	4.3	3.95	4.0	4.0
6	3.2	3.25	3.2	3.35	3.6	5.3	4.95	4.35	3.75	4.0	3.95
7	3.25	3.25	3.15	3.45	3.65	5.35	5.0	4.3	3.7	4.0	4.0
8	3.3	3.25	3.05	3.45	3.65	5.0	5.1	4.2	3.7	3.9	3.9
9	3.3	3.25	3.1	3.4	3.85	5.0	5.05	4.2	3.65	3.85	3.85
10	3.3	3.2	3.05	3.3	4.0	5.3	4.95	4.4	3.6	3.8	3.75
11	3.3	3.2	3.15	3.35	4.0	5.85	4.85	4.5	3.65	3.8	3.7
12	3.3	3.2	3.3	3.4	4.2	6.2	4.95	4.5	3.6	3.8	3.7
13	3.3	3.2	3.25	3.4	4.4	6.65	5.1	4.25	3.5	3.8	3.65
14	3.3	3.25	3.2	3.35	4.1	6.6	5.35	3.95	3.5	3.9	3.6
15	3.3	3.4	3.3	3.4	4.25	6.1	5.4	4.0	3.6	3.85	3.6
16	3.3	3.35	3.4	3.4	4.45	6.1	4.9	4.0	3.7	3.9	3.6
17	3.3	3.25	3.3	3.45	4.6	6.05	4.7	3.85	3.8	3.8	3.55
18	3.3	3.2	3.2	3.55	5.05	5.75	4.7	3.8	3.8	3.8	3.5
19	3.4	3.2	3.25	3.9	5.1	5.3	4.7	3.8	3.7	3.7	3.5
20	3.25	3.2	3.3	4.05	5.2	5.2	4.5	3.75	3.6	3.7	3.45
21	2.95	3.2	3.3	3.7	5.25	5.35	4.4	3.7	3.6	3.85	3.35
22	2.85	3.2	3.3	3.6	5.35	5.45	4.4	3.8	3.6	3.75	3.5
23	2.9	3.25	3.35	3.7	5.62	5.45	4.4	3.9	3.6	3.7	3.65
24	3.3	3.25	3.45	3.8	5.58	5.25	4.55	3.8	3.6	3.8	3.7
25	3.35	3.25	3.6	3.75	5.2	5.05	4.7	3.75	3.6	3.85	3.7
26	3.3	3.2	3.6	3.6	4.85	4.95	4.5	3.7	3.85	3.9	3.65
27	3.3	3.25	3.6	3.6	4.8	4.85	4.6	3.7	4.4	4.0	3.6
28	3.2	3.3	3.6	3.45	4.65	4.8	4.6	3.6	4.2	4.0	3.6
29	3.25	.....	3.5	3.65	4.8	4.75	4.5	3.7	4.05	4.0	3.65
30	3.2	.....	3.5	3.6	4.9	4.75	4.4	3.95	4.0	4.0	3.5
31	3.25	.....	3.4	.....	4.85	.....	4.35	4.0	.....	4.0	.....

NOTE.—From January 1 to February 12 there was some obstruction from slush ice. Discharges have been applied as for open channel.

Rating table for Arkansas River near Canyon, Colo.

JANUARY 1 TO JUNE 17, 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.*
2.80	200	3.70	605	4.60	1,395	5.50	2,580
2.90	225	3.80	675	4.70	1,505	5.60	2,735
3.00	255	3.90	750	4.80	1,620	5.70	2,895
3.10	290	4.00	830	4.90	1,740	5.80	3,060
3.20	330	4.10	915	5.00	1,870	5.90	3,230
3.30	375	4.20	1,005	5.10	2,005	6.00	3,400
3.40	425	4.30	1,095	5.20	2,145	6.20	3,760
3.50	480	4.40	1,190	5.30	2,285	6.40	4,135
3.60	540	4.50	1,290	5.40	2,430	6.60	4,530

JUNE 18 TO NOVEMBER 30, 1906.[b]

3.30	280	4.10	825	4.90	1,685	5.70	2,870
3.40	330	4.20	915	5.00	1,815	5.80	3,040
3.50	385	4.30	1,010	5.10	1,950	5.90	3,220
3.60	445	4.40	1,110	5.20	2,090	6.00	3,400
3.70	510	4.50	1,215	5.30	2,235	6.10	3,580
3.80	580	4.60	1,325	5.40	2,385		
3.90	655	4.70	1,440	5.50	2,540		
4.00	740	4.80	1,560	5.60	2,700		

[a] This table is applicable only for open-channel conditions. It is based on 7 discharge measurements made during 1905-6 and is probably fairly accurate.

[b] This table is applicable only for open-channel conditions. It is based on 6 discharge measurements made during 1905-6 and is probably fairly accurate.

Monthly discharge of Arkansas River near Canyon, Colo., for 1906.

[Drainage area, 3,060 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	425	212	346	21,300	0.113	0.13
February	425	310	349	19,400	.114	.12
March	540	272	383	23,600	.125	.14
April	872	375	501	29,800	.164	.18
May	2,770	425	1,330	81,800	.435	.50
June	4,630	1,500	2,440	145,000	.797	.89
July	2,380	1,060	1,550	95,300	.500	.58
August	1,220	445	800	49,200	.261	.30
September	1,110	385	597	35,500	.195	.22
October	740	510	649	39,900	.212	.24
November	870	305	529	31,500	.173	.19
The period				572,000		

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

ARKANSAS RIVER AT PUEBLO, COLO.

The gaging station at Pueblo, Colo., was established in September, 1894, at the Santa Fe Avenue Bridge. Since that time continuous records have been kept up at various bridges for a period of eleven years. This station is important, being located near the head of the principal irrigated portion of Arkansas Valley and above the headgates of the larger canals. For this reason water superintendents and commissioners depend on gagings made at this station for data by which distribution of the water is made to canals below. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 24, where are given also references to publications that contain data for previous years.

Discharge measurements of Arkansas River at Pueblo, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 18	R. I. Meeker	120	132	2.42	413
April 4	do	139	118	2.28	369
May 2	do	149	130	2.35	417
May 22	E. C. Murphy and R. I. Meeker	149	343	3.93	2,120
May 25	R. I. Meeker	149	392	4.15	2,420
June 15	do	150	627	5.60	4,550
June 15	do	150	582	5.28	3,940
July 11	T. E. Brick	150	306	3.50	1,700
October 6	R. I. Meeker	65	158	2.95	908

Daily gage height, in feet, of Arkansas River at Pueblo, Colo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	2.30	2.22	2.10	2.30	2.50	3.50	3.55	2.98	2.85	2.95	3.18
2	2.45	2.25	2.10	2.45	2.40	3.65	3.58	2.95	3.05	2.95	3.20
3	2.35	2.22	2.00	2.35	2.38	3.75	3.50	3.35	3.20	3.00	3.32
4	2.40	2.25	2.00	2.30	2.30	3.65	3.50	3.15	3.22	3.00	3.32
5	2.42	2.28	2.10	2.25	2.32	3.55	3.55	3.32	3.08	3.10	3.18
6	2.48	2.35	2.05	2.20	2.58	3.82	3.40	3.20	2.52	3.05	3.18
7	2.48	2.32	2.07	2.30	2.58	4.10	3.70	3.10	2.38	3.05	3.12
8	2.48	2.30	2.07	2.38	2.52	3.68	3.85	3.00	2.28	3.05	3.25
9	2.48	2.35	2.05	2.32	2.55	3.55	3.70	2.92	2.28	3.00	3.02
10	2.45	2.38	2.05	2.18	2.75	3.58	3.55	3.88	2.22	2.90	3.10
11	2.50	2.38	2.07	2.20	2.88	4.32	3.55	3.35	2.32	2.80	3.00
12	2.52	2.25	2.07	2.45	3.02	4.95	3.38	3.25	2.85	2.72	2.98
13	2.52	2.25	2.15	2.25	3.10	5.62	3.42	3.20	2.50	3.00	2.90
14	2.55	2.35	2.10	2.25	3.00	5.88	3.70	2.90	2.42	3.10	2.92
15	2.58	2.35	2.10	2.38	2.95	5.12	4.50	3.20	2.42	3.02	2.90
16	2.58	2.40	2.25	2.40	3.12	4.68	3.95	2.88	2.65	2.98	2.90
17	2.52	2.38	2.35	2.40	3.25	4.75	3.78	2.80	2.92	3.00	2.88
18	2.45	2.30	2.40	2.30	3.40	4.40	3.60	2.70	3.10	2.92	2.85
19	2.45	2.25	2.35	2.88	3.58	3.85	3.60	2.62	2.65	2.92	2.82
20	2.48	2.22	2.30	3.25	3.88	3.62	3.52	2.65	2.75	2.92	2.75
21	2.40	2.20	2.25	2.62	4.15	3.85	3.28	2.52	2.55	3.10	2.62
22	2.30	2.20	2.20	2.42	3.92	3.95	3.15	2.50	2.50	3.00	2.78
23	2.20	2.22	2.23	2.55	4.10	3.95	3.18	2.70	2.60	2.85	2.82
24	2.28	2.18	2.17	2.60	4.45	3.85	3.75	3.22	2.50	2.95	2.80
25	2.38	2.15	2.17	2.80	4.20	3.62	3.52	3.00	2.50	3.10	2.88
26	2.38	2.15	2.37	2.65	3.75	3.42	3.35	2.65	3.10	3.15	2.82
27	2.35	2.18	2.53	2.55	3.45	3.40	3.25	2.60	3.25	3.15	2.80
28	2.35	2.20	2.53	2.35	3.42	3.32	3.28	2.45	3.30	3.20	2.78
29	2.28	.....	2.50	2.42	3.38	3.30	3.22	2.45	3.15	3.20	2.82
30	2.25	.....	2.45	2.52	3.78	3.28	3.05	2.75	2.95	3.20	2.78
31	2.25	.....	2.37	.....	3.42	.....	3.02	2.80	.....	3.15	.....

NOTE.—From January 1 to March 20 there was some obstruction from slush ice; also from November 19 to 26. Discharges have been applied as for open channel.

Rating table for Arkansas River at Pueblo, Colo., 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	200	2.90	870	3.80	1,950	4.70	3,180
2.10	240	3.00	980	3.90	2,080	4.80	3,320
2.20	290	3.10	1,090	4.00	2,210	4.90	3,460
2.30	350	3.20	1,210	4.10	2,340	5.00	3,600
2.40	420	3.30	1,330	4.20	2,480	5.20	3,890
2.50	500	3.40	1,450	4.30	2,620	5.40	4,180
2.60	580	3.50	1,570	4.40	2,760	5.60	4,470
2.70	670	3.60	1,690	4.50	2,900	5.80	4,760
2.80	770	3.70	1,820	4.60	3,040	6.00	5,050

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905–6 and is fairly well defined.

Monthly discharge of Arkansas River at Pueblo, Colo., for 1906.

[Drainage area, 4,600 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	564	290	436	26,800	0.095	0.11
February	420	265	334	18,500	.073	.08
March	524	200	309	19,000	.067	.08
April	1,270	280	470	28,000	.102	.11
May	2,830	350	1,260	77,500	.274	.32
June	4,880	1,310	2,240	133,000	.487	.54
July	2,900	1,000	1,590	97,800	.346	.40
August	2,050	460	934	57,400	.203	.23
September	1,330	312	739	44,000	.161	.18
October	1,210	690	999	61,400	.217	.25
November	1,350	598	939	55,900	.204	.23
The period				619,000		

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

ARKANSAS RIVER NEAR SYRACUSE, KANS.

This station was established August 21, 1902, and was discontinued July 31, 1906. It was located on the highway bridge 1 mile south of Syracuse, Kans. The conditions and the bench marks are described in Water-Supply Paper No. 173, page 28, where are given also references to publications that contain data for previous years.

Discharge measurements of Arkansas River near Syracuse, Kans., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 19	T. E. Brick	50	25	2.00	23
June 4	W. G. Russell	39	14	1.80	12
June 26	do	145	74	2.10	80

Daily gage height, in feet, of Arkansas River near Syracuse, Kans., for 1906.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1	2.3	3.4	2.0	2.2	17	2.1	2.0	3.3	5.0
2	2.2	3.1	2.0	2.0	18	2.0	2.0	3.4	4.8
3	2.2	3.2	2.0	2.6	19	2.4	2.0	3.1	4.8
4	2.3	3.1	1.75	2.0	20	2.4	2.0	3.5	4.0
5	2.5	3.0	1.75	3.0	21	2.6	2.0	3.4	3.6
6	2.4	2.9	1.75	2.5	22	2.4	2.0	2.9	3.1
7	2.4	2.7	1.8	2.2	23	2.9	2.0	2.6	2.7
8	2.4	2.5	1.7	2.1	24	2.7	2.0	2.4	2.6
9	2.1	2.5	1.7	2.1	25	2.6	2.0	2.3	1.7
10	2.1	2.4	1.7	2.9	26	2.5	2.0	2.3	1.5
11	2.1	2.4	1.7	3.0	27	2.4	2.0	2.8	3.0
12	2.1	2.1	1.6	5.3	28	2.6	2.0	2.6	2.5
13	2.1	2.0	1.6	2.9	29	3.7	2.0	2.5	2.3
14	1.8	2.0	1.6	3.4	30	3.7	2.0	2.4	2.0
15	1.8	2.0	1.8	4.4	31	.....	2.0	.....	1.6
16	1.8	2.0	3.0	4.8					

ARKANSAS RIVER NEAR DODGE, KANS.

This station was established November 28, 1902, and was discontinued August 11, 1906. It was located one-fourth mile south of Dodge, on the highway bridge. The conditions at this station and the bench marks are described in Water-Supply Paper No. 173, page 30, where are given also references to publications that contain data for previous years. During 1906 discharge measurements were made from the Rock Island Railroad bridge, about one-half mile above the old highway bridge which had been torn down. A new gage was painted on the upstream side of the first cylinder pier from the south abutment of the new iron highway bridge. It reads from 0.8 to 7.0 feet, and is set at approximately the same datum as the old gage.

Discharge measurements of Arkansas River near Dodge, Kans., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 20	T. E. Brick	86	41	0.80	53
June 5	W. G. Russell	103	40	.90	60

Daily gage height, in feet, of Arkansas River near Dodge, Kans., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1	1.80	1.95	0.6	0.4	1.4	17	1.3	1.0	0.7	3.75	.....
2	1.7	2.5	.6	.4	1.0	18	1.3	.9	.8	4.0	.....
3	1.7	2.35	.8	.4	1.0	19	1.3	.9	.7	3.0	.....
4	1.6	2.15	.9	.3	1.0	20	1.4	.8	.9	3.0	.....
5	1.7	2.0	.75	.3	.9	21	1.6	.7	1.0	2.65	.....
6	1.75	1.95	.6	.3	.8	22	1.7	.7	.9	2.0	.....
7	1.7	1.9	.5	.3	.8	23	1.75	.6	1.2	1.9	.....
8	1.7	1.85	.5	.3	.8	24	1.75	.7	1.1	1.7	.....
9	1.7	1.8	.4	.3	.8	25	1.95	.85	1.0	1.65	.....
10	1.6	1.7	.4	.35	.8	26	1.85	.9	1.0	1.5	.....
11	1.5	1.6	.45	.4	.8	27	1.8	.8	1.0	1.6	.....
12	1.6	1.5	.4	.4	.....	28	1.8	.7	.95	1.6	.....
13	1.55	1.3	.4	.3	.....	29	1.7	.7	.9	1.8	.....
14	1.45	1.2	.4	.95	.....	30	1.6	.7	.75	1.6	.....
15	1.4	1.2	.4	1.55	.....	31	.....	.65	.....	1.5	.....
16	1.4	1.15	.4	1.45	.....						

ARKANSAS RIVER AT ARKANSAS CITY, KANS.

This station was established September 23, 1902, and was discontinued July 31, 1906. It was located on the Chestnut Avenue Bridge, one-half mile west of Arkansas City, Kans. The conditions at this station and the bench marks are described in Water-Supply Paper No. 173, page 34, where are given also references to publications that contain data for previous years.

Discharge measurements of Arkansas River at Arkansas City, Kans., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 17	W. G. Russell	241	557	4.30	836
May 21	T. E. Brick	183	198	3.30	304
June 6	W. G. Russell	235	261	3.50	444
June 27	do	106	76	2.55	97

Daily gage height, in feet, of Arkansas River at Arkansas City, Kans., for 1906.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1		5.3	3.5	2.9	17	4.3	3.4	3.3	3.5
2		5.3	3.4	3.5	18	4.3	3.5	3.3	3.3
3		5.4	3.5	3.3	19	4.2	3.4	3.3	3.1
4		5.5	3.4	3.1	20	4.0	3.5	2.8	4.0
5		4.0	3.5	3.6	21	3.8	3.3	2.8	5.2
6		4.0	3.5	3.3	22	4.0	3.2	2.6	4.1
7		3.8	3.5	3.3	23	3.8	3.3	2.5	5.4
8		3.5	3.4	3.1	24	3.7	3.8	3.0	5.5
9		3.5	3.3	3.1	25	3.6	3.7	3.0	5.2
10		3.5	5.4	3.3	26	3.5	3.5	2.9	4.9
11		3.4	5.0	3.6	27	3.5	3.6	2.5	4.7
12		3.7	5.5	4.1	28	3.4	3.4	2.8	4.2
13		3.7	4.8	3.5	29	3.4	3.3	2.6	4.0
14		3.4	4.0	3.6	30	4.4	3.3	2.5	4.0
15		3.5	3.8	3.5	31		3.2		3.9
16		3.4	3.3	3.3					

Rating table for Arkansas River at Arkansas City, Kans., 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	90	3.30	330	4.10	725	4.90	1,240
2.60	105	3.40	375	4.20	780	5.00	1,320
2.70	125	3.50	420	4.30	835	5.10	1,410
2.80	150	3.60	465	4.40	895	5.20	1,500
2.90	180	3.70	515	4.50	960	5.30	1,600
3.00	210	3.80	565	4.60	1,025	5.40	1,700
3.10	245	3.90	615	4.70	1,095	5.50	1,800
3.20	285	4.00	670	4.80	1,165		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and is well defined below gage height 4.3 feet.

Monthly discharge of Arkansas River at Arkansas City, Kans., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April (17-30)	895	375	647	18,000
May	1,800	285	589	36,200
June	1,800	90	454	27,000
July	1,800	180	642	39,500
The period				121,000

NOTE.—Values are rated as fair.

PURGATORY RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Purgatory River, a characteristic stream of eastern Colorado, is the principal tributary of Arkansas River in Colorado. It rises in the Culebra Mountains and flows northeastward across the plains for a distance of 165 miles. In the spring the channel carries a moderate volume of water, but as summer approaches this is greatly diminished by irrigation and natural conditions until the channel is practically dry. The volume of water contributed to the Arkansas is so small that it has no appreciable effect on the discharge of that river save at times of excessive rainfall, when it may discharge a large volume for a short time.

The drainage basin of Purgatory River is long and narrow. The total area is 3,386 square miles, of which 742 square miles, lying above Trinidad, are mountainous, the country being made up of shales, sandstones, and igneous rocks. This area is much broken by numerous stream channels, which are normally dry. The lower basin is largely foothill country, merging into rough plains farther east. Drainage lines are well defined throughout this area. For 60 miles of its length, commencing 25 miles below Trinidad, Purgatory River flows in a deep canyon. There are numerous small tributary canyons at various angles to the main channel.

In the mountainous portion the Weather Bureau records at Clearview for fifteen years give a mean annual rainfall of 23 inches; at Trinidad, ten years' record, 17 inches. The plains drainage has approximately a mean annual precipitation of 12 inches.

No storage is practiced on this stream, though investigations are being made by a corporation with the purpose of constructing a large storage reservoir for use in irrigation.

No power has been developed, and because of the abundance of coal in the vicinity of Trinidad it is doubtful if power development would be feasible, even under very favorable circumstances.

PURGATORY RIVER AT TRINIDAD, COLO.

This station was established May 1, 1896, at the Animas Street Bridge and was discontinued July 31, 1899, the greater portion of the water in the river being diverted above the gaging station; the channel was also shifting and results not satisfactory. July 25, 1905, the Trinidad station was reestablished at the old location on the Animas Street Bridge for the purpose of collecting general hydrographic data, especially flood data, and was maintained until December 31,

1905. It was reestablished November 1, 1906, to take the place of the station near Alfalfa, which had been discontinued for the winter. The conditions at this station and the bench marks are described in Water-Supply Paper No. 173, page 40, where are given also references to publications that contain data for previous years.

Discharge measurements of Purgatory River at Trinidad, Colo., in 1906–7.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
November 1	L. D. Bull	32	24	4.30	47
November 9	do	32	21	4.25	34
November 16	do	29	22	4.30	36
November 29	do	31	19	4.20	29
December 9	do	32	18	4.20	30
December 23 [a]	do	30	19	4.28	10
1907.					
January 5	L. D. Bull	30	16	4.15	19
January 10	do	27	13	4.02	14
January 19	do	28	14	4.10	18
January 30	do	29	17	4.20	24
February 6	do	29	14	4.05	17

[a] Measurement is about 30 per cent of the open-channel rating, owing to needle ice in the river.

Daily gage height, in feet, of Purgatory River at Trinidad, Colo., for 1906.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1	4.3	4.2	12	4.25	4.2	23	4.35	4.35
2	4.4	4.2	13	4.25	4.15	24	4.25	4.5
3	4.35	4.4	14	4.25	4.1	25	4.2	4.1
4	4.3	4.3	15	4.25	4.05	26	4.45	4.15
5	4.3	4.3	16	4.2	4.0	27	4.35	4.05
6	4.3	4.15	17	4.3	4.05	28	4.3	4.05
7	4.25	4.15	18	4.2	4.15	29	4.2	4.05
8	4.25	4.1	19	4.4	4.2	30	4.2	4.05
9	4.25	4.2	20	4.4	4.2	31		4.3
10	4.25	4.2	21	4.4	4.2			
11	4.25	4.2	22	4.55	4.3			

NOTE.—Needle ice in river during part of December.

Rating table for Purgatory River at Trinidad, Colo., 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.*
4.00	13	4.20	27	4.40	60	4.60	120
4.10	18	4.30	41	4.50	88		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1906–7 and is well defined below gage height 4.3 feet.

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Monthly discharge of Purgatory River at Trinidad, Colo., for 1906.

[Drainage area, 742 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
November	104	27	43.0	2,560	0.058	0.06
December	88	13	28.3	1,740	.038	.04
The period				4,300		

NOTE.—Values are rated as follows: November, good; December, approximate, owing to uncertainty concerning ice conditions.

PURGATORY RIVER NEAR ALFALFA, COLO.

This station was established March 23, 1905, one-eighth of a mile below the canyon entrance, 4 miles east of Alfalfa post-office, and about 25 miles east of Trinidad, in T. 33 S., R. 60 W. On November 1, 1906, it was transferred to Trinidad, Colo., for the winter months. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 41.

Discharge measurements of Purgatory River near Alfalfa, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 27	L. D. Bull	70	64	4.22	83
January 31	do	26	22	3.58	44
February 2	do	22	7	2.80	7
February 11	do	20	9	2.75	9
February 14	do	40	22	3.10	32
February 18	do	16	8	2.70	11
February 22	do	40	25	3.10	45
February 26	do	16	9	2.70	10
March 8	do	14	6.4	2.45	6.31
March 12	do	16	7.6	2.55	8.81
March 19	do	15	5.7	2.40	4.34
March 26	do	12	4.5	2.35	3.82
April 2	do	12	3.9	2.25	1.36
April 10	do	12	3.3	2.20	.81
April 16	do	12	3.6	2.20	1.59
April 22	do	38	40	3.50	95
April 28	do	42	19	2.75	24
May 6	do	30	12	2.60	11
June 4	do	20	24	2.80	37
October 9	R. I. Meeker	24	18	2.64	25
October 9	L. D. Bull	24	17	2.62	25
October 18	do	23	14	2.45	14

Daily gage height, in feet, of Purgatory River near Alfalfa, Colo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.0	3.0	2.55	2.3	2.6	2.2	2.6	3.5	2.3	2.7
2	3.0	2.8	2.5	2.25	2.6	4.56	10.05	3.7	2.3	2.7
3	3.0	2.8	2.45	2.25	2.6	3.55	3.2	3.55	4.65	2.7
4	2.95	2.8	2.45	2.2	2.5	2.85	2.8	3.3	3.8	2.7
5	2.95	2.8	2.45	2.2	2.4	2.62	2.9	3.0	3.6	2.7
6	2.95	2.8	2.45	2.2	2.5	2.35	3.0	5.95	2.9	2.7
7	2.95	2.8	2.45	2.2	2.5	2.3	2.7	4.0	2.7	2.7
8	2.9	2.8	2.45	2.2	2.5	2.2	2.7	3.55	2.7	2.9
9	2.9	2.8	2.45	2.2	2.45	2.15	4.8	3.2	2.6	2.6
10	2.9	2.8	2.45	2.2	2.4	2.1	3.76	5.0	2.6	2.45

Daily gage height, in feet, of Purgatory River near Alfalfa, Colo., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
11	2.9	2.8	2.6	2.2	2.4	2.1	3.28	4.1	2.45	2.4
12	2.9	2.8	2.55	2.2	2.35	4.48	2.85	3.8	2.4	2.4
13	2.9	3.1	2.55	2.4	2.35	3.5	2.75	3.6	2.35	2.35
14	3.35	3.15	2.9	2.3	2.56	3.5	2.7	3.3	2.3	2.5
15	3.35	3.05	2.8	2.25	2.4	3.6	6.84	3.0	2.3	2.5
16	3.35	2.9	2.7	2.2	2.3	3.6	8.3	2.95	2.3	2.45
17	3.35	2.9	2.6	2.2	2.3	3.55	5.32	2.8	2.3	2.4
18	3.3	2.7	2.5	2.2	2.3	3.6	6.6	2.8	3.0	2.35
19	3.3	2.7	2.4	2.5	2.51	3.25	4.95	3.65	2.75	2.3
20	3.3	2.7	2.5	2.8	2.3	2.92	4.7	3.4	2.55	2.3
21	3.3	3.0	2.5	3.3	3.3	2.8	4.3	3.3	2.4	2.4
22	3.35	3.1	2.5	3.55	3.0	2.7	7.2	2.8	2.35	2.65
23	3.4	3.0	2.5	3.32	3.0	6.1	7.1	2.7	2.3	2.65
24	3.6	2.95	2.5	3.18	2.8	3.5	8.36	3.45	3.2	2.75
25	3.8	2.85	2.4	2.82	2.5	3.1	6.3	2.8	2.6	2.95
26	3.9	2.7	2.35	2.7	2.4	2.85	4.3	2.8	3.7	2.8
27	4.2	2.6	2.45	2.8	2.3	2.75	4.1	2.5	4.35	2.6
28	4.0	2.6	2.4	2.75	2.3	2.65	4.0	2.4	3.15	2.6
29	3.95	.....	2.35	2.85	2.4	2.6	3.7	2.4	2.85	2.55
30	3.6	.....	2.3	2.7	2.3	2.6	3.6	2.3	2.8	2.45
31	3.35	.....	2.3	.....	2.2	.....	3.55	2.3	.....	2.4

NOTE.—This station transferred to Trinidad on November 1 for the winter months.

Daily discharge, in second-feet, of Purgatory River near Alfalfa, Colo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1	13	13	6	2	13	17	30	20	10	1.6	4
2	13	7	5	1.4	13	18	27	11	7	1.6	5
3	13	7	3	1.4	12	19	27	11	4	11	13
4	12	7	4	1	8	20	27	13	7	27	5
5	12	9	4	1	5	21	27	34	7	73	70
6	12	9	5	1	7	22	30	45	7	101	44
7	12	9	6	1	7	23	32	37	7	75	44
8	10	9	6	1	7	24	44	30	7	60	29
9	10	9	6	1	6	25	56	20	4	29	16
10	10	9	6	1	6	26	62	10	3	21	11
11	10	9	10	1	6	27	81	7	6	27	7
12	10	11	9	1	5	28	68	7	4	24	7
13	10	32	9	4	5	29	65	.....	3	29	11
14	30	35	23	4	12	30	44	.....	2	20	7
15	30	28	18	3	6	31	30	.....	2	.....	4
16	30	20	14	1.6	3						

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Rating table for Purgatory River near Alfalfa, Colo., from June 1 to October 31, 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	3	3.30	76	4.50	208	6.40	695
2.20	5	3.40	85	4.60	222	6.60	778
2.30	8	3.50	95	4.70	237	6.80	865
2.40	12	3.60	105	4.80	253	7.00	955
2.50	17	3.70	115	4.90	271	7.20	1,045
2.60	23	3.80	126	5.00	290	7.40	1,145
2.70	30	3.90	137	5.20	331	7.60	1,250
2.80	37	4.00	148	5.40	377	7.80	1,360
2.90	44	4.10	159	5.60	427	8.00	1,480
3.00	52	4.20	171	5.80	483	9.00	2,140
3.10	60	4.30	183	6.00	545	10.00	2,900
3.20	68	4.40	195	6.20	618	11.00	3,780

NOTE.—The above table is based on 4 discharge measurements made during June to October, 1906, and high-water measurements of 1905. It is not well defined.

Monthly discharge of Purgatory River near Alfalfa, Colo., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	81	10	28.6	1,760
February	45	7	16.7	928
March	23	2	6.90	424
April	101	1	17.6	1,050
May	70	3	12.8	787
June	581	3	76.5	4,550
July	2,940	23	431	26,500
August	529	8	89.4	5,500
September	230	8	45.6	2,710
October	48	8	22.1	1,360
The period				45,600

NOTE.—Values are rated as approximate, owing to shifting conditions of flow.

CIMARRON RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Cimarron River rises in the Raton Mountain Range in Colfax County, N. Mex., at an elevation of nearly 7,000 feet, and flows eastward across Beaver County, in Oklahoma, then across the southwest corner of Kansas, entering Oklahoma again in Woodward County and following a southeasterly course to its junction with Arkansas River at the Indian Territory line. The basin lies between those of Arkansas and North Canadian rivers, and is within the arid belt. From west to east it is 100 miles from the source to the gaging station at Garrett, Okla., and 450 miles to its mouth; its extreme width is not more than 50 miles; its area is 5,200 square miles.

CIMARRON RIVER NEAR GARRETT, OKLA.

This station was established May 8, 1905. It is located at Strong's ranch, about 3 miles west of Garrett, Okla., 20 miles east of Kenton, and 50 miles by stage from Clayton, N. Mex., the nearest railroad station. The station is below the mouth of North Carriso and South Carriso creeks and 1 mile below the site of the proposed dam for a storage reservoir. The conditions and the bench marks are described in Water-Supply Paper No. 173, page 46.

Discharge measurements of Cimarron River near Garrett, Okla., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq.-ft.*	*Feet.*	*Sec.-ft.*
April 21	E. Patterson	14	10	0.83	15
April 21	do	13	9	.78	13
April 22	do	12	8	.69	10
April 23	do	12	7	.64	8
May 21	do	5	1.8	.37	1.8
June 22	do	11	4.5	.41	2.6
June 24	do	104	573	8.20	1,960
June 25	do	74	302	5.05	728
June 25	do	76	328	5.50	870
June 25	do	99	401	6.30	1,110
June 25	do	77	347	6.00	974
June 25	do	74	281	4.20	542
June 26	do	74	268	4.10	509
June 26	do	75	295	4.65	622
June 26	do	78	325	5.07	752
June 26	do	75	292	4.40	580
June 27	do	65	156	1.87	109
June 27	do	65	160	1.75	99
August 18	J. M. Giles	12	7	.60	7
August 19	do	12	7	.62	8
October 25	Wm. A. Lamb	22	23	1.02	32

Daily gage height, in feet, of Cimarron River near Garrett, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.85	0.85	0.5	0.4	0.55	0.4	0.9	0.85	0.95	1.4	1.0	1.0
2	.85	.85	.5	.4	.55	.4	.9	1.65	.85	1.5	1.0	1.0
3	.8	.85	.5	.4	.5	5.6	2.72	1.2	.9	1.0	1.0	1.0
4	.8	.75	.5	.45	.5	3.7	1.4	1.1	.9	1.0	1.0	1.0
5	.8	.65	.5	.4	.5	1.1	1.1	1.0	1.0	.95	1.0	1.0
6	.8	.65	.6	.4	.45	1.0	1.0	.9	.9	.9	1.0	1.0
7	.8	.6	.45	.4	.45	.8	.9	.85	.85	.9	1.0	.95
8	.8	.6	.45	.4	.45	.75	.9	.75	.8	.9	1.0	.95
9	.8	.6	.4	.4	.4	.7	2.65	.85	.7	.9	1.0	.95
10	.8	.65	.4	.4	.4	.65	2.68	1.2	.7	1.0	1.0	.95
11	.85	.65	.45	.4	.4	.6	1.78	.9	.7	.95	1.0	.95
12	.9	.7	.45	.35	.4	.6	1.0	.75	.7	.95	.95	.95
13	.95	.75	.45	.35	.4	.6	1.0	.7	.65	.95	.95	.95
14	1.0	.75	.6	.35	.4	.6	1.0	.7	7.58	1.0	.95	.95
15	1.0	.75	.55	.35	.4	.55	3.52	.65	8.2	1.0	.95	.95
16	.95	.75	.6	.35	.4	.55	4.0	1.6	3.5	1.0	.95	.95
17	.95	.75	.65	.35	.35	.55	1.7	.9	2.5	1.0	.95	.9
18	.95	.75	.65	.35	.35	.55	1.6	.65	1.5	1.0	.9	.9
19	.95	.75	.65	3.35	.35	.5	1.7	.6	1.4	1.0	.9	.9
20	.95	.7	.6	.9	.35	.45	1.0	.6	1.15	1.0	.9	.9
21	.9	.7	.6	.85	.35	.45	1.0	.85	1.0	1.0	.9	.9
22	.85	.7	.6	.7	.35	.4	.95	1.1	2.0	1.0	.9	.9
23	.75	.7	.6	.65	4.5	3.5	.9	2.1	1.4	1.0	.9	.9
24	.9	.7	.4	.6	1.1	8.5	.85	1.85	1.0	1.0	1.0	.9
25	.9	.7	.4	.55	.85	5.95	4.75	1.0	1.0	1.0	1.5	.9
26	.85	.7	.4	.55	.6	4.25	3.34	7.09	2.0	1.0	1.4	.9
27	.8	.7	.5	.5	.55	1.1	1.6	1.7	[a] 7.1	1.0	1.2	.9
28	.85	.6	.4	.5	.5	1.35	1.4	1.55	2.0	1.0	1.15	.9
29	.85	.....	.4	.55	.45	1.1	1.5	1.5	1.7	1.0	1.1	.9
30	.85	.....	.4	.55	.45	1.0	1.0	2.0	1.5	1.0	1.1	.9
31	.85	.....	.4	.....	.4	.....	.9	1.3	.....	1.0	.....	.9

[a] Maximum gage height, 12.0 feet.

Rating table for Cimarron River near Garrett, Okla., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.30	0.5	1.40	57	2.50	195	4.20	524
.40	2.5	1.50	68	2.60	211	4.40	571
.50	4.8	1.60	79	2.70	228	4.60	619
.60	7.5	1.70	90	2.80	245	4.80	669
.70	10.5	1.80	102	2.90	262	5.00	720
.80	14	1.90	114	3.00	280	6.00	1,020
.90	19	2.00	126	3.20	316	7.00	1,410
1.00	24	2.10	139	3.40	353	8.00	1,910
1.10	30	2.20	152	3.60	392	9.00	2,510
1.20	38	2.30	166	3.80	434	10.00	3,150
1.30	47	2.40	180	4.00	478		

NOTE.—The above table is based on discharge measurements made during 1906 and is well defined. It has also been applied to 1905 gage heights above 6.0 feet and the monthly discharges as recomputed are given below.

Monthly discharge of Cimarron River near Garrett, Okla., for 1905–6.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.				
May 7-31	3,380	25	307	15,200
June	2,700	14	144	8,570
July	159	5	24.5	1,510
August	1,220	6	142	8,730
September	810	5	88.1	5,240
October	14	7	10.4	640
November	68	14	19.7	1,170
December	19	8	15.4	947
The period				42,000
1906.				
January	24	12	17.4	1,070
February	16	7.5	10.9	605
March	9	2.5	5.0	307
April	344	1.5	16.0	952
May	595	1.5	23.7	1,460
June	2,210	2.5	191	11,400
July	656	16	113	6,950
August	1,460	7.5	85.7	5,270
September	2,030	9	226	13,400
October	68	19	25.6	1,570
November	68	19	26.4	1,570
December	24	19	20.9	1,290
The year	2,210	1.5	63.5	45,800

NOTE.—The above values for 1905 supersede those given in Water-Supply Paper No. 173. They are more accurate owing to the availability of new data since the first publication in the 1905 report. Values for 1905 and 1906 are rated as excellent.

MISCELLANEOUS MEASUREMENTS IN CIMARRON RIVER DRAINAGE BASIN.

Miscellaneous measurements made on Cimarron River by J. M. Giles in 1906.

Date.	Stream.	Locality.	Width.	Area of section.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 20	Cimarron River	Springer, N. Mex.	.....	82	2.00	263
August 14	do	do	46	23	1.12	27
August 15	do	do	46	21	1.10	22

CANADIAN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Canadian River rises in the mountains of Colfax County, N. Mex., flows southward across Mora and San Miguel counties, then turns east and flows across northern Texas, Oklahoma, and Indian Territory, uniting with Arkansas River about 80 miles above Fort Smith, Ark.

The drainage area is wooded in the upper portion and in Indian Territory, but consists of dry plains in Texas and Oklahoma. There are few tributaries, Ute Creek and Mora and Sapello rivers in New Mexico being the principal ones. The run-off is very uncertain, varying from extreme floods to practically nothing in a dry season.

CANADIAN RIVER AT CALVIN, IND. T.

This station was established in 1904 by the United States Weather Bureau. It is located at the railroad bridge about one-fourth mile west of Calvin, Ind. T. The conditions and the bench marks are described in Water-Supply Paper No. 173, page 58, where are given also references to publications that contain data for previous years.

Discharge measurements of Canadian River at Calvin, Ind. T., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 9	E. R. Kerby	240	281	3.20	678
January 30	J. M. Giles	207	286	3.02	309
February 27	E. R. Kerby	370	444	3.40	636
March 13	....do	95	112	2.80	200
April 27	Wm. A. Lamb	160	153	2.56	233
May 29	J. M. Giles	540	614	3.68	1,640
June 6	Wm. A. Lamb	560	1,090	4.80	3,810
June 14	....do	267	245	3.13	357
July 9	....do	115	93	2.90	94
July 14	....do	565	1,260	4.35	3,750
July 15	....do	563	1,340	4.38	4,010
July 26	....do	700	2,120	5.70	10,200
July 27	....do	658	1,840	5.28	6,560
August 14	....do	715	2,500	5.80	14,400
August 19	....do	420	1,230	3.55	4,240
August 26	J. M. Giles	655	1,620	3.90	6,000
August 26	Wm. A. Lamb	675	1,810	3.95	6,240
September 21	....do	685	1,840	3.58	6,110
October 18	....do	341	480	2.52	1,110
November 8	....do	217	245	2.30	300
December 23	....do	230	306	2.90	724
August 26[a]	Giles and Lamb	825	14,600	21.00	128,000

[a] Computed from a slope measurement made using Kutter's formula.

Daily gage height, in feet, of Canadian River at Calvin, Ind. T., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.0	2.9	3.1	3.0	4.6	5.0	3.4	4.4	3.0	2.0	2.6	3.9
2	3.1	2.8	3.5	2.8	3.9	3.6	3.4	4.3	3.0	2.3	2.5	3.5
3	3.6	2.8	3.4	3.0	4.5	3.7	3.2	4.0	2.9	2.2	2.4	3.5
4	3.7	2.7	3.2	3.1	4.1	6.7	3.1	3.9	2.8	2.3	2.4	4.1
5	3.5	3.2	3.0	5.5	3.7	5.3	3.0	4.3	2.6	2.1	2.4	4.4
6	3.3	2.8	3.0	5.0	3.2	4.8	3.0	3.9	3.7	2.0	2.3	4.4
7	3.3	2.8	3.1	4.7	3.1	4.6	2.9	14.0	2.8	2.0	2.2	3.6
8	3.2	2.7	2.9	4.7	3.1	4.4	2.9	9.8	2.9	2.0	2.2	3.1
9	3.1	2.8	2.9	4.4	3.2	4.2	2.9	7.4	2.9	2.0	2.2	3.5
10	3.2	2.7	2.9	4.0	3.0	3.8	2.9	5.4	2.8	2.0	2.2	3.5
11	3.1	2.7	2.8	3.6	2.9	3.7	2.9	4.6	2.8	1.9	2.2	3.5
12	3.0	2.7	2.8	3.5	2.8	3.3	4.1	4.5	11.1	1.8	2.1	3.3
13	3.0	3.0	2.8	4.0	2.7	3.1	3.6	5.6	7.4	2.1	2.1	3.1
14	3.2	3.0	2.7	3.6	2.7	3.1	4.5	5.9	5.0	2.1	2.2	3.0
15	3.2	2.9	2.7	3.3	2.6	3.3	4.5	4.5	4.5	2.4	2.2	3.1
16	3.1	2.9	2.6	3.1	3.0	3.8	4.6	4.1	4.1	2.8	2.2	3.0
17	3.1	2.9	2.4	3.0	3.5	3.4	3.8	3.7	4.4	2.7	2.1	3.0
18	3.7	2.9	2.8	2.9	3.0	3.8	3.8	3.4	4.2	2.5	2.1	3.0
19	3.5	3.4	3.0	3.0	2.9	3.6	4.5	3.6	4.0	3.4	2.1	2.9
20	3.5	3.7	2.8	3.1	2.8	3.5	4.6	3.4	3.9	3.1	2.1	3.3
21	3.2	3.2	2.8	3.1	2.8	3.4	4.5	3.1	3.6	2.8	2.1	3.1
22	3.2	3.0	2.8	3.3	2.8	3.3	4.1	3.0	3.3	2.8	2.2	3.0
23	2.9	3.0	2.8	3.1	3.2	3.2	3.8	2.9	3.0	2.5	2.2	2.9
24	2.8	2.9	3.0	2.8	3.9	3.1	5.4	3.2	2.9	2.3	2.2	2.9
25	3.0	3.6	3.0	2.5	3.3	3.1	5.0	3.2	2.9	2.2	2.2	2.8
26	3.2	3.4	3.3	2.5	3.1	3.1	5.5	3.9	2.7	2.2	2.2	2.8
27	3.0	3.4	3.5	2.5	4.0	3.0	5.3	3.8	2.9	2.1	2.3	3.1
28	3.0	3.2	3.6	2.3	3.3	3.0	4.6	3.4	2.6	2.2	2.5	3.0
29	3.0	.....	3.6	2.3	3.8	3.0	4.5	3.0	2.3	2.4	2.6	3.0
30	3.0	.....	3.7	4.8	3.7	3.8	5.9	2.9	2.3	2.6	2.7	3.0
31	2.9	.....	3.6	.....	3.2	.....	5.1	3.1	.....	2.4	.....	2.9

Daily discharge, in second-feet, of Canadian River at Calvin, Ind. T., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	275	175	510	390	3,500	4,950	1,000	2,975	2,250	100	460	2,450
2	460	100	1,200	200	1,940	1,360	1,000	2,750	2,250	400	400	1,600
3	1,590	100	1,000	390	3,210	1,550	670	2,140	1,980	250	340	1,600
4	1,830	75	670	510	2,330	21,700	510	1,940	1,710	400	340	3,000
5	1,340	450	390	8,200	1,550	6,700	390	2,750	1,280	200	340	3,950
6	880	100	390	4,950	675	4,140	390	1,940	4,950	100	300	3,950
7	880	100	500	3,800	360	3,500	275	65,700	1,700	100	240	1,800
8	690	75	280	3,800	360	2,980	275	32,600	1,980	100	240	975
9	475	100	280	2,960	660	2,550	275	22,800	1,980	100	240	1,600
10	690	75	280	2,140	390	1,740	275	12,500	1,700	100	240	1,600
11	475	75	200	1,360	275	1,550	275	8,820	1,700	50	240	1,600
12	275	75	200	1,200	200	830	2,330	8,410	47,800	25	200	1,270
13	275	300	200	2,140	130	500	1,350	13,500	22,800	175	200	975
14	690	300	130	1,360	130	500	3,210	14,900	11,500	175	240	850
15	690	200	130	825	90	830	3,210	8,400	9,400	350	240	975
16	475	200	100	510	390	1,740	3,500	6,800	7,870	625	240	975
17	475	200	30	390	1,200	1,000	1,740	5,000	9,000	540	200	850
18	1,830	200	200	275	390	1,740	1,740	3,600	8,250	400	200	850
19	1,340	640	390	390	275	1,360	3,210	4,500	7,500	1,240	200	730
20	1,340	870	200	510	200	1,200	3,500	3,600	7,120	900	200	1,280
21	680	450	200	510	200	1,000	3,210	2,570	6,100	625	200	975
22	680	300	200	825	200	830	2,340	2,250	5,100	625	240	850
23	175	300	200	510	660	660	1,740	1,990	3,500	400	240	740
24	100	200	390	190	1,940	510	7,400	2,900	3,000	340	240	740
25	300	860	390	50	830	510	4,950	2,900	2,900	250	240	630
26	450	630	820	50	360	510	8,250	6,000	1,900	250	240	630
27	300	630	1,200	50	2,140	390	6,650	5,700	2,800	200	300	975
28	300	450	1,410	25	830	390	3,500	3,600	1,400	240	400	850
29	300	.....	1,410	25	1,740	390	3,210	2,250	500	340	470	850
30	300	.....	1,650	4,150	1,550	1,740	12,500	1,990	500	470	530	850
31	175	.....	1,410	.....	675	.....	5,450	2,570	.....	340	.....	740

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Canadian River at Calvin, Ind. T., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	1,830	100	669	41,100
February	870	75	294	16,300
March	1,650	30	534	32,800
April	8,200	25	1,420	84,500
May	3,500	90	948	58,300
June	21,700	390	2,310	137,000
July	12,500	275	2,850	175,000
August	65,700	1,940	8,400	516,000
September	47,800	500	6,080	362,000
October	1,240	25	336	20,700
November	530	200	280	16,700
December	3,950	630	1,350	83,000
The year	65,700	25	2,130	1,540,000

MORA RIVER AND CANAL AT LA CUEVA, N. MEX.

This station was established August 25, 1903, by M. C. Hinderlider. It is located at the wagon bridge at the village of La Cueva, N. Mex., in the Mora land grant, 26 miles directly north of Las Vegas. The bridge to which the gage was attached was carried away during the flood of September 29, 1904, but the station was reestablished April 29, 1905, at the old section, the bridge having been replaced. The conditions at the river station and the bench marks are described in Water-Supply Paper No. 173, page 60, where are given also references to publications that contain data for previous years.

The conditions at the canal station and the bench mark are described in Water-Supply Paper No. 131, page 163.

Discharge measurements of Mora River at La Cueva, N. Mex., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 17	E. Patterson	24	30	1.27	61
April 27	J. M. Giles	23	37	1.60	110
May 25	E. Patterson	22	37	1.55	96
July 19	J. M. Giles	22	24	1.30	59
September 25	Wm. A. Lamb	16.5	13	.70	11

Daily gage height, in feet, of Mora River at La Cueva, N. Mex., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.6	1.5	0.6	1.3	0.8	1.0	1.15	0.95
2		1.6	1.6	.7	1.2	.8	1.0	1.1	1.0
3		1.6	1.8	1.15	1.3	1.2	.95	1.1	1.0
4		1.6	1.7	1.3	1.2	1.1	.8	1.1	2.3
5		1.65	1.6	1.3	1.35	.9	1.2	1.05	1.4
6		1.8	1.45	1.3	1.2	.9	1.2		1.15
7		1.7	1.6	1.2	1.15	.9	1.15	1.0	1.2
8		1.6	1.5	1.7	1.2	.85	1.05	1.0	1.3
9		1.6	1.45	1.7	1.3	.8	1.0	1.0	1.2
10		1.7	1.6	1.5	1.1	.85	1.0	1.0	1.2

Daily gage height, in feet, of Mora River at La Cueva, N. Mex., for 1906—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	1.8	1.5	1.4	1.0	0.85	1.0	1.0	1.1
12	.....	1.75	1.5	1.35	1.0	.8	.95	1.0	1.1
13	1.2	1.8	1.8	1.3	.9	.8	1.0	.95	1.1
14	1.15	1.65	1.7	1.4	.7	.7	1.0	.95	.8
15	1.1	1.65	1.5	1.3	.65	.8	1.0	.95	.8
16	1.4	1.6	1.4	[a]1.3	.55	.75	1.0	.9	.9
17	1.3	1.6	1.6	1.4	.55	.7	.95	.9	1.0
18	1.3	1.6	1.4	1.4	.55	.75	.95	.85	1.0
19	1.5	1.8	1.2	1.3	.6	.75	.9	.8	.9
20	1.45	1.75	1.0	1.55	1.0	.7	.9	.9	1.0
21	1.5	1.7	1.1	1.2	1.0	.7	.95	1.05	.85
22	1.6	1.65	1.1	1.25	.9	.7	.95	.9	.9
23	1.7	1.65	1.0	1.25	.9	.7	.95	.9	.8
24	1.8	1.7	1.25	1.2	.9	.7	.85	.9	.8
25	1.75	1.6	.9	1.15	.8	.6	1.2	.85	.8
26	1.75	1.5	.7	1.5	.9	.8	1.15	.85	.8
27	1.65	1.5	.7	1.2	.8	1.4	1.2	.8	.8
28	1.6	1.6	.6	1.4	.8	1.2	1.15	.85	.85
29	1.6	1.7	.6	1.4	.8	1.1	1.15	.9	.7
30	1.6	1.6	.55	1.45	.9	1.05	1.1	.9	.8
31	.....	1.6	.....	1.3	.9	.....	1.15	.....	.9

[a] Maximum gage height, 4.4 feet.

Rating table for Mora River at La Cueva, N. Mex., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.55	4	0.90	24	1.30	61	1.70	125
.60	6	1.00	32	1.40	74	1.80	150
.70	11	1.10	40	1.50	89	2.30	300
.80	17	1.20	50	1.60	106		

NOTE.—The above table is based on 5 discharge measurements made during 1906 and is well defined.

Monthly discharge of Mora River at La Cueva, N. Mex., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 13–30	150	40	93.4	3,330
May	150	89	117	7,190
June	150	4	71.6	4,260
July	125	6	65.4	4,020
August	68	4	30.2	1,860
September	74	6	22.2	1,320
October	50	17	34.5	2,120
November	45	17	28.4	1,690
December	300	11	39.4	2,420
The period	.....	.....	.....	28,200

NOTE.—Values are rated as follows: April to July, excellent; August to December, good.

Discharge measurements of Mora canal at La Cueva, N. Mex., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 27	J. M. Giles	8.5	9.2	1.20	14
May 25	E. Patterson	8	9.2	1.15	14
September 26	Wm. A. Lamb	6.5	6.4	.93	5.0

Daily gage height, in feet, of Mora canal at La Cueva, N. Mex., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.2	1.4	1.0	0.75	1.2			
2		1.1	1.3	1.0	1.2	1.05			
3		1.1	1.1	1.1	.95	1.1	0.2		
4		1.15	1.2	1.25	.95	.7	.4		
5		1.2	1.2	1.25	1.1	.6			
6		.95	1.35	1.2	1.0	.55	1.2		
7		1.2	1.3	1.05	1.1	.7			
8		1.3	1.2		1.15	.5	.8		
9		1.15	1.3		1.1	.6	.9		
10		1.2	1.25		.9	.4	.95		
11		1.2	1.2		.8	.2	1.0		
12		1.3	1.35	.85	.8	.6	.9		
13	1.1	1.3	1.25	.7	.75		.6		
14	1.1	1.1	1.2	.7	.7	1.0	.8		
15	1.2	1.15	1.35	1.05	.65	1.0	.8		
16		1.1	1.2	1.0	1.0	1.1	.4		
17	1.2	1.2	1.4		1.0	1.2			
18	1.2	1.1	1.2		1.0	1.1			
19		1.3	1.2		1.2	1.1			
20		1.4	1.2		1.2	1.15			
21		1.3	1.25		1.2	1.05			1.0
22		1.2	1.3		1.0	.95			.6
23		1.0	1.3		.8	.85			.9
24		1.3	1.3		.8	.9			.8
25		1.2	1.3		.8	.9			1.0
26		1.2	1.4		.7	.9			1.0
27	.85	1.35	1.3		1.2	.7			.8
28	1.05	1.05	1.2		1.2	.95			.9
29	1.0	1.1	1.0		1.2				.8
30	1.3	1.4	.9	.8	1.0	.4			
31		1.4		.8	.9				

NOTE.—Water was turned out on the days when the gage was not read.

Rating table for Mora canal at La Cueva, N. Mex., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	0.4	0.60	2.0	1.00	6.4	1.40	27
.30	.6	.70	2.6	1.10	9.8		
.40	1.0	.80	3.5	1.20	15		
.50	1.4	.90	4.6	1.30	21		

NOTE.—The above table is based on 3 discharge measurements made during 1906 and is not well defined.

Monthly discharge of Mora canal at La Cueva, N. Mex., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April (9 days)	21	4.0	11.6	207
May	27	5.5	15.5	953
June	27	4.6	18.2	1,080
July (14 days)	18	2.6	8.0	222
August	15	2.3	7.6	467
September (28 days)	15	.4	5.5	305
October (12 days)	15	.4	4.2	100
December (9 days)	6.4	2.0	4.5	80
The period				3,420

NOTE.—Values are rated as approximate.

SAPELLO RIVER AT LOS ALAMOS, N. MEX.

This station was established August 22, 1903, for the purpose of determining the amount of water available for diversion into the San Guijuela reservoir for the Las Vegas project. It is located at a ford crossing Sapello River at a point about one-fourth mile due north from Los Alamos, N. Mex., which is about 13 miles north of Las Vegas. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 63, where are given also references to publications that contain data for previous years.

Discharge measurements of Sapello River at Los Alamos, N. Mex., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 15	J. M. Giles	12	9	0.83	17
April 16	E. Patterson	32	28	1.35	60
April 17	do	54	32	1.40	60
April 27	J. M. Giles	54	33	1.40	71
May 25	E. Patterson	28	22	.60	41
July 19	J. M. Giles	27	16	.40	21
July 20	do	28	19	.55	30
August 16	do	20	8	− .05	5
September 25	Wm. A. Lamb	8	2.4	− .20	2.1

Daily gage height, in feet, of Sapello River at Los Alamos, N. Mex., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.50	0.90	0.70	1.15	1.35	0.55	.....	0.25	−0.10	−0.15	0.28	0.32
2	.60	.90	.70	1.15	1.40	1.15	0.10	.25	− .10	− .15	.32	.92
3	.65	.80	.70	1.20	1.50	.90	.15	.25	+ .40	− .12	.32	1.00
4	.70	.80	.70	1.15	1.45	.85	.10	.30	.40	− .08	.28	3.70
5	.85	.80	.70	1.15	1.55	.75	.15	.30	.25	− .05	.22	2.65
6	.95	.80	.70	1.15	1.40	.65	.25	.30	.20	− .10	.20	2.30
7	1.15	.80	.70	2.05	1.55	.60	.15	.30	.08	− .12	.28	2.35
8	1.35	.80	.70	1.20	1.40	.65	.45	.20	− .08	− .12	.28	1.45
9	1.35	.80	.70	1.15	1.40	.55	.30	.20	− .08	+ .20	.20	1.05
10	1.35	.80	.70	1.15	1.80	.55	.15	.15	− .10	.12	.22	.95
11	1.40	.80	.70	1.15	1.65	.55	.10	.10	− .10	.22	.22	1.00
12	1.55	.80	.70	1.15	1.35	.55	.10	.10	− .10	.20	.20	.85
13	1.45	.80	.70	1.15	1.15	1.05	1.00	.00	− .10	.20	.22	.55
14	1.35	.80	.80	1.15	1.05	.90	.50	.00	− .20	.18	.18	.62
15	1.00	.80	.80	1.15	.95	.40	.40	− .10	− .18	.25	.20	.60
16	1.00	.85	.80	1.25	.90	.35	.70	− .10	− .20	.25	.22	.52
17	1.15	.80	.80	1.35	.80	.25	.40	− .10	− .18	.15	.22	.68
18	1.15	.80	.80	1.30	.90	.15	.30	+ .10	− .18	.20	.25	.72
19	.95	.80	.80	1.50	.85	.10	.40	− .05	− .22	.20	.20	.50
20	.95	.80	.80	1.35	1.05	.10	.45	− .10	− .20	.18	.20	.52
21	.95	.80	.80	1.30	.85	0	.30	− .10	− .20	.10	.20	.55
22	.90	.80	.80	1.35	.75	0	.30	− .18	− .12	.10	.20	.62
23	.90	.80	.80	1.35	.70	− .10	.30	.28	− .15	.15	.20	.48
24	.90	.80	.80	1.30	.75	− .10	.25	.15	− .20	.12	.20	.50
25	.90	.80	.80	1.30	.65	− .10	− .10	.10	− .20	.20	.20	.50
26	.95	.80	.90	1.35	.60	− .10	.25	.00	+ .15	.18	.22	.48
27	.90	.80	.90	1.35	.60	− .10	.20	− .08	.75	.18	.26	.50
28	.90	.80	1.10	1.40	.55	− .10	.20	− .10	.35	.20	.20	.48
29	.90	.....	1.15	1.35	.45	− .10	1.10	− .08	.20	.25	.20	.48
30	.90	.....	1.15	1.35	.55	− .10	.45	− .10	.02	.25	.20	.50
31	.90	.....	1.15	.....	.55	.....	.30	− .10	.....	.25	.....	.45

UTE CREEK NEAR LOGAN, N. MEX.

This station was established August 12, 1904, and was discontinued June 30, 1906. It was located about 7 miles northwest of Logan, N. Mex., and about 4 miles above the mouth of Ute Creek, near the old Martinez house. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 64, where are given also references to publications that contain data for previous years.

Discharge measurements of Ute Creek near Logan, N. Mex., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 12	J. M. Giles	1	0.2	0.75	0.1
April 13	E. Patterson	1.2	.08	.71	.02

Daily gage height, in feet, of Ute Creek near Logan, N. Mex., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	0.9	0.9	0.8	0.4	0.8	0.8	17	1.2	0.9	0.5	0.6	0 8	0.6
2	.9	.9	.5	.4	.7	.6	18	1.1	.9	.5	.6	.6	.6
3	.9	.9	.5	.4	.6	4.4	19	1.1	.9	.5	1.4	.6	.6
4	1.0	.9	.5	.4	.6	2.1	20	1.0	.9	.5	1.2	.6	.6
5	1.0	.9	.5	.8	.6	1.9	21	1.0	.8	.5	1.2	.6	.6
6	1.0	.9	.5	.8	.6	1.0	22	1.0	.8	.5	1.2	1.45	.6
7	1.0	.9	.5	.8	.6	1.0	23	.9	.8	.5	1.0	2.1	.6
8	1.0	.9	.5	.8	.6	.9	24	.9	.8	.5	1.0	1.9	.6
9	1.0	.9	.5	.8	.6	.8	25	.9	.8	.5	.8	1.0	.6
10	1.0	.9	.5	.8	.6	.8	26	.9	.8	.5	.8	.9	.6
11	1.1	.9	.5	.6	.6	.8	27	.9	.8	.5	.8	.9	.6
12	1.2	1.1	.5	.6	1.1	.8	28	.9	.8	.4	.8	.9	.6
13	1.2	1.1	.5	.6	1.1	.8	29	.9	.....	.4	.8	.9	.6
14	1.2	1.0	.5	.6	1.0	.7	30	.9	.....	.4	.8	.8	.6
15	1.2	1.0	.5	.6	.9	.7	31	.9	.....	.4	.....	.8	.....
16	1.2	.9	.5	.6	.9	.6							

NOTE.—Owing to the fragmentary discharge data, daily discharges have not been computed. The creek was probably dry on days when the gage height was less than 0.6 foot.

NORTH FORK OF CANADIAN RIVER NEAR WOODWARD, OKLA.

This station was established September 13, 1903, and was discontinued June 30, 1906. It was located 7 miles east of Woodward, at the railroad bridge. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 67, where are given also references to publications that contain data for previous years.

Discharge measurements of North Fork of Canadian River near Woodward, Okla., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 16	E. Patterson	71	89	2.60	104
March 13	do	64	44	2.50	53
March 26	J. M. Giles	152	158	2.75	210
April 8	do	141	134	2.85	181
April 26	E. Patterson	112	102	2.65	147
May 30	J. M. Giles	72	111	2.65	155
June 24	do	62	81	2.50	108

Daily gage height, in feet, of North Fork of Canadian River near Woodward, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	2.6	2.6	2.7	2.8	2.8	2.6	17	2.8	2.9	2.9	2.6	2.5	2.6
2	2.7	2.6	2.6	2.8	2.9	2.7	18	2.7	2.9	2.9	2.7	3.3	2.7
3	2.7	2.6	2.6	2.8	2.8	2.9	19	2.7	3.0	2.9	2.7	3.3	2.6
4	2.7	2.6	2.6	2.8	2.8	2.9	20	2.7	3.0	3.1	2.8	3.1	2.5
5	2.7	2.6	2.6	2.8	2.8	2.8	21	2.6	2.9	2.8	2.8	3.0	2.5
6	2.8	2.7	2.7	2.8	2.7	2.8	22	2.6	2.8	2.8	2.8	2.8	2.5
7	2.7	2.6	2.6	2.8	2.6	2.6	23	2.6	2.8	2.8	2.7	2.9	2.5
8	2.7	2.5	2.8	2.8	2.6	2.6	24	2.6	2.8	2.8	2.7	2.9	2.5
9	2.7	2.4	2.8	2.7	2.6	2.6	25	2.7	2.8	2.8	2.8	2.9	2.6
10	2.5	2.5	2.8	2.7	2.5	2.6	26	2.7	2.8	2.8	2.7	3.0	3.2
11	2.5	2.7	2.8	2.7	2.5	2.6	27	2.7	2.8	2.8	2.6	2.9	3.2
12	2.6	2.6	2.6	2.7	2.5	2.6	28	2.6	2.7	3.0	2.5	2.8	2.7
13	2.8	2.6	2.5	2.7	2.5	2.6	29	2.6	.....	2.9	2.5	2.7	2.7
14	2.8	2.6	2.6	2.6	2.4	2.5	30	2.7	.....	3.0	3.0	2.7	2.6
15	2.8	2.6	2.8	2.6	2.5	2.7	31	2.7	.....	2.9	.....	2.6	.....
16	2.8	2.6	2.8	2.6	2.5	2.7							

Daily discharge, in second-feet, of North Fork of Canadian River near Woodward, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	87	100	116	195	205	138	17	120	209	192	114	106	140
2	115	100	88	195	246	174	18	120	209	192	145	450	175
3	115	100	88	195	205	255	19	120	250	222	145	450	140
4	115	100	88	180	205	255	20	120	240	314	192	350	108
5	115	100	82	180	205	213	21	92	198	182	192	300	108
6	120	130	108	180	166	213	22	92	160	208	192	210	108
7	115	100	82	162	132	138	23	92	160	208	154	253	108
8	115	74	140	162	132	138	24	92	160	208	164	253	108
9	115	52	140	128	134	138	25	120	160	230	203	253	140
10	62	74	140	128	104	138	26	120	148	230	164	302	400
11	62	130	128	138	104	138	27	120	148	230	130	255	400
12	87	100	73	138	104	140	28	92	116	322	100	213	175
13	120	100	53	138	104	140	29	92	.....	254	100	174	175
14	120	100	73	107	78	108	30	120	.....	300	290	174	140
15	120	100	128	107	104	175	31	120	.....	254	.....	138	.....
16	120	100	154	114	104	175							

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of North Fork of Canadian River near Woodward, Okla., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	120	62	108	6,640
February	250	52	133	7,390
March	322	53	169	10,400
April	290	100	158	9,400
May	450	78	200	12,300
June	400	108	170	10,100
The period				56,200

NOTE.—Values are rated as fair.

NORTH FORK OF CANADIAN RIVER NEAR ELRENO, OKLA.

This station was established October 27, 1902, by W. G. Russell, at the highway bridge 2 miles north of Elreno, Okla. The conditions at this station and the bench marks are described in Water-Supply

Paper No. 173, page 69, where are given also references to publications that contain data for previous years.

Discharge measurements of North Fork of Canadian River near Elreno, Okla., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 8	E. R. Kerby	90	107	2.75	144
January 10	do	53	76	2.50	122
January 29	J. M. Giles	89	97	2.70	112
February 6	E. R. Kerby	65	81	2.65	109
March 13	do	80	99	2.70	117
March 25	J. M. Giles	88	88	2.66	103
April 9	do	105	155	3.55	316
April 18	do	104	116	3.15	213
April 18	Wm. A. Lamb	104	120	3.12	203
April 26	do	100	111	3.02	180
May 12	J. M. Giles	94	103	2.85	142
May 19	do	95	99	2.75	132
May 26	Wm. A. Lamb	104	155	3.40	246
May 28	J. M. Giles	103	136	3.14	211
June 5	Wm. A. Lamb	95	117	2.90	150
June 13	J. M. Giles	95	84	2.70	110
July 3	Wm. A. Lamb	96	99	2.89	147
July 13	do	105	299	4.85	626
July 25	do	111	376	5.52	854
July 25	do	112	511	6.85	1,620
July 25	do	117	639	8.08	2,280
August 13	do	114	522	6.98	1,310
August 15	do	110	353	5.59	820
August 27	J. M. Giles	103	154	3.50	289
September 21	Wm. A. Lamb	109	349	5.40	790
October 17	do	104	175	3.50	283
November 7	do	104	181	3.65	309
December 24	do	108	227	4.25	470

Daily gage height, in feet, of North Fork of Canadian River near Elreno, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.8	2.7	3.4	2.9	3.0	3.6	5.6	3.6	3.9	3.8	5.4
2	2.7	2.8	2.6	3.4	3.0	3.0	3.0	5.6	3.5	3.8	3.7	5.8
3	2.7	2.8	2.6	3.5	3.4	2.9	2.9	5.4	3.4	3.6	3.6	6.8
4	2.7	2.8	2.6	3.7	3.6	2.9	2.8	5.2	3.4	3.6	3.6	6.7
5	2.7	2.8	2.6	4.1	3.8	2.9	2.7	4.9	3.3	3.5	3.6	6.3
6	2.6	2.7	2.4	4.0	3.8	2.9	2.9	4.8	3.2	3.4	3.6	5.8
7	2.7	2.6	2.4	3.9	3.5	3.0	2.9	4.6	3.3	3.4	3.6	5.6
8	2.5	2.6	2.3	3.8	3.2	3.3	3.0	6.0	3.6	3.3	3.5	5.3
9	2.5	2.8	2.4	3.6	3.0	3.0	3.4	5.4	3.8	3.3	3.5	5.0
10	2.5	2.8	2.5	3.6	3.0	3.0	3.1	5.4	3.9	3.3	3.5	4.9
11	2.5	2.7	2.5	3.6	2.8	2.8	3.0	5.3	4.0	3.2	3.5	4.8
12	2.8	2.6	2.6	3.5	2.8	2.8	7.5	8.7	4.0	3.2	3.5	4.8
13	2.7	2.6	2.6	3.4	2.8	2.8	4.8	5.6	4.0	3.0	3.5	4.7
14	2.7	2.6	2.7	3.4	2.8	2.8	7.1	5.1	4.5	3.3	3.5	4.6
15	2.7	2.7	2.7	3.3	2.9	2.7	6.1	4.9	4.8	3.4	3.5	4.5
16	2.9	2.7	2.7	3.3	2.8	2.7	5.6	4.7	4.3	3.5	3.5	4.6
17	3.0	2.7	2.5	3.4	2.8	2.8	5.6	4.3	3.5	3.7	3.5	4.6
18	3.0	3.0	2.5	3.1	2.7	2.7	5.1	3.9	3.6	3.7	3.5	4.4
19	3.0	2.9	2.6	3.0	2.7	2.6	4.8	4.2	3.5	3.7	3.4	4.4
20	3.0	3.1	2.6	3.0	2.7	2.6	4.6	3.9	3.5	3.8	3.4	4.3
21	2.9	2.9	2.6	3.0	2.7	2.6	4.3	3.7	3.5	3.8	3.4	4.3
22	2.9	2.8	2.5	3.0	4.2	2.6	4.3	3.5	6.0	3.9	3.4	4.3
23	2.8	2.9	2.5	2.9	4.2	2.6	4.5	3.5	5.4	4.0	3.4	4.3
24	2.8	2.7	2.5	2.9	4.2	2.5	5.2	3.5	5.2	4.3	3.4	4.3
25	2.7	2.6	2.8	3.0	4.1	2.5	4.6	3.5	5.0	4.5	3.4	4.2
26	2.7	2.6	3.0	3.0	3.6	2.5	4.1	3.5	4.9	4.7	3.8	4.2
27	2.7	2.7	3.1	3.0	3.4	2.5	5.8	3.5	4.6	4.5	4.8	4.2
28	2.7	2.8	3.1	2.9	3.1	3.0	6.0	3.6	4.2	4.4	5.0	4.2
29	2.7	.....	3.1	2.9	3.1	3.5	5.9	3.6	4.0	4.4	5.6	4.2
30	2.7	.....	3.2	2.9	3.1	3.8	5.9	3.6	3.9	4.3	5.0	4.2
31	2.7	.....	3.2	.....	3.0	.....	5.8	3.6	.....	4.0	.....	4.2

Rating table for North Fork of Canadian River near Elreno, Okla., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.30	63	3.50	280	4.70	574	5.90	990
2.40	76	3.60	302	4.80	602	6.00	1,030
2.50	90	3.70	325	4.90	631	6.20	1,115
2.60	105	3.80	348	5.00	660	6.40	1,205
2.70	121	3.90	371	5.10	690	6.60	1,300
2.80	138	4.00	395	5.20	725	6.80	1,400
2.90	156	4.10	419	5.30	760	7.00	1,510
3.00	175	4.20	444	5.40	795	7.20	1,630
3.10	195	4.30	469	5.50	830	7.40	1,750
3.20	215	4.40	494	5.60	870		
3.30	236	4.50	520	5.70	910		
3.40	258	4.60	547	5.80	950		

NOTE.—The above table is based on 28 discharge measurements made during 1906 and is well defined

Monthly discharge of North Fork of Canadian River near Elreno, Okla., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	175	90	128	7,870
February	195	105	131	7,280
March	215	63	119	7,320
April	419	156	243	14,500
May	444	121	225	13,800
June	348	90	149	8,870
July	1,810	121	603	37,100
August	2,530	280	599	36,800
September	1,030	215	420	25,000
October	574	175	341	21,000
November	870	258	340	20,200
December	1,400	444	642	39,500
The year	2,530	63	328	239,000

NOTE.—Values are rated as good.

MISCELLANEOUS MEASUREMENTS IN CANADIAN RIVER DRAINAGE BASIN.

Miscellaneous measurements made in Canadian River drainage basin by J. M. Giles in 1906.

Date.	Stream.	Locality.	Area of section.	Discharge.
			Sq. ft.	*Sec.-ft.*
January 31	Canadian River	Bridgeport, Okla	120	150
June 22	Deep Fork of Canadian River	Midlothian, Okla	7	7.4

RED RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The headwaters of Red River include several forks, all of which have their sources in northern Texas. Red River takes a general easterly direction along the northern boundary of Texas, and then turns toward the southeast and flows through a low, swampy region in Louisiana into the Mississippi not far from the southern boundary of the State of Mississippi.

North Fork and Salt Fork rise in the Panhandle of Texas and flow in a general southeasterly course across the southwest corner of Oklahoma, uniting with Prairie Dog Fork a short distance above Vernon, Tex. Elm Fork, rising in the same locality, joins North Fork 50 or 75 miles above its mouth. The flow is very uncertain, most of the run-off being flood water after heavy rains. The flow ceases entirely in the late summer and fall in ordinary dry years. The drainage area consists of dry, semiarid plains varied by sandhills in some portions. The underlying rocks are sandstone, limestone, and gypsum in the upper portion and granite where the streams pass through the Wichita Mountains.

Washita River rises in northern Texas, crosses southern Oklahoma, and flows into Red River in the southern part of Indian Territory, about 10 miles from Denison, Tex.

Sulphur Fork of Red River has its headwaters in Hunt and Fannin counties, Tex., flows eastward, forming the boundary between Delta, Red River, and Bowie counties on the north, and Hopkins, Franklin, Titus, Morris, and Cass counties on the south, and empties into Red River in Arkansas about 7 miles north of the Louisiana boundary line. The flow of this river is very unreliable, changing with the rainfall. If the summer is at all dry it ceases altogether, but enough water always remains standing in pools to water stock. During or immediately after protracted or unusually heavy rains the river becomes very wide and deep, floods its bottoms, and often occasions considerable loss of stock and damage to planters and the railroads.

Big Cypress Creek has its headwaters in Franklin and Titus counties, Tex., flows in a general easterly direction, and empties into Red River. The flow of the river is unreliable, varying with the rainfall. In the summer it ceases and the river becomes dry except where the water stands in holes. After long or heavy rains the stream is liable to overflow its banks.

3690—IRR 209—07——4

RED RIVER AT ARTHUR CITY, TEX.

This station was established January 1, 1905. The United States Weather Bureau had maintained a gaging station at this point since 1891. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 72.

Discharge measurements of Red River at Arthur City, Tex., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 17	H. H. Fox	290	2,000	7.6	4,200
March 18	do	506	3,830	11.0	13,100
1906.					
May 6	H. H. Fox			20.0	40,800
May 6	do			19.0	37,000
May 7	do			18.1	32,000
May 8	do			17.0	31,000
May 9	do			15.9	22,300
May 10	do			14.0	17,500
May 11	do			13.2	15,000
May 12	do			11.2	9,000
May 14	do			9.0	7,040
June 21	T. U. Taylor			9.7	7,000
June 22	do			9.4	6,000

Daily gage height, in feet, of Red River at Arthur City, Tex., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.5	8.2	7.6	7.8	11.5	7.1	7.5	14.6	8.8	10.0	8.0	6.7
2	8.2	8.1	7.2	7.8	15.5	9.95	9.8	12.4	8.6	9.6	8.0	6.7
3	9.0	8.1	7.2	7.8	25.0	10.1	9.7	11.5	9.5	9.4	7.8	6.6
4	9.4	6.6	11.3	7.8	26.0	11.15	9.5	11.0	9.4	9.0	7.7	8.0
5	9.2	6.3	10.9	7.2	23.0	14.05	9.0	10.5	14.5	8.7	7.5	11.3
6	9.2	8.4	9.8	8.0	18.2	18.4	8.6	10.0	13.5	8.4	7.4	10.8
7	11.0	8.4	9.2	8.0	18.2	18.95	8.0	10.6	13.2	8.0	7.2	11.4
8	11.5	8.0	8.7	18.0	17.8	18.8	7.7	11.2	13.2	8.0	7.2	10.6
9	11.5	7.6	9.0	16.5	15.8	16.4	7.3	14.0	13.5	8.0	7.2	10.0
10	11.2	7.6	8.7	14.0	14.2	14.4	7.7	17.5	14.2	7.8	7.1	9.7
11	10.0	7.3	8.5	12.8	13.2	13.5	7.4	17.2	13.0	7.6	7.1	9.6
12	9.8	7.0	8.3	11.5	11.2	13.05	9.3	22.0	11.6	7.4	7.0	9.2
13	7.8	7.0	7.1	9.2	9.5	11.7	12.0	23.0	12.5	7.4	7.0	9.0
14	7.5	15.0	6.8	11.8	9.0	10.9	11.2	22.5	13.3	7.3	7.0	8.9
15	7.0	13.2	6.8	12.0	8.8	10.35	10.3	22.0	15.5	7.9	6.9	8.8
16	6.9	12.4	6.8	12.0	8.5	9.95	9.5	22.5	16.5	8.3	6.9	9.0
17	6.7	12.0	6.5	11.8	17.7	9.55	9.3	20.3	16.6	8.4	6.9	9.6
18	6.7	11.4	6.5	11.8	19.0	9.9	9.0	19.5	16.8	9.0	6.9	9.8
19	6.7	11.0	6.5	9.0	17.0	9.0	9.7	15.7	16.4	13.8	6.8	9.7
20	6.7	10.7	8.9	9.0	15.0	8.65	8.5	14.0	15.6	13.2	7.0	9.4
21	6.3	10.0	9.3	12.0	14.0	9.8	9.2	12.7	15.4	11.8	7.0	9.2
22	6.3	9.7	9.3	12.0	14.0	9.15	9.0	11.9	17.0	10.7	6.9	9.0
23	13.3	9.2	8.2	11.8	11.45	8.65	8.8	10.9	15.0	10.1	7.0	8.8
24	13.7	9.2	7.8	10.5	11.3	8.3	12.8	10.3	13.6	9.8	6.8	8.5
25	9.2	11.5	8.2	9.6	11.1	8.25	11.2	9.8	11.9	9.4	6.8	8.0
26	9.0	10.0	12.0	9.0	11.05	9.25	10.5	9.5	11.4	9.4	6.8	8.0
27	8.8	10.0	11.6	8.0	10.9	8.55	13.0	9.2	11.3	9.6	6.8	7.9
28	8.5	8.0	10.8	8.0	15.4	8.0	12.3	9.7	11.5	9.0	6.8	7.8
29	8.2	.....	10.1	9.8	14.7	7.85	12.5	9.8	10.7	8.5	6.8	7.7
30	8.2	.....	8.2	9.6	12.78	7.4	14.6	9.2	10.4	8.1	6.7	7.6
31	8.2	.....	7.8	.....	10.3	.....	11.7	9.0	.....	8.0	.....	7.5

Rating table for Red River at Arthur City, Tex., for 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.*
6.30	2,200	7.80	3,870	9.40	6,450	13.00	14,600
6.40	2,290	7.90	4,010	9.60	6,810	14.00	17,650
6.50	2,380	8.00	4,150	9.80	7,170	15.00	21,050
6.60	2,480	8.10	4,300	10.00	7,550	16.00	24,800
6.70	2,580	8.20	4,450	10.20	7,940	17.00	28,700
6.80	2,680	8.30	4,600	10.40	8,340	18.00	32,750
6.90	2,790	8.40	4,760	10.60	8,750	19.00	37,000
7.00	2,900	8.50	4,920	10.80	9,170	20.00	41,400
7.10	3,010	8.60	5,080	11.00	9,600	21.00	45,900
7.20	3,120	8.70	5,240	11.20	10,040	22.00	50,500
7.30	3,240	8.80	5,410	11.40	10,490	23.00	55,200
7.40	3,360	8.90	5,580	11.60	10,950	24.00	60,000
7.50	3,480	9.00	5,750	11.80	11,420	25.00	64,900
7.60	3,610	9.20	6,090	12.00	11,900	26.00	69,900
7.70	3,740						

[a] The Weather Bureau has kept a record of gage heights at this station since 1891, and the above table would give the approximate discharge if applied to them. The measurements of 1905 do not plot consistently with those of 1906, indicating a change of conditions from year to year. The Weather Bureau records indicate that the river stage has been as low as 2.1 feet twice since 1891.

NOTE.—The above table is based on discharge measurements made during 1905–6 and is fairly defined between gage heights 8.0 feet and 20.0 feet. Below 8.0 feet it is only approximate.

Monthly discharge of Red River at Arthur City, Tex., for 1906.

[Drainage area, 40,200 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	16,700	2,200	5,970	367,000	0.149	0.17
February	21,000	2,200	6,940	385,000	.173	.18
March	11,900	2,380	5,350	329,000	.133	.15
April	32,800	3,120	9,430	561,000	.235	.26
May	69,900	4,920	21,000	1,290,000	.522	.60
June	36,800	3,010	11,400	678,900	.284	.32
July	19,600	3,240	7,780	478,000	.194	.22
August	55,200	5,750	20,600	1,270,000	.512	.59
September	28,700	5,080	16,100	958,000	.400	.45
October	17,000	3,240	6,190	381,000	.154	.18
November	4,150	2,580	3,030	180,000	.075	.08
December	10,500	2,480	5,710	351,000	.142	.16
The year	69,900	2,200	9,960	7,230,000	.248	3.36

NOTE.—Values are rated as fair.

NORTH FORK OF RED RIVER NEAR GRANITE, OKLA.

This station was established June 23, 1903, by Fred Bonstedt. It is located at the highway bridge 2 miles east and one-half mile north of Granite, Okla. The Chicago, Rock Island and Pacific Railway crosses the river near this point. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 73, where are given also references to publications that contain data for previous years.

Discharge measurements of North Fork of Red River near Granite, Okla., in 1906

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 12	E. R. Kerby	55	50	6.15	64
January 25	do	37	35	5.90	38
January 27	J. M. Giles	42	38	5.95	43
February 2	E. R. Kerby	43	34	6.00	46
February 13	do	60	45	6.20	73
February 23	do	54	37	5.95	57
March 7	do	25	14.5	5.55	10
March 21	do	19	7.9	5.53	8
March 22	J. M. Giles	17	8.0	5.55	8
April 11	do	91	79	6.15	114
April 13	Wm. A. Lamb	86	85	6.39	174
April 24	do	69	67	6.40	96
May 5	do	74	45	6.30	70
May 14	do	24	13	5.88	15
May 15	J. M. Giles	27	20	6.05	26
May 16	do	108	97	6.58	204
May 16	do	108	83	6.53	151
May 22	Wm. A. Lamb	49	24	6.11	27
May 23	do	94	48	6.35	63
May 24	do	553	1,530	8.70	4,550
June 2	do	150	85	6.58	162
June 3	do	133	119	6.58	275
June 12	do	37	26	6.10	40
June 14	J. M. Giles	42	33	6.05	44
June 16	do	44	35	6.23	60
June 16	do	45	35	6.20	55
June 17	do	67	56	6.40	97
June 18	Wm. A. Lamb	58	55	6.35	87
June 19	do	48	41	6.20	58
June 20	do	38	34	6.10	46
June 25	do	52	32	6.14	47
June 26	do	190	168	6.82	404
June 27	do	123	97	6.50	211
June 27	do	124	71	6.35	128
July 6	do	13	6	5.79	7
July 11	do	149	166	6.90	362
July 12	do	133	135	6.85	383
July 17	do	325	280	7.28	732
July 19	do	203	130	6.62	251
July 23	do	228	84	6.60	127
July 29	do	370	319	7.55	1,020
July 29	do	420	455	7.80	1,530
August 1	do	142	73	6.60	119
August 6	do	248	174	7.02	523
August 6	do	248	188	6.95	448
August 7	do	174	144	6.75	332
August 11	do	242	216	7.35	623
August 16	do	91	66	6.30	133
August 24	do	17	11	5.75	13
August 28	do	175	124	6.75	252
August 29	do	164	112	6.62	202
September 3	do	108	64	6.30	93
September 19	Lamb and Hutchins	390	404	7.58	1,100
September 26	G. H. Hutchins	76	142	6.45	147
September 27	do	130	115	6.40	123
October 7	do	76	31	6.28	2[illegible]
October 15	Wm. A. Lamb	540	1,350	9.90	6,90[illegible]
October 16	do	421	752	8.20	2,920
October 18	G. H. Hutchins	144	354	6.70	827
October 19	do	146	363	6.55	720
October 28	do	179	267	6.45	416
October 29	do	176	266	6.30	418
November 8	do	198	182	6.48	267
November 10	Wm. A. Lamb	138	135	6.60	272
November 25	G. H. Hutchins	261	218	6.90	412
November 26	do	262	533	7.56	1,410
December 26	Wm. A. Lamb	125	95	7.00	121

Daily gage height, in feet, of North Fork of Red River near Granite, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.05	6.0	5.7	6.20	6.1	6.0	6.1	6.55	6.4	6.4	6.15	7.5
2	6.05	6.0	5.7	6.0	6.85	6.6	6.1	6.5	6.35	6.35	6.15	7.85
3	6.15	5.95	5.4	6.0	6.6	6.6	6.0	6.4	6.3	6.3	6.15	7.85
4	6.2	5.9	5.6	7.0	6.4	6.7	6.0	6.25	7.58	6.2	6.35	7.5
5	6.4	5.8	5.55	7.0	6.3	6.6	5.95	6.8	7.05	6.3	6.4	7.45
6	6.2	5.85	5.6	7.1	6.2	7.05	5.9	7.3	6.9	6.3	6.45	7.15
7	6.1	5.9	5.55	6.8	6.15	6.45	5.8	6.75	6.8	6.3	6.5	7.0
8	6.2	5.8	5.55	6.85	6.15	6.3	5.85	6.9	6.6	6.3	6.45	6.8
9	6.1	5.8	5.5	6.7	6.1	6.1	7.7	6.5	6.65	6.3	6.7	6.8
10	6.1	5.8	5.55	6.4	6.1	6.05	7.65	8.0	6.55	6.4	6.6	6.8
11	6.15	5.9	5.55	6.35	6.0	6.05	6.9	7.6	6.45	6.35	6.55	6.8
12	6.15	5.9	5.6	6.2	6.0	6.05	7.3	7.45	6.4	6.25	6.5	7.05
13	6.05	6.0	5.5	6.5	5.95	6.05	7.6	7.25	6.4	6.25	6.45	7.05
14	6.3	6.35	5.45	6.7	5.9	6.1	8.0	6.6	6.45	7.2	6.5	7.15
15	6.2	6.5	5.35	6.4	6.0	6.25	6.7	6.3	6.55	9.9	6.5	7.2
16	6.1	6.3	5.45	6.2	6.35	6.25	7.9	6.25	8.5	7.75	6.5	6.9
17	6.1	6.15	5.5	6.1	6.5	6.5	7.25	6.15	7.9	7.2	6.5	6.9
18	6.1	6.1	5.55	6.1	6.5	6.45	6.75	6.25	7.95	6.8	6.5	6.8
19	6.1	6.05	5.6	6.0	6.4	6.25	6.55	6.0	7.9	6.55	6.5	7.2
20	6.1	6.3	5.4	6.15	6.35	6.2	6.6	5.95	7.0	6.5	6.55	7.15
21	6.05	6.1	5.6	6.4	6.2	6.35	7.0	5.95	6.85	6.45	6.55	7.05
22	6.0	6.0	5.55	6.7	6.1	6.15	6.75	5.95	6.7	6.45	6.55	6.9
23	5.75	5.9	5.65	6.45	6.2	6.05	6.3	5.95	7.05	6.8	6.6	7.05
24	5.75	5.9	5.8	6.4	8.0	6.15	6.25	5.95	6.6	6.6	6.65	7.0
25	5.9	5.9	6.0	6.3	7.95	6.1	6.25	5.7	6.6	6.55	6.9	7.0
26	5.9	5.8	6.0	6.2	7.1	7.9	6.3	6.3	6.45	6.4	7.35	6.95
27	5.95	5.8	6.0	6.1	6.5	6.5	6.25	6.85	6.4	6.4	7.55	7.0
28	5.9	5.8	6.1	6.0	6.35	6.35	6.2	6.85	6.4	6.35	7.3	7.0
29	5.9	.....	6.15	6.0	6.25	6.25	7.95	6.45	6.4	6.3	7.25	7.0
30	5.95	.....	6.2	6.15	6.2	6.2	7.0	6.5	6.4	6.28	7.35	7.1
31	6.0	.....	6.4	.....	6.15	.....	6.75	6.4	.....	6.2	.....	7.0

NOTE.—Gage heights were estimated September 16 to 30.

Daily discharge, in second-feet, of North Fork of Red River near Granite, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	52	46	18	125	35	23	63	120	125	60	113	1,360
2	53	46	18	35	365	165	63	90	110	45	113	2,250
3	65	38	2	35	200	275	43	65	90	33	113	2,250
4	73	32	13	500	90	315	43	40	1,180	15	190	1,150
5	113	20	10	500	70	275	34	355	550	33	207	900
6	73	22	13	555	52	560	24	750	420	33	226	725
7	58	32	10	340	43	140	8	330	350	33	245	400
8	73	22	10	370	43	86	15	415	240	33	226	225
9	58	22	7	260	34	40	1,350	195	250	33	327	225
10	58	22	10	175	34	40	1,260	1,920	180	60	287	225
11	65	32	10	162	21	40	385	1,180	145	45	267	225
12	64	32	13	114	21	40	735	950	125	23	247	450
13	52	44	7	200	18	40	1,110	700	125	23	227	450
14	82	101	4	260	15	44	2,480	85	145	900	247	375
15	73	142	1	175	23	73	286	132	180	7,000	247	425
16	58	91	4	125	102	73	2,260	120	3,000	1,950	247	170
17	58	65	7	103	140	160	700	95	1,600	1,180	247	170
18	58	58	10	103	140	140	310	120	1,700	875	247	100
19	58	51	13	85	120	75	218	61	1,600	775	247	450
20	58	91	2	115	95	58	240	50	460	650	247	385
21	52	58	12	175	52	87	450	50	400	220	265	300
22	47	44	8	260	62	43	310	50	300	220	287	170
23	22	37	14	120	52	27	55	50	580	355	287	140
24	22	37	28	96	2,600	47	45	50	250	272	307	125
25	38	37	46	60	2,350	46	45	5	250	254	440	125
26	38	26	46	38	920	2,350	55	132	150	300	1,250	75
27	43	26	46	27	140	211	45	285	130	400	1,420	125
28	38	26	58	20	100	128	40	285	125	380	1,220	125
29	38	.....	65	20	73	67	1,820	172	90	420	1,180	125
30	43	.....	73	32	61	53	450	185	60	415	1,250	175
31	47	.....	113	.....	50	.....	310	159	.....	385	.....	125

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of North Fork of Red River near Granite, Okla., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	113	22	55.8	3,430
February	142	20	46.4	2,580
March	113	1	22.3	1,370
April	555	20	173	10,300
May	2,600	15	262	16,100
June	2,350	23	191	11,400
July	2,480	8	492	30,300
August	1,920	5	297	18,300
September	3,000	60	497	29,600
October	7,000	15	562	34,600
November	1,420	113	414	24,600
December	2,250	75	468	28,800
The year	7,000	1	290	211,000

NORTH FORK OF RED RIVER NEAR HEADRICK, OKLA.

This station was established July 17, 1905. It is located at the Navajo dam site, about 4 miles northeast of Headrick and 8 miles west of Mountain Park, Okla. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 76.

Discharge measurements of North Fork of Red River near Headrick, Okla., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 17	E. R. Kerby	77	182	2.55	143
January 25	J. M. Giles	75	170	2.35	78
January 27	E. R. Kerby	75	182	2.35	89
January 27	do	54	74	2.35	91
January 30	do	54	74	2.35	90
January 30	do	75	182	2.35	90
February 9	do	40	40	2.25	57
February 16	do	82	198	2.90	286
February 20	do	80	138	2.50	136
March 3	do	40	38	2.10	42
March 10	do	35	27	2.07	34
March 16	do	35	26	2.05	32
March 19	J. M. Giles	20	28	2.10	31
March 20	do	40	25	2.10	34
March 24	E. R. Kerby	40	37	2.10	39
March 27	do	52	43	2.30	72
April 10	E. C. Murphy	110	223	3.28	379
April 13	J. M. Giles	98	158	2.90	178
April 15	Wm. A. Lamb	105	199	3.10	283
April 22	do	100	122	2.80	230
May 2	do	223	609	4.55	1,600
May 10	do	80	149	2.75	102
May 16	do	150	553	4.30	1,320
May 19	do	104	414	3.37	301
May 22	J. M. Giles	84	112	3.10	182
May 25	do	260	871	5.27	4,720
May 25	do	260	821	5.07	3,930
May 25	do	259	775	4.92	3,220
May 26	do	179	557	4.34	1,440
May 26	do	169	527	4.23	1,350
May 28	Wm. A. Lamb	110	330	3.45	349
May 30	do	75	294	3.10	206
June 8	do	130	294	3.30	307
June 18	J. M. Giles	155	309	3.44	465
June 20	do	150	256	3.30	385
June 22	Wm. A. Lamb	140	151	2.85	179
June 29	do	130	341	3.30	317
July 7	do	56	48	2.56	73
July 18	do	155	400	3.97	686
July 21	do	230	756	4.85	2,080
July 22	do	130	370	3.73	693
August 3	do	69	226	2.95	173
August 4	do	68	221	2.95	173

Discharge measurements of North Fork of Red River near Headrick, Okla., in 1906—Continued.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 8	Wm. A. Lamb	215	574	4.66	1,610
August 10	do	260	866	5.32	2,700
August 17	do	170	191	2.90	245
August 23	do	110	96	2.50	113
August 29	J. M. Giles	216	347	3.53	484
August 30	Wm. A. Lamb	188	259	3.20	313
September 4	do	195	264	3.22	345
September 7	do	164	304	3.45	424
September 17	do	240	878	5.35	4,200
September 24	G. H. Hutchins	160	471	3.95	953
October 4	do	90	257	2.75	133
October 12	Wm. A. Lamb	95	220	2.70	96
October 13	do	70	80	2.65	91
October 17	G. H. Hutchins	148	496	3.92	1,280
October 21	do	120	257	3.40	490
October 27	do	94	157	3.25	320
November 6	do	97	144	3.15	253
November 12	Hutchins and Lamb	109	140	3.24	220
November 21	G. H. Hutchins	106	100	3.20	164
November 27	do	192	479	4.31	1,270
December 2	do	251	728	5.16	4,350
December 28	Wm. A. Lamb	160	240	3.68	418

Daily gage height, in feet, of North Fork of Red River near Headrick, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.4	2.2	2.5	3.6	3.0	3.1	3.6	3.0	2.8	3.15	4.80
2	2.6	2.4	2.2	2.4	4.6	3.2	2.8	3.0	2.9	2.8	3.15	5.16
3	2.6	2.4	2.1	2.3	3.6	4.55	2.7	3.0	3.1	2.7	3.18	5.00
4	2.6	2.4	2.1	2.9	3.6	4.0	2.6	3.0	3.2	2.7	3.20	4.68
5	2.6	2.4	2.1	5.1	3.5	4.4	2.5	3.0	4.9	2.7	3.20	4.60
6	2.8	2.3	2.1	4.5	3.0	4.0	2.5	3.0	3.8	2.72	3.18	4.28
7	2.7	2.3	2.1	4.1	2.9	3.5	2.5	4.9	3.5	2.70	3.22	4.10
8	2.7	2.3	2.1	3.8	2.9	3.2	2.5	4.8	2.3	2.70	3.35	3.95
9	2.7	2.2	2.1	3.3	2.8	3.0	2.5	3.5	2.5	2.70	3.55	3.90
10	2.7	2.2	2.1	3.3	2.7	3.0	5.0	5.3	2.7	2.68	3.42	3.90
11	2.6	2.2	2.1	3.0	2.7	3.0	4.5	5.3	2.7	2.62	3.32	3.88
12	2.6	2.2	2.1	2.9	2.7	2.9	4.8	4.0	2.7	2.61	3.22	3.80
13	2.5	2.2	2.1	2.8	2.6	2.8	4.8	3.9	2.6	2.60	3.20	3.80
14	2.5	2.2	2.1	3.5	2.6	2.8	4.4	3.4	2.7	3.28	3.20	3.88
15	2.5	2.2	2.0	3.0	5.6	3.1	3.5	3.1	3.4	5.58	3.15	3.80
16	2.6	2.9	2.0	3.0	4.2	3.1	3.5	3.0	3.5	4.30	3.18	3.80
17	2.5	2.7	2.0	2.8	3.7	4.2	4.0	2.9	5.2	3.98	3.15	3.75
18	2.5	2.6	2.0	2.7	3.6	3.5	3.6	2.8	4.9	3.88	3.15	3.75
19	2.5	2.5	2.0	2.7	3.6	3.3	3.4	2.7	5.0	3.55	3.15	3.70
20	2.5	2.5	2.0	2.7	3.3	3.0	3.3	2.7	5.0	3.55	3.15	3.70
21	2.5	2.6	2.1	2.7	3.1	3.0	4.8	2.6	4.8	3.42	3.10	3.70
22	2.5	2.6	2.1	3.05	3.2	2.8	3.5	2.4	3.5	3.42	3.25	3.70
23	2.5	2.4	2.1	2.9	3.2	2.8	3.2	2.4	3.7	3.38	3.29	3.70
24	2.5	2.4	2.1	2.7	4.3	2.7	3.1	2.0	4.0	3.65	3.40	3.58
25	2.4	2.3	2.1	2.6	5.1	3.5	3.0	2.0	3.4	3.45	3.52	3.65
26	2.4	2.3	2.1	2.6	4.25	4.0	2.9	2.0	3.3	3.40	3.90	3.60
27	2.4	2.2	2.3	2.5	3.9	5.0	3.0	4.9	3.4	3.30	4.34	3.60
28	2.4	2.2	2.3	2.5	3.4	3.7	3.0	3.8	3.2	3.25	4.40	3.68
29	2.4	.....	2.3	2.6	3.1	3.2	4.6	3.4	2.9	3.22	4.55	3.75
30	2.4	.....	2.3	4.3	3.0	3.1	4.4	3.2	2.8	3.18	5.05	3.75
31	2.4	.....	2.3	.....	3.0	.....	3.6	3.0	.....	3.15	.....	3.70

Daily discharge, in second-feet, of North Fork of Red River near Headrick, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	160	91	47	110	600	170	220	510	220	135	260	2,420
2	160	92	47	90	1,680	260	120	190	190	135	260	4,350
3	160	93	40	70	600	2,040	95	190	255	100	270	3,840
4	160	94	40	225	600	1,000	80	190	295	100	290	2,840
5	160	95	40	4,080	520	1,680	70	190	2,700	100	290	2,540
6	235	70	40	1,900	260	1,000	70	190	755	100	270	1,530
7	195	70	38	1,160	170	465	70	2,990	465	100	300	1,040
8	195	70	36	755	170	260	70	1,850	70	100	390	760
9	195	47	36	400	130	170	70	440	80	100	560	680
10	195	47	36	400	90	170	3,620	2,680	120	90	435	680
11	160	47	34	290	90	170	1,910	2,680	120	80	375	670
12	160	47	34	260	90	170	2,000	880	120	65	320	550
13	130	47	34	230	60	160	2,000	740	95	65	290	550
14	130	47	34	510	60	160	1,680	380	120	470	290	575
15	130	47	32	290	6,450	480	410	250	380	5,980	255	550
16	160	277	32	290	1,350	480	410	280	460	1,990	270	550
17	130	198	32	230	680	1,250	715	245	3,660	1,370	255	500
18	130	160	31	210	600	520	470	224	2,650	1,220	255	460
19	130	135	31	210	600	335	480	180	3,000	680	135	440
20	130	135	34	210	380	235	315	180	3,000	680	135	440
21	125	160	35	210	280	235	2,000	130	2,430	520	110	440
22	125	160	36	305	320	160	390	95	460	520	305	440
23	120	100	37	225	320	160	240	95	610	460	330	440
24	120	100	38	160	1,320	140	200	20	980	820	390	300
25	90	70	39	130	4,080	520	160	20	395	545	560	240
26	90	70	39	130	1,250	1,000	130	20	340	480	2,700	360
27	90	47	70	115	875	3,620	160	2,000	395	390	1,380	360
28	90	47	70	115	380	685	160	700	295	335	1,430	420
29	90	.....	70	130	260	330	1,600	380	185	310	1,480	490
30	90	.....	70	1,480	220	280	1,240	280	135	265	3,160	490
31	90	.....	70	.....	220	.....	450	220	.....	250	.....	400

NOTE.—Daily discharges obtained by indirect method for shifting channels.

Monthly discharge of North Fork of Red River near Headrick, Okla., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	235	90	140	8,610
February	277	47	95.1	5,280
March	70	31	42.0	2,580
April	4,080	70	497	29,600
May	6,450	60	797	49,000
June	3,620	140	610	36,300
July	3,620	70	697	42,900
August	2,990	20	625	38,400
September	3,660	70	833	49,600
October	5,980	65	599	36,800
November	3,160	110	592	35,200
December	4,350	240	979	60,200
The year	6,450	20	542	394,000

400 289,728

ELM FORK OF RED RIVER NEAR MANGUM, OKLA.

This station was established April 12, 1905. It is located on the highway bridge about 4 miles north of Mangum, Okla. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 79.

Discharge measurements of Elm Fork of Red River near Mangum, Okla., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 12	E. R. Kerby	58	27	2.35	23
January 25	do	50	21	2.25	19
January 27	J. M. Giles	40	18	2.32	22
February 2	E. R. Kerby	50	23	2.25	25
February 13	do	65	31	2.45	34
February 23	do	30	13	2.25	14
March 7	do	30	11	2.25	12
March 21	do	30	13	2.25	14
March 23	J. M. Giles	31	13	2.25	12
March 27	E. R. Kerby	32	14	2.27	17
April 11	J. M. Giles	62	27	2.50	32
April 12	Wm. A. Lamb	61	27	2.45	37
April 24	do	49	22	2.32	22
May 5	do	54	30	2.44	38
May 14	do	50	22	2.31	21
May 15	J. M. Giles	324	1,180	5.38	1,930
May 15	do	176	444	4.42	1,080
May 16	do	106	134	3.25	249
May 22	Wm. A. Lamb	66	37	2.56	38
May 23	do	133	175	3.38	333
May 24	do	350	1,510	6.80	3,980
May 24	do	340	1,180	6.00	2,660
June 2	do	220	511	4.64	1,190
June 3	do	158	199	3.50	335
June 13	do	80	71	2.80	95
June 15	J. M. Giles	85	66	2.83	110
June 16	do	183	384	4.50	892
June 18	Wm. A. Lamb	105	80	2.78	114
June 19	do	100	95	2.91	136
June 20	do	80	47	2.60	53
June 25	do	90	71	2.72	88
June 26	do	259	587	4.92	1,380
June 26	do	222	480	4.58	1,080
June 27	do	116	84	2.82	111
July 5	do	55	27	2.40	24
July 11	do	157	166	3.20	267
July 17	do	135	81	2.80	135
July 19	do	105	40	2.60	53
July 23	do	135	49	2.65	58
August 1	do	90	61	2.70	71
August 6	do	320	733	5.18	1,830
August 7	do	218	424	4.38	905
August 11	do	117	110	3.10	153
August 16	do	77	59	2.75	75
August 24	J. M. Giles	66	39	2.60	48
August 28	Wm. A. Lamb	135	68	2.82	78
August 29	do	90	27	2.78	69
September 3	do	135	95	3.00	137
September 19	do	97	208	3.60	384
September 27	G. H. Hutchins	86	56	2.80	89
October 8	do	87	41	2.70	57
October 16	Wm. A. Lamb	320	1,080	5.95	2,710
October 19	G. H. Hutchins	172	150	3.15	251
October 29	do	116	79	2.90	115
November 7	do	224	416	4.20	979
November 8	do	173	155	3.32	271
November 9	Wm. A. Lamb	137	71	2.90	96
November 26	G. H. Hutchins	204	212	3.58	441
December 26	Wm. A. Lamb	97	97	3.20	156

Daily gage height, in feet, of Elm Fork of Red River near Mangum, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.4	2.3	2.2	2.2	5.2	2.5	2.4	2.7	2.6	2.8	2.9	4.1
2	2.4	2.2	2.2	2.2	2.8	4.0	2.4	2.6	2.8	2.7	2.9	4.7
3	2.4	2.2	2.2	2.2	2.5	3.6	2.4	2.6	2.6	2.5	2.9	4.1
4	2.5	2.2	2.2	4.8	2.4	3.5	2.4	2.6	4.7	2.6	2.9	3.9
5	2.4	2.2	2.2	6.0	2.6	4.5	2.4	2.9	3.7	2.6	2.9	3.8
6	2.4	2.2	2.2	3.4	2.4	3.0	2.4	5.3	3.0	2.7	2.9	3.7
7	2.4	2.2	2.2	3.0	2.4	2.8	2.4	4.9	2.7	2.7	4.35	3.6
8	2.3	2.2	2.2	3.1	2.4	2.7	2.4	2.9	2.7	2.7	3.3	3.6
9	2.3	2.2	2.2	2.7	2.4	2.5	2.4	5.05	2.7	2.7	3.0	3.5
10	2.3	2.2	2.2	2.6	2.3	2.5	2.6	4.6	2.7	2.6	2.9	3.5
11	2.3	2.2	2.2	2.5	2.3	2.5	3.5	3.3	2.6	2.6	2.9	3.5
12	2.4	2.2	2.2	2.4	2.3	2.6	2.6	6.3	2.8	2.5	2.9	3.5
13	2.4	2.4	2.2	4.2	2.3	2.8	4.0	3.1	2.6	2.5	2.9	3.4
14	2.3	2.4	2.2	2.6	2.3	2.6	3.0	2.9	2.6	5.5	2.9	3.4
15	2.3	2.4	2.2	2.6	5.2	2.5	3.6	2.8	4.0	6.3	2.8	3.4
16	2.3	2.4	2.2	2.5	3.0	4.45	3.9	2.7	3.1	2.4	2.8	3.3
17	2.3	2.3	2.2	2.4	2.8	3.1	2.9	2.7	7.9	3.3	2.9	3.3
18	2.3	2.3	2.2	2.4	2.6	2.7	2.6	2.7	4.0	3.2	2.9	3.3
19	2.3	2.4	2.2	2.4	2.5	3.0	2.5	2.7	4.0	3.1	2.8	3.3
20	2.3	2.4	2.2	2.5	2.6	2.5	5.35	2.7	3.2	3.1	2.8	3.3
21	2.3	2.3	2.2	2.5	3.0	2.5	3.5	2.6	3.1	3.0	3.6	3.3
22	2.3	2.3	2.2	2.5	2.6	2.5	2.7	2.6	3.2	3.0	3.9	3.3
23	2.3	2.3	2.2	2.4	3.4	2.5	2.7	2.6	3.3	3.1	3.0	3.3
24	2.3	2.2	2.2	2.4	5.0	2.4	2.6	2.6	2.9	3.1	2.3	3.2
25	2.3	2.2	2.2	2.3	5.1	2.4	2.5	2.6	2.8	3.0	3.2	3.2
26	2.2	2.2	2.2	2.3	3.2	5.9	2.5	5.0	2.8	2.9	3.1	3.2
27	2.3	2.2	2.3	2.3	2.9	3.0	2.5	4.5	2.9	2.9	3.1	3.2
28	2.3	2.2	2.3	2.2	2.8	2.6	5.1	3.0	2.7	2.9	3.0	3.2
29	2.3	.....	2.3	2.3	2.1	2.5	4.5	2.7	2.7	2.9	4.5	3.2
30	2.3	.....	2.3	2.2	2.8	2.5	3.3	2.8	2.8	2.9	4.1	3.2
31	2.3	.....	2.2	.....	2.1	.....	2.9	2.6	.....	2.9	.....	3.5

Daily discharge, in second feet, of Elm Fork of Red River near Mangum, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	25	27	14	17	1,730	45	25	70	50	85	115	870
2	25	22	14	17	96	700	25	48	90	59	115	1,300
3	25	22	14	17	48	400	25	48	50	20	115	870
4	30	22	14	1,320	33	335	25	48	1,240	32	115	700
5	25	22	14	2,720	63	890	25	110	475	32	115	600
6	25	22	14	340	33	150	25	~~1,840~~	138	59	115	520
7	25	22	14	150	33	95	25	1,430	68	59	1,080	445
8	21	22	14	180	33	77	25	110	68	59	260	445
9	21	22	14	78	33	45	25	1,560	68	59	145	380
10	21	22	14	48	21	45	75	1,150	68	38	115	380
11	21	22	14	32	21	45	380	197	50	38	115	380
12	25	22	14	37	21	60	75	~~3,160~~	88	19	115	380
13	25	32	14	840	21	95	700	153	50	19	115	315
14	21	30	14	48	21	60	200	110	50	~~2,050~~	115	315
15	21	28	14	48	1,730	45	460	88	700	~~3,180~~	90	315
16	21	26	14	32	150	1,020	640	68	165	6	90	215
17	21	20	14	26	90	200	165	68	~~2,430~~	350	115	215
18	21	20	14	26	47	96	75	68	700	300	115	210
19	21	20	14	26	38	160	50	68	700	215	90	210
20	21	18	14	32	47	40	1,900	68	200	215	90	210
21	21	16	14	32	150	40	400	50	165	160	445	210
22	21	14	13	32	47	40	103	50	200	160	700	210
23	21	14	12	26	340	40	103	50	235	215	145	210
24	21	14	12	22	1,510	25	75	48	110	215	12	157
25	21	14	12	20	1,620	25	40	48	90	160	215	157
26	18	14	12	20	1,730	2,580	30	1,520	90	115	175	157
27	21	14	17	20	122	150	30	1,060	110	115	175	157
28	21	14	17	18	97	60	1,630	112	70	115	145	155
29	21	.....	17	20	10	45	1,060	60	70	115	1,220	155
30	21	.....	17	18	97	45	196	75	90	115	870	150
31	21	.....	17	.....	10	.....	110	48	.....	115	.....	350

NOTE.—These discharges were obtained by the indirect method for shifting channels.

probably 618
5x5
10/4/06.

Monthly discharge of Elm Fork of Red River near Mangum, Okla., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	30	18	22.2	1,360
February	32	14	20.6	1,140
March	17	12	14.2	873
April	2,720	17	209	12,400
May	1,730	10	324	19,900
June	2,580	25	255	15,200
July	1,900	25	281	17,300
August	3,160	48	438	26,900
September	6,180	50	414	24,600
October	3,180	6	274	16,800
November	1,220	12	248	14,800
December	1,300	155	366	22,500
The year	6,180	6	239	174,000

ELK CREEK NEAR HOBART, OKLA.

This station was established as a regular gaging station September 22, 1904. It is located at the highway bridge about 7 miles south of Hobart, Okla. The conditions and the bench marks are described in Water-Supply Paper No. 173, page 82, where are given also references to publications that contain data for previous years.

Discharge measurements of Elk Creek near Hobart, Okla., in 1903–1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1903.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 18	Fred. Bonstedt				14.3
October 22	E. R. Kerby				16.6
November 26	do				18.0
December 22	do				17.0
1904.					
May 6	E. R. Kerby				48
June 9	do				947
August 29	do				22
September 22	Gordon and Kerby	6.4	2.9	0.90	1.8
October 21	Kerby and Johnson	7.3	4.3	.95	3.0
1905.					
January 29	E. R. Kerby	16	14	2.00	10
February 24	Kerby and Whittington	16	33	2.90	33
April 13	E. R. Kerby	20	9.5	2.20	23
April 26	J. M. Giles	21	75	5.60	200
April 27	Murphy and Kerby	19.5	31	3.76	68
May 23	J. M. Giles	17	21	3.00	39
May 31	do	33	151	8.65	403
May 31	do	33	148	8.57	398
July 7	E. R. Kerby	17	11	2.50	24
July 12	do	16	11	2.50	21
July 26	J. M. Giles	16	10	2.52	20
July 26	do	14	11	2.55	21
August 3	E. R. Kerby	14	8	2.25	12
August 25	do	14	8	2.30	13
September 14	do	17	13	2.65	25
September 19	do	16	8	2.30	13
September 23	J. M. Giles	18	13	2.25	11
September 28	E. R. Kerby	15	7	2.20	11
October 14	do	11	4.2	2.10	6
October 26	do	11	4.2	2.20	6
November 28	do		13	2.50	18
December 28	do		14	2.50	17
1906.					
January 18	E. R. Kerby	15	12	2.60	17
January 26	do	16	9.6	2.50	13.2
January 26	J. M. Giles	16	9.0	2.50	13
February 24	E. R. Kerby	16	10	2.50	10

Discharge measurements of Elk Creek near Hobart, Okla., in 1903–1906—Continued.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 21	J. M. Giles	16	10	2.55	12
March 29	E. R. Kerby	17	13	2.70	20
April 11	E. C. Murphy	20.5	15.6	3.03	26
April 16	Wm. A. Lamb	16	16	2.95	32
April 23	do	18	17	3.05	32
April 30	do	20	36	3.75	65
May 7	do	16	10	2.63	21
May 12	do	16	9	2.57	19
May 15	do	32	104	6.95	241
May 21	do	16	12	2.68	26
June 1	do	15	8	2.45	19
June 20	J. M. Giles	16	7.6	2.32	16
July 11	Wm. A. Lamb	52	499	15.49	1,210
July 12	do	42	377	13.61	916
July 20	do	16	27	3.19	41
August 2	do	16	11	2.65	28
August 22	do	18	13	2.30	18
August 28	do	16	38	3.71	67
October 16	do	21	110	6.78	315
November 11	do	17	22	2.70	36

Daily gage height, in feet, of Elk Creek near Hobart, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.5	2.5	2.6	3.3	2.4	3.0	2.8	3.3	2.8	2.8	8.2
2	2.6	2.5	2.6	2.6	5.0	3.4	2.9	2.8	3.5	2.8	2.8	8.0
3	2.6	2.5	2.6	2.6	3.6	4.4	2.6	2.7	3.5	2.8	2.8	6.4
4	2.6	2.4	2.6	4.45	2.9	4.1	2.6	2.8	3.4	2.8	2.8	5.8
5	2.7	2.3	2.6	6.55	2.8	5.3	2.6	2.9	3.2	2.8	2.8	5.4
6	2.6	2.3	2.6	8.1	2.7	4.4	2.6	3.9	3.0	2.7	2.8	5.0
7	2.6	2.3	2.6	4.4	2.6	3.0	2.6	5.1	2.5	2.7	2.8	4.3
8	2.6	2.4	2.5	3.5	2.7	2.8	2.5	3.4	2.5	2.7	2.7	4.3
9	2.5	2.4	2.5	3.5	2.7	2.7	2.5	2.9	2.5	2.7	2.7	4.3
10	2.5	2.5	2.5	3.3	2.7	2.6	6.5	2.9	2.5	2.5	2.7	4.3
11	2.6	2.5	2.5	3.0	2.7	2.5	11.4	2.8	2.7	2.5	2.7	4.3
12	2.6	2.5	2.6	2.9	2.7	2.6	14.1	2.8	3.0	2.5	2.6	4.2
13	2.6	2.5	2.6	2.8	2.6	2.8	6.8	2.7	3.4	2.4	2.6	4.1
14	2.6	2.5	2.6	4.3	2.5	2.7	5.1	2.7	3.4	4.6	2.7	4.0
15	2.6	2.5	2.6	3.3	9.1	3.3	3.6	2.6	3.6	6.3	2.7	4.0
16	2.6	2.5	2.5	3.0	3.1	2.7	3.4	2.5	4.0	5.6	2.7	4.0
17	2.6	2.5	2.5	2.9	2.8	2.5	3.4	2.5	3.1	5.1	2.7	3.9
18	2.6	2.5	2.7	2.9	2.6	2.5	3.4	2.5	3.8	4.6	2.7	3.9
19	2.6	2.5	2.7	2.8	2.6	2.4	3.4	2.5	3.8	3.6	2.7	3.8
20	2.6	2.5	2.6	2.9	2.7	2.3	3.4	2.3	5.2	2.9	2.7	3.8
21	2.6	2.5	2.5	2.9	2.7	2.3	3.4	2.3	4.1	2.9	2.8	3.8
22	2.5	2.5	2.6	3.3	2.5	2.3	3.0	2.3	3.9	3.0	2.8	3.6
23	2.5	2.5	2.7	3.1	2.5	2.3	3.0	2.3	3.9	3.0	3.0	3.6
24	2.5	2.5	2.7	2.8	2.5	2.3	3.0	2.3	3.7	3.0	3.0	3.6
25	2.5	2.5	2.7	2.7	3.3	8.3	2.9	2.3	3.2	3.0	4.0	3.6
26	2.5	2.5	2.6	2.7	4.4	9.3	4.2	4.9	3.2	2.9	4.0	3.6
27	2.5	2.5	2.6	2.7	2.9	12.3	4.1	3.2	3.0	2.9	6.1	3.6
28	2.5	2.5	2.6	2.7	2.8	5.3	4.2	2.9	3.0	2.8	6.2	3.5
29	2.4	.....	2.7	2.6	2.5	4.1	3.0	2.7	2.8	2.8	7.4	3.5
30	2.5	.....	2.6	4.7	2.5	3.3	2.9	2.4	2.8	2.8	8.2	3.5
31	2.4	.....	2.6	.....	2.4	.....	2.8	2.2	.....	2.8	.....	3.5

Daily discharge, in second-feet, of Elk Creek near Hobart, Okla., for 1904.

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

Daily discharge, in second-feet, of Elk Creek near Hobart, Okla., for 1905–6.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1	16	16	14	14	42	644	30	11	11	10	7	14
2	16	16	14	14	24	160	30	13	11	10	7	14
3	16	16	14	18	19	91	30	13	13	10	7	14
4	16	16	14	18	19	97	27	11	11	10	17	14
5	16	16	16	18	17	86	27	11	11	9	11	14
6	16	16	233	18	15	91	24	11	11	9	11	14
7	16	16	103	16	15	86	24	13	11	9	19	14
8	16	16	39	14	17	405	27	13	23	9	15	14
9	16	16	29	14	17	115	30	13	560	9	15	16
10	16	16	23	352	46	91	75	11	275	9	13	16
11	21	16	18	56	17	75	43	11	75	9	11	16
12	21	16	16	36	21	53	33	11	36	7	11	16
13	21	16	16	23	17	57	29	11	29	6	11	18
14	21	16	16	23	39	53	26	378	26	6	11	18
15	21	16	14	21	24	53	21	942	23	6	11	17
16	21	16	21	19	39	50	18	166	19	6	12	19
17	21	18	33	17	15	50	18	51	19	7	12	19
18	21	18	284	21	15	42	16	47	19	7	12	19
19	21	18	200	21	13	42	16	33	13	7	12	17
20	21	18	103	19	13	39	16	29	13	7	12	17
21	21	18	56	17	91	39	14	23	13	5	12	17
22	21	18	36	17	75	39	97	19	13	5	12	17
23	18	103	23	19	27	36	80	16	11	5	44	17
24	18	51	18	219	19	36	51	16	11	6	44	17
25	18	36	16	925	19	33	53	13	11	6	42	17
26	18	18	16	369	275	33	19	13	11	6	42	17
27	18	18	16	63	1,330	33	16	13	11	6	18	17
28	18	14	14	39	2,440	30	13	11	11	8	18	19
29	18	.....	14	30	2,100	30	11	11	11	8	16	19
30	16	.....	12	50	233	30	11	11	11	8	16	19
31	16	.....	14	.....	470	.....	11	11	.....	9	.....	19
1906.												
1	19	12	10	16	45	18	36	34	48	28	39	378
2	19	12	12	16	135	55	32	34	57	28	39	360
3	19	12	13	16	59	109	22	30	57	28	39	233
4	19	10	13	97	30	91	22	34	52	28	39	192
5	22	8	13	244	26	160	22	37	44	28	39	166
6	19	8	13	369	23	109	22	84	36	25	39	140
7	19	7	13	90	21	38	22	146	19	25	39	109
8	19	9	10	45	23	30	19	59	19	25	36	109
9	16	9	10	45	23	27	19	37	19	25	36	109
10	16	11	10	36	23	24	240	37	19	19	36	109
11	18	11	10	25	23	21	699	34	25	19	36	109
12	18	11	13	22	23	24	1,020	34	36	19	33	102
13	18	11	13	21	20	30	261	30	52	16	33	96
14	18	11	13	88	17	27	146	30	52	120	36	92
15	18	11	13	43	460	51	60	27	62	226	36	92

Daily discharge, in second-feet, of Elk Creek near Hobart, Okla, for 1905–6—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.												
16	17	11	11	34	42	27	50	23	82	179	36	92
17	17	11	11	30	30	21	50	23	40	150	36	86
18	17	11	15	30	23	21	50	23	72	123	36	86
19	17	10	15	25	23	18	50	23	72	72	36	81
20	17	10	13	28	26	16	50	18	153	43	36	81
21	17	10	11	28	26	16	50	18	87	43	39	81
22	14	10	13	41	21	16	34	18	76	47	39	72
23	13	10	17	34	21	16	35	18	76	47	47	72
24	13	10	17	23	21	16	35	16	67	47	47	72
25	13	10	18	20	51	387	32	16	44	47	92	72
26	13	10	15	22	109	480	96	134	44	43	92	72
27	13	10	14	22	34	800	90	46	36	43	212	72
28	13	10	14	22	30	160	96	32	36	39	219	68
29	10	.....	20	20	21	88	40	25	28	39	309	68
30	13	.....	17	118	21	48	36	16	28	39	378	68
31	10	.....	17	.....	18	.....	32	12	.....	39	.....	68

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Elk Creek near Hobart, Okla., for 1904–1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1904.				
September (22-30)	3	2	2.4	43
October	8	2	2.4	148
November	14	3	7.2	428
December	18	8	14.2	873
The period	.....	.....	.....	1,490
1905.				
January	21	16	18.4	1,130
February	103	14	21.6	1,200
March	284	12	46.9	2,880
April	925	14	83.3	4,960
May	3260~~2,440~~	13	269 ~~243~~	16,500~~14,900~~
June	644	30	90.6	5,390
July	97	11	29.5	1,810
August	942	11	63.1	3,880
September	560	11	44.1	2,620
October	10	5	7.5	461
November	44	7	16.7	994
December	19	14	16.6	1,020
The year	3260~~2,440~~	5	56.8	~~41,200~~
1906.			57.9	
January	22	10	16.3	1,000
February	12	7	10.2	566
March	20	10	13.5	830
April	369	16	55.7	3,310
May	460	17	47.4	2,910
June	800	16	98.1	5,840
July	1,020	19	112	6,890
August	146	12	37.0	2,280
September	153	19	51.3	3,050
October	226	16	54.8	3,370
November	378	33	73.6	4,380
December	378	68	113	6,950
The year	1,020	7	56.9	41,400

NOTE.—Valuflores 1904 to 1906 are rated as fair.

40.3 29151

OTTER CREEK NEAR MOUNTAIN PARK, OKLA.

This station was established April 2, 1903, by G. H. Matthes. It is located on G. M. Dale's homestead, in the SE. ¼ sec. 21, T. 3 N., R. 17 W. of the Indian meridian, and is 2 miles west and 1 mile north of Mountain Park, Okla. The conditions at the station and

the bench marks are described in Water-Supply Paper No. 173, page 83, where are given also references to publications that contain data for previous years.

Discharge measurements of Otter Creek near Mountain Park, Okla., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 16	E. R. Kerby	11	4	1.20	2.8
January 19	do	11	4	1.20	3.0
January 25	J. M. Giles	6	3.4	1.15	2.7
January 28	E. R. Kerby	11	3.5	1.15	2.6
February 8	do	11	4	1.17	3.2
February 21	do	11	4	1.20	3.8
March 2	do	11	2.5	1.15	1.5
March 15	do	11	3.1	1.15	1.7
March 25	do	11	2.5	1.15	1.5
April 10	E. C. Murphy	19	13	1.80	24
April 13	J. M. Giles	16	12	1.61	14
April 15	do	6	4.6	1.52	11
April 22	Wm. A. Lamb	15	12	1.50	8.6
May 2	do	32	38	2.50	68
May 10	do	16	12	1.40	7.6
May 16	do	32	70	3.64	166
May 22	J. M. Giles	14	12	1.45	12
May 24	do	31	40	2.55	76
May 28	Wm. A. Lamb	17	15	1.46	13
May 30	do	16	13	1.35	8.7
June 8	do	15	12	1.30	7.7
June 18	J. M. Giles	28	18	1.72	25
June 29	Wm. A. Lamb	22	19	1.88	27
July 18	do	16	12	1.35	8
August 3	do	8	2.8	1.20	3.7
September 18	Lamb and Hutchins	39	203	6.95	669
September 18	do	49	329	9.25	1,040
October 12	Wm. A. Lamb	16	12	1.40	7.6
December 28	do	17	14	1.50	14

Daily gage height, in feet, of Otter Creek near Mountain Park, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.2	1.2	1.2	1.2	4.7	1.3	1.6	1.2	1.2	1.5	1.3	4.2
2	1.2	1.2	1.2	1.2	2.5	1.5	1.5	1.2	1.2	1.5	1.3	5.7
3	1.3	1.2	1.2	1.2	2.0	1.7	1.5	1.2	1.2	1.5	1.3	3.6
4	1.2	1.2	1.2	12.4	1.8	1.9	1.4	1.2	1.2	1.5	1.3	2.7
5	1.2	1.2	1.2	12.0	1.6	1.6	1.4	1.3	1.2	1.5	1.3	2.3
6	1.2	1.2	1.2	4.3	1.5	1.5	1.4	1.3	1.6	1.5	1.3	2.1
7	1.2	1.2	1.2	2.7	1.5	1.4	1.4	1.3	1.3	1.4	1.5	2.0
8	1.2	1.2	1.2	2.2	1.5	1.3	1.4	1.5	1.2	1.4	1.5	1.9
9	1.2	1.2	1.2	2.0	1.4	1.3	1.4	1.7	1.2	1.4	1.4	1.8
10	1.2	1.2	1.2	1.8	1.4	1.3	1.9	1.4	1.2	1.4	1.4	1.7
11	1.2	1.2	1.2	1.7	1.4	1.3	2.0	6.0	1.2	1.4	1.3	1.7
12	1.2	1.2	1.2	1.7	1.4	1.6	1.8	2.5	1.2	1.4	1.3	1.7
13	1.2	1.2	1.2	1.6	1.4	1.3	1.5	1.6	10.0	1.4	1.4	1.7
14	1.2	1.2	1.2	1.6	3.55	1.3	1.5	1.4	2.6	5.4	1.4	1.7
15	1.2	1.2	1.2	1.5	7.15	6.2	1.4	1.4	9.25	4.5	1.4	1.6
16	1.2	1.2	1.2	1.5	3.9	4.8	1.4	1.3	4.5	2.8	1.4	1.6
17	1.2	1.2	1.2	1.5	2.4	2.4	1.4	1.3	2.5	2.1	1.4	1.6
18	1.2	1.2	1.2	1.5	1.9	1.8	1.3	1.3	7.85	1.8	1.4	1.6
19	1.2	1.2	1.2	1.5	1.7	1.5	1.3	1.2	8.0	1.6	1.4	1.6
20	1.2	1.2	1.2	1.5	1.5	1.5	1.3	1.2	3.6	1.5	1.4	1.6
21	1.2	1.2	1.2	1.5	1.5	1.4	1.3	1.2	2.4	1.5	1.4	1.6
22	1.2	1.2	1.2	1.5	1.5	1.4	1.3	1.2	2.0	1.5	1.4	1.6
23	1.2	1.2	1.2	1.5	1.5	1.4	1.3	1.2	1.8	1.5	1.4	1.5
24	1.2	1.2	1.2	1.5	2.1	1.4	1.3	1.2	1.7	1.5	1.4	1.5
25	1.2	1.2	1.2	1.4	2.9	8.55	1.3	1.3	1.6	1.4	1.5	1.5
26	1.2	1.2	1.2	1.4	2.0	9.8	1.3	1.4	1.5	1.4	1.9	1.5
27	1.2	1.2	1.2	1.4	1.6	3.4	1.3	1.6	1.5	1.4	1.7	1.6
28	1.2	1.2	1.2	1.4	1.5	2.3	1.3	1.5	1.5	1.4	1.6	1.5
29	1.2	.....	1.2	1.4	1.4	1.9	1.3	1.2	1.5	1.3	5.65	1.5
30	1.2	.....	1.2	11.4	1.4	1.7	1.3	1.2	1.5	1.3	5.8	1.5
31	1.2	.....	1.2	.....	1.4	.....	1.2	1.2	.....	1.3	.....	1.5

Rating tables for Otter Creek near Mountain Park, Okla.

JANUARY 1 TO MAY 15, 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.*
1.20	2.5	2.50	69	3.80	198	5.20	373
1.30	4.3	2.60	77	3.90	209	5.40	401
1.40	6.5	2.70	85	4.00	220	5.60	430
1.50	10	2.80	94	4.10	232	5.80	460
1.60	14	2.90	104	4.20	244	6.00	490
1.70	19	3.00	114	4.30	256	7.00	645
1.80	24	3.10	124	4.40	268	8.00	810
1.90	30	3.20	134	4.50	280	9.00	980
2.00	36	3.30	144	4.60	293	10.00	1,160
2.10	42	3.40	154	4.70	306	11.00	1,340
2.20	48	3.50	165	4.80	319	12.00	1,520
2.30	55	3.60	176	4.90	332	13.00	1,710
2.40	62	3.70	187	5.00	345	14.00	1,900

MAY 16 TO DECEMBER 31, 1906.[b]

1.20	4	1.70	24	2.20	53	2.70	86
1.30	7	1.80	29	2.30	59	2.80	95
1.40	10	1.90	35	2.40	65	2.90	104
1.50	14	2.00	41	2.50	71	3.00	114
1.60	19	2.10	47	2.60	78		

[a] The above table is based on 15 discharge measurements made during 1906 and earlier high-water measurements. It is fairly well defined.

[b] This table is based on 14 discharge measurements made during 1906 and is fairly well defined below gage height 1.7 feet. Above gage height 3.0 feet the table is the same as the previous one.

Monthly discharge of Otter Creek near Mountain Park, Okla., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet
	Maximum.	Minimum.	Mean.	
January	4.3	2.5	2.56	157
February	2.5	2.5	2.50	139
March	2.5	2.5	2.50	154
April	1,600	2.5	173	10,300
May	670	6.5	64.4	3,960
June	1,120	7	116	6,900
July	41	4	11.8	726
August	490	4	25.5	1,570
September	1,160	4	156	9,280
October	401	7	37.3	2,290
November	460	7	40.5	2,410
December	445	14	50.5	3,110
The year	1,600	2.5	56.9	41,000

NOTE.—Values are rated as fair.

HORSE CREEK NEAR MOUNTAIN PARK, OKLA.

This station was established April 17, 1905, and was discontinued June 30, 1906. It was located 5 miles north of Mountain Park, in the SE. $\frac{1}{4}$ sec. 1, T. 3 N., R. 17 W., of the Indian meridian. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 87.

Discharge measurements of Horse Creek near Mountain Park, Okla., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 28	E. R. Kerby	.....	.....	0.3	0.3
February 8[a]	....do	.....	.....	.3	0
March 17	J. M. Giles	.....	.....	.4	0
April 9	E. C. Murphy	4	1.7	.91	1.2
April 14	J. M. Giles	3	.9	.75	.5
April 21	Wm. A. Lamb	3	1.5	.85	1.3
May 3	....do	4	1.6	.90	1.3
May 11	....do	2.5	.65	.60	.21
May 17	....do	4	2.0	.98	1.8
May 24	J. M. Giles	24	75.0	4.90	104
May 29	Wm. A. Lamb	3	.98	.72	.6
June 9	....do	2	.6	.60	.3

[a] Frozen.

Daily gage height, in feet, of Horse Creek near Mountain Park, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	0.5	0.3	0.4	0.5	1.4	0.6	17	0.4	0.5	0.4	0.65	1.0	0.9
2	.5	.3	.4	.4	1.0	1.0	18	.4	.5	.5	.65	1.0	.8
3	.8	.3	.4	.4	.9	1.1	19	.4	.5	.5	.6	.85	.7
4	.6	.3	.3	5.9	.85	1.4	20	.4	.6	.5	.85	.8	.65
5	.5	(a)	.3	2.5	.75	1.2	21	.4	.5	.5	.85	.75	.6
6	.4	(a)	.4	1.4	.7	.85	22	.4	.5	.5	.8	.7	.6
7	.4	(a)	.4	1.2	.7	.75	23	.4	.5	.5	.7	.8	.7
8	.4	(a)	.4	1.1	.7	.7	24	.4	.5	.5	.6	2.95	.6
9	.4	(a)	.4	.9	.6	.6	25	.3	.5	.5	.6	1.8	6.6
10	.4	.4	.4	.85	.6	.6	26	.3	.5	.5	.6	1.0	3.1
11	.4	.4	.4	.8	.6	.55	27	.3	.4	.5	.55	.85	1.2
12	.4	.6	.4	.8	.6	.95	28	.3	.4	.5	.5	.8	1.0
13	.5	.8	.4	1.0	.6	.75	29	.3	.....	.5	.6	.7	.9
14	.5	.6	.4	.8	3.0	.65	30	.3	.....	.5	4.25	.7	.8
15	.5	.5	.5	.7	2.8	2.7	31	.3	.....	.5	.....	.65	.....
16	.4	.5	.4	.65	1.3	1.8							

[a] Frozen.

Rating table for Horse Creek near Mountain Park., Okla., from April 1 to June 30, 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.*
0.40	0	1.60	8	2.80	32	3.90	65
.50	0.1	1.70	9	2.90	35	4.00	68
.60	.3	1.80	10	3.00	38	4.20	76
.70	.5	1.90	12	3.10	41	4.40	84
.80	.9	2.00	14	3.20	44	4.60	92
.90	1.3	2.10	16	3.30	47	4.80	100
1.00	2	2.20	18	3.40	50	5.00	108
1.10	3	2.30	20	3.50	53	5.20	116
1.20	4	2.40	22	3.60	56	5.40	124
1.30	5	2.50	24	3.70	59	5.60	132
1.40	6	2.60	26	3.80	62	5.80	140
1.50	7	2.70	29				

NOTE.—The above table is based on 9 discharge measurements made during 1906 and is well defined between gage heights 0.4 foot and 1.0 foot.

Monthly discharge of Horse Creek near Mountain Park, Okla., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	144	0.0	9.11	542
May	38	.3	4.81	296
June	172	.2	9.49	565
The period	.....	.....	.....	1,400

NOTE.—There was practically no flow during January, February, and March. Values April to June are rated as fair.

DRY FORK OF OTTER CREEK NEAR MOUNTAIN PARK, OKLA.

This station was established April 18, 1905, and was discontinued June 30, 1906. It was located about 4 miles northeast of Mountain Park, Okla., in sec 15, T. 3 N., R. 16 W., of the Indian meridian. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 88.

Discharge measurements of Dry Fork of Otter Creek near Mountain Park, Okla., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 17	E. R. Kerby	6	1.8	0.55	0.9
January 27	do	5	1.3	.55	.8
February 8	do	4	1.2	.55	.7
March 9	do	3	.8	.50	.2
March 17	J. M. Giles	3	.6	.50	.4
April 9	E. C. Murphy	8	3.0	.90	6.2
April 14	J. M. Giles	6	3.4	.70	2.9
April 21	W. A. Lamb	6	1.8	.70	2.3
May 3	do	6	2.9	.85	5.4
May 11	do	5	1.8	.60	2.6
May 17	do	8	4.3	1.00	11.0
May 24	J. M. Giles	21	24.0	1.92	47.0
May 24	do	22	31.0	2.21	67.0
May 29	Wm. A. Lamb	6	2.0	.78	3.7
June 9	do	5	1.5	.60	2.6

Daily gage height, in feet, of Dry Fork of Otter Creek near Mountain Park, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	0.4	0.5	0.5	0.5	1.0	0.7	17	0.5	0.5	0.5	0.7	1.0	0.8
2	.5	.4	.5	.5	.9	.8	18	.5	.5	.5	.7	.9	.7
3	.5	.4	.5	.5	.85	.8	19	.5	.5	.5	.65	.9	.6
4	.5	.4	.5	3.75	.8	.8	20	.5	.5	.5	.7	.9	.6
5	.4	.4	.5	1.8	.8	.8	21	.5	.5	.5	.7	.8	.5
6	.4	.4	.5	1.3	.75	.7	22	.5	.5	.5	.7	.8	.5
7	.5	.4	.5	1.2	.7	.7	23	.5	.5	.5	.7	.8	.6
8	.5	.4	.5	1.0	.7	.6	24	.5	.5	.5	.7	1.55	.6
9	.5	.4	.5	.9	.7	.6	25	.5	.5	.5	.7	1.05	3.55
10	.5	.4	.5	.8	.7	.6	26	.5	.5	.5	.65	1.0	1.1
11	.5	.5	.5	.8	.6	.6	27	.5	.5	.5	.65	.9	.9
12	.5	.5	.5	.8	.6	.7	28	.5	.5	.5	.6	.9	.8
13	.5	.6	.5	.75	.6	.6	29	.5		.5	.6	.8	.7
14	.5	.5	.5	.7	.6	.6	30	.5		.5	2.3	.8	.7
15	.5	.5	.5	.7	2.2	.85	31	.5		.5		.8	
16	.5	.5	.5	.7	1.2	.9							

Rating table for Dry Fork of Otter Creek near Mountain Park, Okla., from April 1 to June 30, 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.*
0.50	1	1.40	23	2.30	75	3.20	154
.60	2	1.50	27	2.40	83	3.30	164
.70	3	1.60	31	2.50	91	3.40	174
.80	5	1.70	35	2.60	99	3.50	184
.90	7	1.80	41	2.70	107	3.60	195
1.00	9	1.90	46	2.80	116	3.70	206
1.10	12	2.00	52	2.90	125	3.80	217
1.20	15	2.10	59	3.00	134		
1.30	19	2.20	67	3.10	144		

NOTE.—The above table is based on 10 discharge measurements made during 1906, and is fairly well defined.

Monthly discharge of Dry Fork of Otter Creek near Mountain Park, Okla., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	212	1	14.8	881
May	67	2	8.40	516
June	190	1	9.83	585
The period				1,980

NOTE.—The total discharge for January, February, and March probably did not exceed 100 acre-feet. Values for April to June are rated as approximate.

SALT FORK OF RED RIVER AT MANGUM, OKLA.

This station was established April 11, 1905, and was discontinued June 30, 1906. It was located at the highway bridge one-half mile south of Mangum, Okla. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 91.

Discharge measurements of Salt Fork of Red River at Mangum, Okla., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 12	E. R. Kerby	61	40	2.60	40
January 25	do	45	23	2.40	20
January 27	J. M. Giles	40	21	2.40	22
February 2	E. R. Kerby	50	23	2.45	23
February 13	do	110	81	2.75	109
February 23	do	31	22	2.50	26
March 7	do	10	3.2	2.10	2
March 21	do	6	2	2.00	1
March 23	J. M. Giles	3	0.2	1.90	0.1
March 28	E. R. Kerby	91	5.4	2.55	54
April 11	J. M. Giles	75	71	2.90	55
April 12	Wm. A. Lamb	51	68	2.83	52
April 24	do	38	40	2.90	46
May 5	do	77	60	3.00	78
May 14	do	18	19	2.58	10
May 14	do	165	125	3.10	212
May 15	J. M. Giles	156	327	3.58	677
May 16	do	84	241	2.95	168
May 22	Wm. A. Lamb	53	85	2.45	24
May 23	do	66	129	3.20	206
May 24	do	49	162	3.30	418
June 2	do	147	197	3.55	580
June 3	do	112	130	3.20	186
June 13	do	31	28	2.71	41
June 15	J. M. Giles	42	42	2.90	114
June 16	do	35	28	2.70	39
June 18	Wm. A. Lamb	36	38	2.87	58
June 19	do	41	34	2.81	48
June 20	do	29	19	2.60	16
June 25	do	38	44	2.80	45
June 26	do	31	27	2.50	12

Daily gage height, in feet, of Salt Fork of Red River at Mangum, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	2.5	2.5	2.2	2.4	3.0	2.7	17	2.5	2.6	1.9	2.7	2.8	2.8
2	2.5	2.5	2.1	2.3	3.0	3.5	18	2.5	2.6	1.9	2.7	2.7	2.8
3	2.5	2.5	2.0	2.3	3.0	3.5	19	2.5	2.6	1.9	2.7	2.6	2.8
4	2.8	2.4	2.0	2.3	3.0	3.5	20	2.5	2.6	1.9	3.1	2.6	2.6
5	2.7	2.3	2.0	3.5	2.9	3.0	21	2.5	2.6	1.9	3.25	2.5	2.5
6	2.5	2.3	2.1	3.5	2.9	2.9	22	2.5	2.5	1.9	3.0	2.4	2.5
7	2.5	2.3	2.1	3.3	2.8	2.8	23	2.5	2.5	1.9	3.0	3.0	2.5
8	2.5	2.3	2.1	3.0	2.7	2.5	24	2.5	2.5	1.9	2.9	3.3	2.5
9	2.5	2.3	2.1	3.0	2.6	2.5	25	2.4	2.4	1.9	2.7	3.3	2.6
10	2.5	2.3	2.0	2.9	2.6	2.5	26	2.4	2.4	1.9	2.7	3.0	2.5
11	2.5	2.3	1.9	2.8	2.5	2.5	27	2.4	2.3	1.9	2.6	2.8	2.4
12	2.5	2.8	1.9	2.8	2.5	2.5	28	2.4	2.2	2.6	2.6	2.6	2.3
13	2.5	2.8	1.9	2.8	2.5	2.5	29	2.5	.....	2.6	2.6	2.5	2.3
14	2.7	2.9	1.9	2.9	3.0	2.5	30	2.5.	.....	2.6	2.6	2.3	2.2
15	2.6	2.9	1.9	2.9	3.3	3.3	31	2.5	.....	2.6	.....	2.3	.....
16	2.5	2.8	1.9	2.8	2.9	3.0							

Mean daily discharge, in second-feet, of Salt Fork of Red River at Mangum, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	30	30	3	35	80	40	17	30	55	1	40	95	65
2	30	30	2	24	80	450	18	30	55	1	40	95	60
3	30	30	1	24	80	450	19	30	55	1	40	60	48
4	62	20	1	24	80	450	20	30	55	1	97	60	16
5	51	12	1	270	60	110	21	30	55	1	103	36	12
6	30	12	2	270	55	81	22	30	26	0.5	58	15	12
7	30	12	2	170	40	60	23	30	26	0.2	58	185	12
8	30	12	2	68	25	25	24	30	26	0.1	20	420	12
9	30	12	2	55	12	25	25	20	17	0.1	20	420	16
10	30	12	1	48	12	25	26	21	8	0.1	20	190	12
11	30	12	1	48	10	25	27	22	5	61	10	118	10
12	30	130	1	48	8	25	28	22	3	61	10	60	8
13	30	130	1	48	8	25	29	30	.....	61	10	36	8
14	51	180	1	60	185	25	30	30	.....	61	10	12	6
15	40	180	1	60	400	240	31	30	.....	61	.....	12	.....
16	30	130	1	48	145	110							

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Salt Fork of Red River at Mangum, Okla., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	62	20	31.6	1,940
February	180	3	47.5	2,640
March	61	0.1	10.8	664
April	270	10	61.2	3,640
May	420	8	99.8	6,140
June	450	6	82.1	4,890
The period	.....	.....	.....	19,900

TURKEY CREEK NEAR OLUSTEE, OKLA.

This station was established April 20, 1905. It is located about 200 feet downstream from William Fullerton's irrigation dam, 6 miles northwest of Olustee, Okla. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 94.

Discharge measurements of Turkey Creek near Olustee, Okla., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 21	E. R. Kerby	8	7.0	2.30	12
February 19	do	16	7.2	2.30	8.7
March 19	do	7	3.2	2.45	15
March 19	J. M. Giles	7	3.2	2.45	16
April 13	do	18	11	2.75	23
April 20	Wm. A. Lamb	20	9	2.55	15
May 18	do	18	11	2.65	15
May 22	J. M. Giles	16	11	2.60	13
May 23	do	20	33	3.92	66
June 8	Wm. A. Lamb	17	12	2.60	16
June 16	J. M. Giles	20	31	3.70	68
July 21	Wm. A. Lamb	16	11	2.60	19
August 9	do	19	56	4.20	129
August 22	J. M. Giles	17	12	2.60	16
September 6	Wm. A. Lamb	17	44	3.05	46
December 29	do	19	43	2.80	30

Daily gage height, in feet, of Turkey Creek near Olustee, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	2.3	2.3	2.3	10.5	2.6	2.5	2.7	2.7	2.6	2.7	4.7
2	2.3	2.3	2.3	2.3	3.2	2.9	2.5	2.7	2.7	2.6	2.7	8.4
3	2.3	2.3	2.3	2.3	4.4	4.55	2.2	2.6	4.7	2.6	2.7	4.8
4	2.3	2.3	2.3	8.3	5.9	2.8	2.5	2.6	5.8	2.6	2.7	3.5
5	2.3	2.3	2.3	15.7	2.9	2.7	2.5	2.6	4.0	2.6	2.7	3.3
6	2.3	2.3	2.3	5.7	2.8	2.7	2.5	3.7	3.1	2.6	2.7	3.2
7	2.3	2.3	2.3	3.0	2.7	2.7	2.5	13.25	2.7	2.6	2.8	3.1
8	2.3	2.3	2.3	2.9	2.7	2.7	2.5	7.8	2.7	2.6	3.0	3.0
9	2.3	2.3	2.3	2.8	2.7	2.7	2.5	5.25	2.7	2.6	2.7	3.0
10	2.3	2.3	2.3	2.7	2.7	2.6	2.7	7.4	2.6	2.6	2.7	2.9
11	2.3	2.3	2.3	2.6	2.7	2.6	2.7	7.6	2.6	2.6	2.7	2.9
12	2.3	2.3	2.3	4.8	2.7	2.6	2.7	3.0	2.6	2.6	2.7	2.9
13	2.3	2.3	2.3	2.7	2.7	2.6	2.6	2.7	2.6	2.6	2.7	2.9
14	2.3	2.3	2.3	2.6	2.6	2.6	2.6	2.7	2.6	7.9	2.7	2.9
15	2.3	2.3	2.3	2.5	3.4	3.1	2.7	2.7	4.6	12.55	2.7	2.8
16	2.3	2.3	2.3	2.4	2.9	3.3	4.2	2.7	2.9	9.0	2.7	2.8
17	2.3	2.3	2.3	2.6	2.7	2.8	2.7	2.6	2.7	3.2	2.7	2.8
18	2.3	2.3	2.3	2.5	2.6	2.6	2.7	2.6	10.55	2.9	2.7	2.9
19	2.3	2.3	2.3	2.5	2.6	3.0	3.0	2.6	10.6	2.9	2.7	2.8
20	2.3	2.3	2.3	2.5	2.6	2.5	3.0	2.6	4.0	2.8	2.7	2.8
21	2.3	2.3	2.3	2.5	2.6	2.5	2.7	2.6	2.8	2.8	2.7	2.8
22	2.3	2.3	2.3	2.5	2.6	2.5	2.7	2.6	2.7	2.8	2.7	2.8
23	2.3	2.3	2.3	2.4	3.7	2.7	2.7	2.6	2.7	2.7	2.7	2.8
24	2.3	2.3	2.3	2.4	6.0	2.6	2.7	2.6	2.7	2.7	2.8	2.8
	2.3	2.3	2.3	2.3	3.55	2.8	2.7	2.6	2.6	2.7	2.8	2.8
	2.3	2.3	2.3	2.3	2.7	3.0	2.5	2.6	2.6	2.7	3.1	2.8
	2.3	2.3	2.3	2.3	2.7	2.5	2.2	2.6	2.6	2.7	2.9	2.8
	2.3	2.3	2.3	2.3	2.7	2.5	9.55	2.7	2.6	2.7	3.0	2.8
	2.3		2.3	2.3	2.7	2.5	14.8	2.7	2.6	2.7	6.2	2.8
	2.3		2.3	12.0	2.7	2.5	6.45	2.7	2.6	2.7	6.2	2.8
	2.3		2.3		2.6		2.7	2.7		2.7		2.8

WASHITA RIVER AT ANADARKO, OKLA.

This station, established October 25, 1902, by W. G. Russell, is located at the highway bridge one-half mile north of the Anadarko railroad depot. The conditions at this station and the bench marks are described in Water-Supply Paper No. 173, page 95, where are given also references to publications that contain data for previous years.

Discharge measurements of Washita River at Anadarko, Okla., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 11	E. R. Kerby	61	138	2.75	148
January 13	do	61	140	2.80	151
January 24	do	61	130	2.70	126
January 28	J. M. Giles	61	136	2.70	128
January 29	do	61	136	2.70	134
February 1	E. R. Kerby	61	130	2.70	152
February 3	do	61	139	2.70	156
February 14	do	63	152	2.75	172
March 8	do	62	143	2.75	133
March 22	do	62	143	2.73	130
March 24	J. M. Giles	61	135	2.73	128
April 10	do	71	290	4.80	473
April 10	do	71	275	4.68	449
April 17	Wm. A Lamb	68	169	3.60	288
April 17	J. M. Giles	69	163	3.70	304
April 25	Wm. A. Lamb	62	146	3.19	195
May 13	J. M. Giles	64	136	2.95	181
May 14	do	64	130	2.90	160
May 17	do	70	511	7.97	1,210
May 17	do	70	541	8.36	1,240
May 17	do	70	531	8.22	1,220
May 18	do	70	514	7.94	1,100
May 18	do	70	469	7.30	902
May 18	do	70	419	6.60	799
May 19	do	70	282	4.70	464
May 25	Wm. A. Lamb	68	212	4.20	382
June 4	do	68	190	3.90	344
June 13	J. M. Giles	64	146	2.90	181
June 14	do	64	147	2.90	189
June 21	do	63	133	2.66	149
June 21	Wm. A. Lamb	62	129	2.66	142
July 2	do	64	169	3.25	245
July 12	do	70	552	8.65	1,500
July 13	do	70	680	10.40	1,860
July 28	do	70	307	5.85	706
August 12	do	70	264	5.09	565
August 27	do	68	210	3.80	323
September 20	do	70	782	11.26	2,450
October 17	do	70	307	5.05	566
November 9	do	63	174	3.10	216
December 27	do	68	202	3.70	313

Daily gage height, in feet, of Washita River at Anadarko, Okla., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.8	2.7	2.7	2.9	3.5	3.5	3.4	4.6	4.0	3.8	3.1	4.6
2	2.8	2.7	2.7	2.9	5.4	3.35	3.3	5.4	3.7	3.7	3.1	6.4
3	2.8	2.7	2.7	2.8	5.9	3.3	2.95	4.7	3.55	3.6	3.1	6.3
4	2.8	2.7	2.7	3.0	5.6	3.9	2.8	4.4	3.5	3.55	3.1	6.5
5	2.8	2.7	2.7	3.2	5.1	4.6	2.75	5.2	3.5	3.5	3.1	7.2
6	2.8	2.6	2.7	6.6	4.3	4.7	2.75	7.4	4.0	3.45	3.1	6.3
7	2.8	2.6	2.7	12.0	3.6	3.9	2.7	7.1	3.5	3.35	3.1	5.4
8	2.8	2.6	2.7	11.3	3.4	3.6	2.7	6.55	4.25	3.3	3.1	5.1
9	2.7	2.6	2.7	5.9	3.3	3.3	2.7	7.2	3.8	3.25	3.0	4.8
10	2.7	2.6	2.7	4.8	3.2	3.1	2.9	5.3	3.3	3.2	3.0	4.6
11	2.7	2.6	2.7	4.3	3.1	3.0	3.6	5.0	3.2	3.2	3.0	4.4
12	2.7	2.6	2.7	3.9	3.0	3.0	7.75	5.0	3.15	3.1	3.0	4.3
13	2.7	2.7	2.7	3.7	2.9	2.9	10.95	4.7	3.1	3.1	3.0	4.2
14	2.7	2.7	2.7	3.6	2.9	2.9	12.45	5.2	3.45	3.1	3.0	4.1
15	2.8	2.7	2.7	3.7	3.35	2.85	12.7	5.3	4.65	3.2	3.0	4.0
16	2.8	2.8	2.7	3.7	3.7	2.85	12.5	4.8	6.3	3.4	3.0	4.0
17	2.8	2.8	2.7	3.9	8.2	2.85	10.6	4.4	9.7	5.0	3.0	4.0
18	2.7	2.8	2.7	3.5	7.6	2.85	6.7	4.0	12.8	5.6	3.0	4.0
19	2.7	2.8	2.7	3.3	4.7	2.75	6.1	4.1	9.2	4.4	3.0	3.9
20	2.7	2.7	2.7	3.3	3.8	2.7	5.4	4.4	11.0	3.9	3.0	3.9
21	2.7	2.7	2.7	3.3	3.45	2.65	5.1	4.0	11.6	3.3	3.0	3.85
22	2.7	2.7	2.7	3.4	3.35	2.65	4.9	3.75	10.1	3.5	3.0	3.8
23	2.7	2.7	2.7	3.4	5.7	2.55	4.7	3.55	6.3	3.4	3.0	3.75
24	2.7	2.7	2.7	3.2	5.2	2.55	4.7	3.55	5.1	3.4	3.0	3.75
25	2.7	2.7	2.7	3.2	4.3	2.5	4.6	3.5	5.1	3.3	3.0	3.7
26	2.7	2.7	2.7	3.1	4.3	2.5	6.9	3.5	4.8	3.3	3.15	3.65
27	2.7	2.7	2.9	3.0	5.7	2.5	8.7	3.55	4.6	3.3	3.25	3.7
28	2.7	2.7	3.1	3.0	5.1	3.75	6.3	7.5	4.7	3.3	2.4	3.65
29	2.7	.....	3.1	2.9	4.7	4.1	4.9	7.4	4.15	3.25	3.5	3.65
30	2.7	.....	2.9	3.4	4.2	3.6	4.7	5.1	3.75	3.2	3.7	3.6
31	2.7	.....	2.9	.....	3.7	.....	4.4	4.6	.....	3.15	.....	3.6

Rating table for Washita River at Anadarko, Okla., 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	110	4.10	378	5.70	668	8.60	1,377
2.60	126	4.20	396	5.80	687	8.80	1,443
2.70	142	4.30	414	5.90	706	9.00	1,510
2.80	158	4.40	432	6.00	725	10.00	1,880
2.90	174	4.50	450	6.20	765	11.00	2,280
3.00	190	4.60	468	6.40	805	12.00	2,700
3.10	207	4.70	486	6.60	846	13.00	3,150
3.20	224	4.80	504	6.80	888	14.00	3,600
3.30	241	4.90	522	7.00	930	15.00	4,050
3.40	258	5.00	540	7.20	975	16.00	4,500
3.50	275	5.10	558	7.40	1,024	17.00	5,000
3.60	292	5.20	576	7.60	1,077	18.00	5,500
3.70	309	5.30	594	7.80	1,132	19.00	6,000
3.80	326	5.40	612	8.00	1,190		
3.90	343	5.50	630	8.20	1,251		
4.00	360	5.60	649	8.40	1,313		

NOTE.—The above table is based on 41 discharge measurements made during 1906 and is fairly well defined between gage heights 2.6 feet and 11.2 feet. The extension of the table has been applied to the 1905 gage heights above 7.0 feet, and the monthly discharges as recomputed are given below.

Monthly discharge of Washita River at Anadarko, Okla., for 1905–6.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.				
January (24 days)	144	105	124	5,900
February (16 days)	395	144	226	7,170
March (29 days)	730	191	319	18,300
April (29 days)	2,280	202	556	32,000
May	5,900	274	1,270	78,100
June	5,850	250	992	59,000
July	544	180	252	15,500
August	1,730	120	415	25,700
September	1,380	135	368	21,900
October	134	85	109	6,700
November	880	104	227	13,500
December	333	158	187	11,500
The period				295,000
1906.				
January	158	142	148	9,100
February	158	126	140	7,780
March	207	142	149	9,160
April	2,700	158	446	26,500
May	1,250	174	441	27,100
June	486	110	222	13,200
July	3,020	142	828	50,900
August	1,050	275	547	33,600
September	3,060	207	749	44,600
October	649	207	279	17,200
November	309	190	206	12,300
December	975	292	449	27,600
The year	3,060	110	384	279,000
Water year 1905-06			350	253640

NOTE.—The above values for 1905 supersed those given in Water-Supply Paper No. 173. They are more accurate owing to the availability of new data since the first publication in the 1905 report. Values are rated as follows: 1905, and January to March, 1906, fair; April to December, 1906, good.

OUACHITA RIVER AT ARKADELPHIA, ARK.

This station was established August 1, 1905. It is located at the bridge of the St. Louis, Iron Mountain and Southern Railway at Arkadelphia, Ark. The conditions at the station and the bench marks are described in Water-Supply Paper No. 173, page 99.

Discharge measurements of Ouachita River at Arkadelphia, Ark., in 1906.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 5	J. R. Nagle	17.4	25,500
May 6	do	12.15	15,800
Do	do	11.6	15,600
May 7	do	10.3	13,000
Do	do	10.1	12,600
Do	do	9.5	11,200
June 2	T. U. Taylor	4.6	1,600
June 20	do	3.2	520

Daily gage height, in feet, of Ouachita River at Arkadelphia, Ark., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.4	5.1	6.2	9.4	4.0	3.5	3.0	4.8	3.8	4.9	3.0	3.9
2	6.1	4.5	5.9	7.8	5.1	4.6	3.0	4.6	3.5	4.1	2.9	3.9
3	10.85	4.7	6.1	7.0	16.75	4.6	3.0	4.1	3.4	3.8	2.9	3.7
4	14.15	4.6	5.8	6.4	20.6	4.6	2.9	3.7	3.3	3.6	2.9	3.6
5	11.2	4.7	5.5	6.3	18.55	4.5	2.9	3.5	3.3	3.5	2.9	3.6
6	8.5	4.7	5.2	6.9	11.6	4.4	2.8	3.4	3.2	3.4	2.9	3.5
7	7.3	4.6	5.1	6.3	9.5	4.4	2.8	3.4	3.8	3.3	2.9	3.4
8	6.7	4.5	5.3	6.0	8.1	4.3	2.9	3.6	3.7	3.1	2.8	3.4
9	6.1	4.4	5.4	5.6	7.0	4.3	3.0	3.4	3.5	3.0	2.8	3.6
10	5.7	4.3	5.3	5.4	6.3	4.3	3.1	3.3	3.5	3.0	2.8	3.9
11	5.5	4.2	5.1	5.1	5.8	4.0	3.3	4.1	3.3	3.0	2.8	3.9
12	5.2	4.1	4.9	5.0	5.4	3.8	3.3	4.5	3.5	2.9	2.8	3.8
13	5.0	4.3	4.8	5.0	5.1	3.6	4.6	3.8	3.3	2.9	2.8	3.7
14	4.9	4.6	5.0	4.9	4.8	3.5	6.1	4.9	3.7	2.8	2.8	3.6
15	4.8	4.8	7.2	8.2	4.6	3.4	5.8	4.7	3.3	3.7	2.8	10.0
16	4.6	5.1	6.8	6.5	4.4	3.4	5.0	3.7	4.5	4.5	2.8	16.55
17	4.4	5.0	6.3	5.7	4.2	3.3	6.7	3.7	4.0	4.6	3.8	18.6
18	4.3	4.8	5.8	5.2	4.1	3.3	5.2	3.4	3.6	4.3	6.3	17.6
19	4.2	4.8	6.8	4.9	4.0	3.5	4.7	3.3	3.4	4.0	5.4	11.8
20	4.1	4.9	7.7	4.7	3.9	3.3	4.2	3.4	3.4	4.0	7.7	8.5
21	6.9	5.4	7.1	4.6	3.8	3.3	3.9	3.3	3.6	3.8	7.9	7.1
22	17.05	6.1	6.5	4.9	3.7	3.7	5.7	3.4	3.5	3.7	7.1	6.4
23	19.65	6.1	6.0	4.7	3.7	3.7	5.8	4.1	3.3	3.6	6.5	5.9
24	14.8	8.1	5.7	4.5	3.8	3.5	4.8	3.7	3.1	3.4	5.9	5.7
25	8.7	11.7	6.4	4.4	3.8	3.9	4.3	3.5	3.0	3.3	5.3	5.3
26	7.6	9.5	7.5	4.2	3.7	3.6	3.9	3.6	3.9	3.2	5.0	5.2
27	6.9	7.7	8.2	4.1	3.7	3.4	3.9	4.0	3.4	3.1	4.7	5.0
28	6.5	6.7	8.3	4.1	3.6	3.3	6.3	3.6	3.4	3.0	4.4	5.3
29	6.0	.....	9.4	4.0	3.5	3.2	9.3	5.5	4.9	3.1	4.3	5.7
30	5.6	.....	16.65	4.1	3.5	3.1	6.3	4.8	4.7	3.0	4.1	6.0
31	5.3	.....	14.1	.....	3.4	.....	5.2	4.2	.....	3.0	.....	6.1

Rating table for Ouachita River at Arkadelphia, Ark., 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	50	3.00	420	4.70	1,850	7.80	7,590
1.40	55	3.10	470	4.80	1,980	8.00	8,000
1.50	60	3.20	520	4.90	2,110	9.00	10,050
1.60	70	3.30	580	5.00	2,240	10.00	12,100
1.70	80	3.40	640	5.20	2,540	11.00	14,150
1.80	90	3.50	710	5.40	2,860	12.00	16,200
1.90	105	3.60	780	5.60	3,200	13.00	18,250
2.00	120	3.70	850	5.80	3,560	14.00	20,300
2.10	140	3.80	930	6.00	3,950	15.00	22,350
2.20	160	3.90	1,010	6.20	4,350	16.00	24,400
2.30	185	4.00	1,100	6.40	4,750	17.00	26,450
2.40	210	4.10	1,190	6.60	5,150	18.00	28,500
2.50	240	4.20	1,290	6.80	5,550	19.00	30,550
2.60	270	4.30	1,390	7.00	5,950	20.00	32,600
2.70	305	4.40	1,500	7.20	6,360	21.00	34,650
2.80	340	4.50	1,610	7.40	6,770		
2.90	380	4.60	1,730	7.60	7,180		

NOTE.—The above table is based on 8 discharge measurements made during 1906 and is fairly defined above gage height 3.0 feet. Below 3.0 feet it is liable to large error.

Monthly discharge of Ouachita River at Arkadelphia, Ark., for 1905–6.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.				
August	3,380	50	301	18,500
September	1,730	305	630	37,500
October	11,100	380	1,870	115,000
November	15,600	1,100	4,970	296,000
December	22,600	640	6,720	413,000
The period				880,000
1906.				
January	31,900	1,190	7,380	454,000
February	15,600	1,190	3,380	188,000
March	25,700	1,980	5,740	353,000
April	10,900	1,100	3,370	201,000
May	33,800	640	5,340	328,000
June	1,730	470	964	57,400
July	10,700	340	2,050	126,000
August	3,030	580	1,090	67,000
September	2,110	420	815	48,500
October	2,110	305	758	46,600
November	7,800	340	1,830	109,000
December	29,700	640	5,530	340,000
The year	33,800	305	3,190	2,320,000

NOTE.—Values 1905–6 are rated as good.

MISCELLANEOUS MEASUREMENTS IN RED RIVER DRAINAGE BASIN.

Sulphur Creek is formed by the junction of Antelope Springs and Buffalo Springs near Sulphur, Ind. T. It is tributary to Washita River through Rock Creek.

The following measurements were made January 7, 1907, by N. C. Grover:

Miscellaneous measurements in Red River drainage basin in 1907.

Stream.	Locality.	Width.	Area of section.	Discharge.
		Feet.	*Sq. ft.*	*Sec.-ft.*
Antelope Springs	Above junction	7.4	4.9	3.22
Do	do	6.7	2.7	3.42
Buffalo Springs	do	10.5	5.5	6.11
Sulphur Creek	Below junction	12.2	7.6	10.7

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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 209.]

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

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

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

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; Q, Fuels; R, Structural materials.

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*.

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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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